



MCKV INSTITUTE OF ENGINEERING

NAAC Accredited "A" Grade Autonomous Institute under UGC Act 1956
Approved by AICTE & affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal

243 G.T. Road (N), Liluah, Howrah- 711204, West Bengal, India

Ph: +91 33 26549315/17 Fax +91 33 26549318 Web: www.mckvie.edu.in/

Curriculum for Undergraduate Degree (B.Tech.) in Automobile Engineering (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Range of Credits:

As per AICTE, a student covering 160 credits during 4 years of studies as per curriculum of the Institute will be eligible to get Under Graduate B.Tech. degree. A student will be eligible to get B.Tech. degree with Honours, if he/ she completes an additional 20 credits. These could be acquired through MOOCs prescribed by the Institute. Every student admitted to the 4 years B.Tech programme is required to earn a minimum of 100 Activity Points under Mandatory Additional Requirement (MAR), in addition to the required academic grades, for getting B.Tech./ B.Tech. (Honours) degree. Also some non-credit, mandatory courses are there included in the curriculum. Like theory courses, students are required to appear in the semester examination for all mandatory courses and must get a minimum of pass marks in those courses to be eligible to get the final degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Humanities and Social Sciences including Management Courses	12	12
2	Basic Science Courses	26	25
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.	28	24
4	Professional Core Courses	57	48
5	Professional Elective Courses relevant to chosen specialization/ branch	15	18
6	Open Elective Courses from other technical and / or emerging subjects	9	18
7	Project Work, Seminar and Internship in Industry or elsewhere	13	15
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	Non-Credit	Non-Credit
Total		160	160



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D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	BS	Basic Science Courses
5	ES	Engineering Science Courses
6	HM	Humanities and Social Sciences including Management Courses
7	PC	Professional Core Courses
8	PE	Professional Elective Courses
9	OE	Open Elective Courses
10	MC	Mandatory Courses
11	PW	Project/ Internships/ Sessional

E. Courses in Different Categories:

Humanities and Social Sciences including Management Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	HM-HU101	English	2	0	0	2
2	V	HM-HU501	Economics for Engineers	3	0	0	3
3	VI	HM-HU604	Quantitative Methods for Decision Making	3	0	0	3
4	VII	HM-HU702	Values & Ethics	2	0	0	2
Total Theory				10	0	0	10
Practical/ Sessional							
1	II	HM-HU291	Language Laboratory	0	0	2	1
2	V	HM-HU591	Soft Skill Development Laboratory	0	0	2	1
Total Practical/ Sessional				0	0	4	2
Total				10	0	4	12

Basic Science Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	BS-PH101	Physics	3	1	0	4
2	I	BS-M101	Mathematics-I	3	1	0	4
3	II	BS-CH201	Chemistry	3	1	0	4
4	II	BS-M201	Mathematics-II	3	1	0	4
5	III	BS-M303	Mathematics-III	2	1	0	3
6	III	BS-BIO301	Biology	2	0	0	2
7	IV	BS-M404	Numerical Methods	2	0	0	2
Total Theory				18	5	0	23
Practical/ Sessional							
1	I	BS-PH191	Physics Laboratory	0	0	3	1.5
2	II	BS-CH291	Chemistry Laboratory	0	0	3	1.5
Total Practical/ Sessional				0	0	6	3
Total				18	5	6	26

Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.							
SI No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	ES-EE101	Basic Electrical and Electronics Engineering	4	0	0	4
2	II	ES-CS201	Programming for Problem Solving	3	0	0	3
3	III	ES-AUE301	Engineering Mechanics	3	1	0	4
4	III	ES-AUE302	Fluid Mechanics & Hydraulic Machines	4	0	0	4
5	IV	ES-AUE401	Materials Engineering	3	0	0	3
Total Theory				16	2	0	18
Practical/ Sessional							
1	I	ES-EE191	Basic Electrical& Electronics Engineering Laboratory	0	0	4	2
2	I	ES-ME191	Engineering Graphics & Design	1	0	4	3
3	II	ES-CS291	Programming for Problem Solving	0	0	4	2
4	II	ES-ME292	Workshop/Manufacturing Practices	1	0	4	3
Total Practical/ Sessional				2	0	14	10
Total				18	2	14	28



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Professional Core Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	PC-AUE301	Applied Thermodynamics	3	1	0	4
2	III	PC-AUE302	Manufacturing Methods	3	0	0	3
3	IV	PC-AUE401	Strength of Materials	3	1	0	4
4	IV	PC-AUE402	Machine tools and Machining Technology	3	0	0	3
5	IV	PC-AUE403	Theory of Machines	3	1	0	4
6	IV	PC-AUE404	Metrology & Instrumentation	3	0	0	3
7	V	PC-AUE501	Automotive Engines	3	0	0	3
8	V	PC-AUE502	Automotive Body & Chassis Engineering	3	0	0	3
9	V	PC-AUE503	Heat Transfer	3	0	0	3
10	V	PC-AUE504	Design of Machine Element	3	1	0	4
11	VI	PC-AUE601	Automotive Transmission	3	0	0	3
12	VI	PC-AUE602	Automotive Electrical and Electronic Systems	3	0	0	3
13	VI	PC-AUE701	Vehicle Dynamics	3	0	0	3
Total Theory				39	4	0	43
Practical/ Sessional							
1	III	PC-AUE391	Machine Drawing	0	0	3	1.5
2	IV	PC-AUE491	Manufacturing &Testing Lab	0	0	3	1.5
3	V	PC-AUE591	Fluid Mechanics & Heat Transfer Lab	0	0	3	1.5
4	V	PC-AUE592	Automobile Engineering Lab I (Engine & Chassis Component Lab)	0	0	3	1.5
5	VI	PC-AUE691	Automobile Engineering Lab II (Engine Testing and Pollution Measurement Lab)	0	0	3	1.5
6	VI	PC-AUE692	Automobile Engineering Lab III (Automotive Design Lab)	0	0	3	1.5
7	VI	PC-AUE693	Automobile Engineering Lab IV (Vehicle Maintenance Lab)	0	0	3	1.5
8	VII	PC-AUE791	Automobile Engineering Lab V (Automotive Electrical & Electronics Lab)	0	0	3	1.5
9	VIII	PC-AUE881	Comprehensive Viva Voce	0	0	0	2
Total Practical/ Sessional				0	0	24	14
Total				39	4	24	57

Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	VI	PE-AUE601	Professional Elective -I	3	0	0	3
2	VII	PE-AUE701	Professional Elective -II	3	0	0	3
3	VII	PE-AUE702	Professional Elective-III	3	0	0	3
4	VIII	PE-AUE801	Professional Elective-IV	3	0	0	3
5	VIII	PE-AUE802	Professional Elective-V	3	0	0	3
Total Theory				15	0	0	15
Practical/ Sessional							
	-	-	-	-	-	-	-
Total Practical/ Sessional				0	0	0	0
Total				15	0	0	15

List of Elective Courses	
PE-AUE601	Professional Elective-I
PE-AUE601A	Hybrid & Electric Vehicles
PE-AUE601B	Transport Management & Motor Vehicles Act
PE-AUE601C	Tyre Technology
PE-AUE701	Professional Elective – II
PE-AUE701A	Advanced Manufacturing Technology and Management
PE-AUE701B	Advanced Automotive Materials
PE-AUE701C	Finite Element Method & its Applications
PE-AUE702	Professional Elective – III
PE-AUE702A	Automotive Component & System Design
PE-AUE702B	Automotive Pollution control & Alternate Fuels
PE-AUE702C	Two and Three Wheelers
PE-AUE801	Professional Elective - IV
PE-AUE801A	Off Road Vehicles
PE-AUE801B	Automotive Air Conditioning
PE-AUE801C	Battery Technology and Management Systems
PE-AUE801D	Fuel cell Technology
PE-AUE802	Professional Elective - V
PE-AUE802A	Thermal Management of Hybrid Systems
PE-AUE802B	Noise, Vibrations and Harshness
PE-AUE802C	Electric Motors for Automotive Applications



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Open Elective Courses from other technical and / or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	VII	OE-AUE701	Open Elective-I	3	0	0	3
2	VIII	OE-AUE801	Open Elective -II	3	0	0	3
3	VIII	OE-AUE802	Open Elective -III	3	0	0	3
Total Theory				9	0	0	9
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				9	0	0	9

List of Open Elective Courses	
OE-AUE701	Open Elective – I
OE-AUE701A	Quality Control & Reliability Engineering
OE-AUE701B	Mechatronic Systems
OE-AUE701C	Machine Learning
OE-AUE701D	Cloud Computing
OE-AUE801	Open Elective - II
OE-AUE801A	Tribology
OE-AUE801B	Internet of Things
OE-AUE801C	Soft Computing
OE-AUE802	Open Elective - III
OE-AUE802A	Computational Fluid Dynamics
OE-AUE802B	Entrepreneurship Development
OE-AUE802C	Robotics and Robot Application
OE-AUE 802D	Non-Destructive Testing Methods



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Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	PW-AUE581	Project-I (Mini Project-30 hrs. Total)	0	0	2	1
2	VI	PW-AUE681	Project-II (Summer Internship-90 hrs. Total)	0	0	0	3
3	VII	PW-AUE781	Project-III	0	0	6	3
4	VIII	PW-AUE882	Project-IV	0	0	12	6
Total Theory				0	0	18	13
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				0	0	18	13

Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	IV	MC471	Environmental Science	2	0	0	0
2	V	MC571	Aptitude Skill Development-I	2	0	0	0
3	VI	MC671	Aptitude Skill Development-II	2	0	0	0
4	VI	MC673	Essence of Indian Knowledge Tradition	2	0	0	0
5	VII	MC772	Constitution of India	2	0	0	0
Total Theory				10	0	0	0
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				10	0	0	0

Curriculum for Undergraduate Degree (B.Tech.) in Automobile Engineering (w.e.f. AY: 2020-21)

Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)							
Mandatory Induction Program- 3 Weeks Duration							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-PH101	Physics	3	1	0	4
2	BS	BS-M101	Mathematics-I	3	1	0	4
3	ES	ES-EE101	Basic Electrical & Electronics Engineering	4	0	0	4
4	HM	HM-HU101	English	2	0	0	2
	Total Theory			12	2	0	14
Practical/ Sessional/ Mandatory Course							
1	BS	BS-PH191	Physics Laboratory	0	0	3	1.5
2	ES	ES-EE191	Basic Electrical & Electronics Engineering Lab	0	0	4	2
3	ES	ES-ME191	Engineering Graphics & Design	1	0	4	3
	Total Practical/ Sessional/ Mandatory Course			1	0	11	6.5
Total of First Semester				14	2	11	20.5

Second Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-CH201	Chemistry	3	1	0	4
2	BS	BS-M201	Mathematics–II	3	1	0	4
3	ES	ES-CS201	Programming for Problem Solving	3	0	0	3
Total Theory				9	2	0	11
Practical/ Sessional/ Mandatory Course							
1	BS	BS-CH291	Chemistry Laboratory	0	0	3	1.5
2	ES	ES-CS291	Programming for Problem Solving Lab	0	0	4	2
3	ES	ES-ME292	Workshop/ Manufacturing Practices	1	0	4	3
4	HM	HM-HU291	Language Laboratory	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				1	0	13	7.5
Total of Second Semester				10	2	13	18.5



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Third Semester (Second Year)

Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-M303	Mathematics -III	2	1	0	3
2	BS	BS-BIO301	Biology	2	0	0	2
3	ES	ES-AUE301	Engineering Mechanics	3	1	0	4
4	ES	ES-AUE302	Fluid Mechanics & Hydraulic Machines	4	0	0	4
5	PC	PC-AUE301	Applied Thermodynamics	3	1	0	4
6	PC	PC-AUE302	Manufacturing Methods	4	0	0	4
Total Theory				18	3	0	21
Practical/ Sessional/ Mandatory Course							
1	PC	PC-AUE391	Machine Drawing	0	0	3	1.5
Total Practical/ Sessional/ Mandatory Course				0	0	3	1.5
Total of Third Semester				18	3	3	22.5

Fourth Semester (Second Year)

Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-M404	Numerical Methods	2	0	0	2
2	ES	ES-AUE401	Materials Engineering	3	0	0	3
3	PC	PC-AUE401	Strength of Materials	3	1	0	4
4	PC	PC-AUE402	Machine Tools and Machining Technology	3	0	0	3
5	PC	PC-AUE403	Theory of Machines	3	1	0	4
6	PC	PC-AUE404	Metrology & Instrumentation	3	0	0	3
Total Theory				17	2	0	19
Practical/ Sessional/ Mandatory Course							
1	PC	PC-AUE491	Manufacturing &Testing Lab	0	0	3	1.5
2	MC	MC471	Environmental Science	2	0	0	0
Total Practical/ Sessional/ Mandatory Course				0	0	5	1.5
Total of Fourth Semester				19	2	3	20.5



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Fifth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-AUE501	Automotive Engines	3	0	0	3
2	PC	PC-AUE502	Automotive Body & Chassis Engineering	3	0	0	3
3	PC	PC-AUE503	Heat Transfer	3	0	0	3
4	PC	PC-AUE504	Design of Machine Element	3	1	0	4
5	HM	HM-HU501	Economics for Engineers	3	0	0	3
Total Theory				14	1	0	16
Practical/ Sessional/ Mandatory Course							
1	PC	PC-AUE591	Fluid Mechanics & Heat Transfer Lab	0	0	3	1.5
2	PC	PC-AUE592	Automobile Engineering Lab-I (Engine & Chassis Component Lab)	0	0	3	1.5
3	HM	HM-HU591	Soft Skill Development Lab	0	0	2	1
4	PW	PW-AUE581	Project-I (Mini Project-30 hrs. Total)	0	0	2	1
5	MC	MC571	Aptitude Skill Development-I	0	0	2	0
Total Practical/ Sessional/ Mandatory Course				0	0	10	5
Total of Fifth Semester				14	1	10	21

Sixth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-AUE601	Automotive Transmission	3	0	0	3
2	PC	PC-AUE602	Automotive Electrical and Electronic Systems	3	0	0	3
3	PE	PE-AUE601	Professional Elective-I	3	0	0	3
4	HM	HM-HU604	Quantitative Methods for Decision Making	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PC	PC-AUE691	Automobile Engineering Lab II (Engine Testing and Pollution Measurement Lab)	0	0	3	1.5
2	PC	PC-AUE692	Automobile Engineering Lab III (Automotive Design Lab)	0	0	3	1.5
3	PC	PC-AUE693	Automobile Engineering Lab IV (Vehicle Maintenance Lab)	0	0	3	1.5
4	MC	MC671	Aptitude Skill Development-II	2	0	0	0
5	MC	MC673	Essence of Indian Knowledge Tradition	2	0	0	0
6	PW	PW-AUE671	Project-II (Summer Intership-90 hrs. Total)	0	0	0	3
Total Practical/ Sessional/ Mandatory Course				4	0	9	7.5
Total of Sixth Semester				16	0	9	19.5

List of Elective Courses	
PE-AUE601	Professional Elective-I
PE-AUE601A	Hybrid & Electric Vehicles
PE-AUE601B	Transport Management & Motor Vehicles Act
PE-AUE601C	Tyre Technology

Seventh Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-AUE701	Vehicle Dynamics	3	0	0	3
2	PE	PE-AUE701	Professional Elective-II	3	0	0	3
3	PE	PE-AUE702	Professional Elective-III	3	0	0	3
4	OE	OE-AUE701	Open Elective-I	3	0	0	3
5	HM	HM-HU702	Values & Ethics	2	0	0	2
Total Theory				14	0	0	14
Practical/ Sessional/ Mandatory Course							
1	PC	PC-AUE791	Automobile Engineering Lab-V (Automotive Electrical & Electronics Lab)	0	0	3	1.5
2	PW	PW-AUE781	Project-III	0	0	6	3
3	MC	MC772	Constitution of India	2	0	0	0
Total Practical/ Sessional/ Mandatory Course				0	0	9	4.5
Total of Seventh Semester				14	0	9	18.5

List of Elective Courses	
PE-AUE701	Professional Elective-II
PE-AUE701A	Advanced Manufacturing Technology and Management
PE-AUE701B	Advanced Automotive Materials
PE-AUE701C	Finite Element Method & its Applications
PE-AUE702	Professional Elective-III
PE-AUE702A	Automotive Component & System Design
PE-AUE702B	Automotive Pollution control & Alternate Fuels
PE-AUE702C	Two and Three Wheelers
List of Open Elective Courses	
OE-AUE701	Open Elective-I
OE-AUE701A	Quality Control & Reliability Engineering
OE-AUE701B	Mechatronic Systems
OE-AUE701C	Machine Learning
OE-AUE701D	Cloud Computing

Eighth Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-AUE801	Professional Elective-IV	3	0	0	3
2	PE	PE-AUE802	Professional Elective-V	3	0	0	3
3	OE	OE-AUE801	Open Elective-II	3	0	0	3
4	OE	OE-AUE802	Open Elective-III	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PC	PC-AUE881	Comprehensive Viva Voce	0	0	0	2
2	PW	PW-AUE882	Project-IV	0	0	12	6
Total Practical/ Sessional/ Mandatory Course				0	0	12	8
Total of Eighth Semester				12	0	12	20

List of Elective Courses	
PE-AUE801	Professional Elective-IV
PE-AUE801A	Off Road Vehicles
PE-AUE801B	Automotive Air Conditioning
PE-AUE801C	Battery Technology and Management Systems
PE-AUE801D	Fuel cell Technology
PE-AUE802	Professional Elective-V
PE-AUE802A	Thermal Management of Hybrid Systems
PE-AUE802B	Noise, Vibrations and Harshness
PE-AUE802C	Electric Motors for Automotive Applications
List of Open Elective Courses	
OE-AUE801	Open Elective-II
OE-AUE801A	Tribology
OE-AUE801B	Internet of Things
OE-AUE801C	Soft Computing
OE-AUE802	Open Elective-III
OE-AUE802A	Computational Fluid Dynamics
OE-AUE802B	Entrepreneurship Development
OE-AUE802C	Robotics and Robot Application
OE-AUE 802D	Non-Destructive Testing Methods



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Part III: Detailed Curriculum

Induction Program (Mandatory)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Duration

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Please refer **Appendix-A** for AICTE guidelines on Mandatory Induction Program.

First Semester

Course Name:	Physics		
Course Code:	BS-PH101	Category:	Basic Science Course
Semester:	First	Credit:	4.0
L-T-P:	3-1-0	Pre-Requisites:	Mathematics Course with Vector Calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	Understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	Describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Module-1: Foundations of Quantum Mechanics	(8L)
	Introduction to Quantum Physics: Brief idea about the historical development of quantum mechanics.	1
	Black Body Radiation: Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws.	2
	Compton Effect: Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	2
	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation.	2
	Uncertainty Principle: Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero point energy, Numerical problems.	1
2	Module-2: Schrödinger Wave Equation and Its Applications	(8L)
	Formulation of Quantum Mechanics: Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of associated problems.	3
	Schrödinger Wave Equation: Time independent Schrödinger's equation from time dependent one by the separation of variable method.	1
	Applications of Quantum Mechanics: Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator	4
3	Module-3: Dielectric Materials and their Applications	(5L)
	Concept of Dielectric and Polarization: Electric field inside a Dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, Atomic polarizability and polarization vector.	1
	Inter Relationship among Dielectric Parameters: Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems	2

	on relation between polarizability, susceptibility and dielectric constant. Types of Polarization: Electronic polarization and derivation of electronic polarizability, Concept of ionic and orientational polarization (no derivation). Applications of Dielectric: Dielectric breakdown and dielectric strength, Concept of Dielectric loss, Few applications of dielectrics in different fields.	1 1
4	Module-4: Time Varying Fields Electromagnetic Induction: Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in Motors and Generators, Calculation of Induced EMF. Displacement Current: Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	(3L) 2 1
5	Module-5: Electromagnetic Waves Maxwell's Electromagnetic Field Equations: Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators etc.). Plane Electromagnetic Wave in Free Space: Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. Plane Electromagnetic Wave in Medium: Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. Energy in an Electromagnetic Field: Flow of energy associated to electromagnetic field and Poynting vector.	(6L) 2 1 2 1
6	Module-6: Laser and Fiber Optics Introduction to Laser: Properties of light sources, Need of suitable light source in communication, Invention of laser, Characteristics and applications of laser. Interaction of Light with Matter: Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them. Components and Working of Laser Systems: Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO₂ laser). Optical Communication: Introduction, Need for optical communication, Salient features of optical fibers, Amplitude and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth analog/digital communication system Light Guidance in Fibers: Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single	(9L) 1 1 2 2 1



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	and multimode fibers, Step-index and graded-index fibers. Transmission characteristics of optical fibers: Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion, bit rate - length product, Minimization of intermodal dispersion.	2
Total		39L

Course Outcomes:

After completion of the course, students will be able to:

1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various medium of propagations.
4	Understand the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy etc.
6	Explain the workings of various LASERs and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the dispersion leading to calculation of Bit Rate of a communication channel..

Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Aurther Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
9	'Understanding Lasers' by Jeff Hecht
10	'An Introduction to Fiber Optics' by Ajoy Ghatak and K. Thyagrajan

Course Name:	Mathematics-1		
Course Code:	BS-M101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know Convergence of sequence and series
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function
3	To know the uses of matrix in different areas in engineering
4	To know the use of mean value theorems in engineering fields
5	Use of vector functions in different fields of Engineering

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Determinants and Matrices: (i) Introduction to determinant, properties (proofs of identities are excluded). (ii) Types of matrices, rank of a matrix, inverse of a matrix, Linear systems of equations, Cramer's rule, eigen-values and eigen-vectors, Caley-Hamilton theorem.	6L
2	Differential Calculus (Function of single variable): (i) Indeterminate forms and L'Hospital's rule; Successive differentiation, Leibnitz's theorem. (ii) Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin theorems with remainders; Maxima and minima. (iii) Evolutes and Involute.	6L
3	Differential Calculus (Function of multi-variables): (i) Concept of limit, continuity and partial differentiation, chain rule, total differential, Jacobian, Euler's theorem on homogeneous function. (ii) Hessian, Maxima and minima; Lagrange's multipliers.	8L
4	Integral Calculus: (i) Line integrals; double integrals, change of order; triple integrals. (ii) Evaluation of surface areas and volumes of revolutions.	6L



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5	Vector Calculus: (i) Vector differential operator, scalar and vector point function, gradient, directional derivative, divergence and curl. (ii) Divergence theorem, Green's and Stoke's theorem (Statements only) and applications.	8L
6	Sequence and Series: (i) Sequence, type of a sequence. (ii) Series of positive terms; Geometric and p-series and their convergence criterion; Convergence test of series: Comparison test, D'Alembert's ratio test, Cauchy's root test. (iii) Alternating series; Absolute convergence, Leibnitz's theorem.	6L
Total		40

Course Outcomes:

After completion of the course, students will be able to:

1	Apply knowledge of differential and integral calculus to determine curvature and evaluation of different types of improper integrals
2	Utilize mean value theorems for solution of engineering problems.
3	Learn matrices, concept of rank, methods of matrix inversion and their applications.
4	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
5	Determine eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces to solve physical and engineering problems
6	Solve multiple integrals and utilize it to different physical problems

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	Higher Algebra, S. K. Mapa, Levant Books
5	Advanced Higher Algebra, Chakravorty and Ghosh, U N Dhar Pvt. Ltd.
6	Vector Analysis, Schaum's outline
7	An introduction to Integral calculus, Maity and Ghosh, NCBA
8	An introduction to Differential Calculus, Maity and Ghosh, NCBA
9	An introduction to Engineering mathematics-I, G.P. Samanta, New Age publication
10	Vector Analysis, Chakravorty and Ghosh, U N Dhar Pvt. Ltd



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Course Name:	Basic Electrical and Electronics Engineering		
Course Code:	ES-EE101	Category:	ES
Semester:	First	Credit:	4
L-T-P:	4-0-0	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:	
1	To provide comprehensive idea about AC and DC circuit analysis
2	To make the students understand about working principals and applications of electric machines
3	To make the students understand the components of low voltage electrical installations
4	To provide basic idea about general structure of electrical power system.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
Module 1	DC Circuits Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5
Module 2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel),	4
Module 3	Three phase system Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2
Module 4	DC Machines Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor	5



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Module 5	AC Machines Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency Three-phase induction motor Generation of rotating magnetic fields, Construction and working of a three-phase induction motor.	4
Module 6	Electrical Installations Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3
Module 7	General structure of electrical power system: Power generation to distribution through overhead lines and underground cables with single line diagram	1
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.

Learning Resources:

1	D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2	C.L. Wadhwa, "Basic Electrical Engineering, New Age, 2007.
3	S K Bhattacharya, Basic Electrical and Electronics Engineering, Pearson, 2011
4	Ashfaq Husain and Haroon Ashfaq, "Fundamentals of Electrical Engineering", Dhanpat Rai & Co., Delhi, 2007.
5	J.B. Gupta, Basic Electrical Engineering, Kataria & Sons, 2015.
6	L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
7	E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:	
1	To make the students understand about the semiconductor.
2	To make the students understand about Diode and its circuit.
3	To make the students understand about different Transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1.	<i>Introduction to Semiconductors:</i> Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5
2	<i>Diode and Diode Circuits:</i> Formation of P-N junction, depletion region, built-in-potential, forward and reverse biased P-N junction, energy band diagrams, V-I characteristics, Zener diode forward and reverse characteristics, Avalanche breakdown and Zener breakdown, junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, PIV, ripple factor, efficiency.	4 3
3	<i>Introduction to Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET):</i> Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier. JFET (N channel only) structure, Drain and Transfer characteristics.	4 2
4	<i>Introduction to OPAMP and Digital Electronics:</i> Introduction to Operational Amplifiers: Characteristics, Inverting and Non-Inverting mode of operation, summing amplifier, difference amplifier. Introduction to binary number; Basic Boolean algebra; Introduction to integrated circuits, Logic gates and truth tables for different logic operations and simple digital circuits using the basic gates.	3 3
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	identify semiconductor materials, draw band-diagrams, distinguish between intrinsic and extrinsic semiconductors, n- and p- type semiconductors, calculate drift and diffusion current components
2	explain the junction properties and the phenomenon of rectification, draw the I-V characteristics and identify operating points; Calculate ripple factors, efficiency of power supplies.
3	draw and explain the I-V characteristics of BJTs and FET – both input and output;
4	understand basics of OPAMP and learn the use of it as amplifier.
5	Explain binary numbers and identify different logic gates and circuit implementation.

Learning Resources:

1	Rakshit and Chattopadhyay: Introduction to Electronics Principle
2	Malvino: Electronic Principle.
3	Millman&Halkias: Integrated Electronics.
4	Boyelstad&Nashelsky: Electronic Devices & Circuit Theory.

Course Name:	English		
Course Code:	HM-HU101	Category:	HM
Semester:	First	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	1. Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills (speaking, reading and writing).

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	TECHNICAL COMMUNICATION: Theory of Communication – Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills	1L
2	VOCABULARY BUILDING: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms	1L

3.	BASIC WRITING SKILLS. Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences in logical order.	1 L
4	GRAMMAR: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9 L
5	WRITING PRACTICES: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10 L
6.	READING COMPREHENSION: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		24L

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:

1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Universal English. Prof. Prasad Kataria Publications, 2019.
6.	"Communication Skills for Professionals"-NiraKonar, Prentice Hall of India 2nd edition, New Delhi, 2011
7.	Gajendra Singh Chauhan, SmitaKashiramka and L. Thimmesh. Functional English. Cengage, 2019. Course Outcomes The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.



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Course Name:	Physics Laboratory		
Course Code:	BS-PH191	Category:	Basic Science Courses
Semester:	First	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Apply the concepts of physics to carry out experiments on Quantum physics, EMT, Optics and General properties of matter and interpret the same for deduction of results.

Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Determination of Dispersive Power of the Material of a Prism	3P/ Week
2	Determination of wavelength of a monochromatic light by Newton's ring	
3	Determination of Wavelength of the Given LASER Light by Diffraction Method	
4	Determination of Thermo-electric Power of a given Thermocouple	
5	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method	
6	Determination of Hall Coefficient of a Semiconductor	
7	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell	
8	Determination of Unknown Resistance using Carey Foster's Bridge	
9	Determination of Planck Constant using Photocell	
10	Verification of Bohr's Atomic Orbital Theory Through Frank-Hertz Experiment	
11	Determination of Rydberg Constant by Studying Hydrogen Spectrum	
12	Determination of Band Gap of a Semiconductor by Four Probe Method	
13	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure	
14	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method	
15	Determination of Coefficient of Viscosity by Poiseuille's Capillary Flow Method	
Total		36P



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Course Outcomes:

After completion of the course, students will be able to:

1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.

Learning Resources:

1	An Advanced Course in Practical Physics, by D. Chattopadhyay, P. C. Rakshit
2	A Manual of Practical Engineering Physics and Material Science, by A S Vasudeva
3	A Textbook of Engineering Physics Practical, by Dr. R Das, Dr. R Kumar, C S Robinson & P K Sahu

Course Name:	Basic Electrical and Electronics Engineering Lab		
Course Code:	ES-EE191	Category:	ES
Semester:	First	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:

1	Provide working knowledge for the analysis of basic DC and AC circuits
2	Measurement of power in three phase system
3	Provide working knowledge on Electric machines.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	3



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2	Calibration of ammeter and Wattmeter.	3
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	3
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method	3
5	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3
6	Determination of Torque –Speed characteristics of separately excited DC motor.	3
Total		18P

Course Outcomes:

After completion of the course, students will be able to:

1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.
3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the different characteristics of separately excited DC motor.

Learning Resources:

1	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:

1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.

Course Contents:

Exp. No.	Description of Topic	Contact Hrs.
1.	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	3



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2	a) Study of I-V characteristics of Junction diodes. b) Study of I-V characteristics of Zener diodes.	3
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	3
4	a) Study of I-V characteristics of BJTs. for CB configurations b) Study of I-V characteristics of BJTs. for CE configurations	3
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	3
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	3
Total		18P

Course Outcomes:

After completion of the course, students will be able to:

1	identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.
3	implement half wave and full wave rectifier circuits and can analyse the performance of them.
4	realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	use OPAMP as amplifier and verify the truth tables of different logic gates.

Learning Resources:

1	Laboratory Manual

Course Name:	Engineering Graphics & Design		
Course Code:	ES-ME191	Category:	Engineering Sciences
Semester:	First	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05



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Course Objectives:

1	To make students aware of importance of engineering drawing and to familiar with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P
5	Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P
7	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1L+4P
8	Sections and Sectional Views Of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1L+4P
9	Overview of Computer Graphics, Customisation& CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object	1L+4P

	Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	
10	Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	2L+8P
11	Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	2L+8P
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Familiarize with basics of drawing, dimensioning, scales, curves
2	Comprehend the theory of orthographic projection and its applications
3	Prepare and interpret isometric projection



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4	Create and modify 2D drawing using AutoCAD software

Learning Resources:	
1	Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6	Corresponding set of CAD Software Theory and User Manuals

Second Semester

Course Name:	Chemistry		
Course Code:	BS-CH201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	The objective of the Chemistry course is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Atomic and molecular structure <i>Atomic Structure:</i> Dalton's atomic theory; Fundamental of sub atomic particles; Rutherford's atomic model; Bohr's atomic model; Dual nature of electron; Heisenberg's uncertainty principle; Schrodinger wave equation; Orbitals and Quantum numbers; Particle in a box solutions (One dimension) and their applications for simple sample. <i>Molecular Structure:</i> Molecular orbital theory: Postulates of MOT; Bonding and anti bonding orbital's; MO diagram of diatomic molecules (H ₂ , He ₂ , Li ₂ , Be ₂); Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties (Octahedral and tetrahedral complexes); Band structure of solids and the role of doping on band structures (Band theory, Valence band and conduction band, Conductor, Semiconductor, Insulator, p-Type and n-Type semiconductor).	10L
2	Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals' interactions; Ideal gas equation, compressibility factor, Real gas equation, Boyles Temperature, Critical state (Critical pressure, critical volume and critical temperature).	5L
3	Periodic properties Mendeleev's periodic table; Periodic properties (Atomic radii, Ionic radii, Ionization potential, electron affinity, Electronegativity, metallic and non metallic character, oxidizing and reducing character); Polarizability	4L

	(Fajans' rule); Hard soft acids and bases; molecular geometries (VSEPR theory, Hybridization, sigma and pi bond, determination of hybridization state and structure of molecules); Hydrogen bond (Inter and intra molecular H bond); Effective nuclear charge; oxidation states.	
4	Use of free energy in chemical equilibria <i>Thermodynamics:</i> First law of thermodynamics, Internal energy & Enthalpy, Heat capacity, Adiabatic & Isothermal process, Reversible & Irreversible process, Second law of thermodynamics, Entropy, Free energy, Gibbs-Helmholtz equation. <i>Electrochemistry:</i> Electrochemical cell (Electrolytic cell & Galvanic cell), Representation of cell, Free energy and EMF, Reversible and Irreversible cell, Nernst equation and application, Application of EMF measurement on ΔG, ΔH, ΔS, equilibrium constant of a reversible chemical reaction and valency of an ion. Hydrogen Half cell, calomel half cell, Quinhydrone half cell. <i>Water Chemistry:</i> Hydrosphere; Hydrological cycle; Sources of water; Acidity and alkalinity of water; Pollutants of water; Biochemical and Chemical oxygen demand; Removal of dissolved solids from water (Electrodialysis & Reverse osmosis); Hardness of water (Types of hardness, Removal of hardness of water). <i>Corrosion:</i> Oxidation corrosion, Corrosion by gases, Pilling Bedworth rule, Electrochemical corrosion, Hydrogen evolution type & oxygen absorption type of corrosion, Corrosion of bimetals, Waterline corrosion, Crevice corrosion, Pitting corrosion, Stress corrosion, Factors influencing the corrosion, Prevention of corrosion.	10L
5	Spectroscopic techniques and applications Electromagnetic spectrum; Principles of spectroscopy and selection rules; UV/Vis Spectroscopy (Energy diagram of electron excitation, Lambert-Beer's law, Bathochromic and Hypsochromic shift, Hyperchromic and hypochromic effect, Instrumental technique, Solvent effect, application); IR spectroscopy [Basic principle, Stretching and bending vibration of AX₂ type molecule(non linear), Calculation of stretching frequency, Identification of organic compounds by IR spectroscopy, Instrumental technique and application]; NMR spectroscopy (Principle of NMR spectra, chemical shift, shielding and deshielding nucleus, application of NMR).	4L
6	Stereochemistry Isomerism, Structural isomerism, Metamerism, Tautomerism, Stereoisomerism, Optical activity, Configurations and symmetry and Chirality, Enantiomers and Diastereomers, Conformational analysis, Fischer and Sawhorse and Newman projection (inter conversion), R-, S-	5L

	and E-, Z- Nomenclature.	
7	Organic reactions and synthesis of a drug molecule Introduction to reactions involving <i>Addition Reaction:</i> Nucleophilic addition reaction [Acid catalysed reaction; Base catalysed reaction, Reactions of aldehyde or ketone with hydrocyanic acid, sodium bisulphite, water, Grignard reagent, alcohols], Electrophilic addition reaction [addition of Br₂ to alkene; addition of hydrogen halide in symmetrical and unsymmetrical alkene (Markownikov rule); addition of Hypohalous acid, sulphuric acid and water to unsymmetrical alkene; addition of hydrogen halide in unsymmetrical alkene in presence of peroxide (Anti Markownikov rule) Ozonolysis reaction. <i>Substitution Reaction:</i> Electrophilic substitution reaction [Chlorination of Benzene; Nitration of Benzene; Friedel-Crafts Reaction (Alkylation, Acylation)], Nucleophilic substitution reaction [S_N1 and S_N2 reaction]. <i>Elimination Reaction:</i> E1 elimination and E2 elimination: Hofmann and Saytzev elimination. <i>Nucleophilic addition followed by elimination Reaction:</i> Reaction of carbonyl compound with ammonia, Primary amine. <i>Cyclization reaction:</i> Diels-Alder reaction. <i>Oxidation Reaction:</i> Oxidation of alcohol (Primary, secondary and tertiary alcohol); autoxidation of ether; Oxidation of aldehyde and ketone; Baeyer-Villiger oxidation; Oxidation of aromatic compounds (Oxidation of toluene and its derivatives, benzaldehyde, acetophenone, phenol). <i>Reduction Reaction:</i> Reduction of alkenes; Alkynes; carbonyl compounds (aldehydes and ketones); Carboxylic acid and esters; Bouveault-Blanc reduction; Clemensen reduction; Wolf-Kishner reduction; Meerwein-Ponndorf-Verley reduction; Pinacol-Pinacolone rearrangement; Reduction of aromatic compounds (Benzaldehyde, Benzoic acid, Nitrobenzene, m-dinitrobenzene, Diazonium salt). <i>Name Reactions:</i> Aldol condensation and Mixed Aldol condensation; Claisen-schmidt reaction; Cannizaro reaction; Crossed Cannizaro reaction; Kolbe-Schmitt reaction; Gattermann-Koch aldehyde synthesis <i>Synthesis of a commonly used drug molecule:</i> Paracetamol, Aspirin	7L
Total		45L

Course Outcomes:

After completion of the course, students will be able to:

1	Demonstrate microscopic chemistry in terms of atomic and molecular orbitals and



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	intermolecular forces.
2	Illustrate bulk properties and processes using thermodynamic considerations.
3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
4	Articulate periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5	List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:	
1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2	University Chemistry, by B. H. Mahan
3	Fundamentals of environment and Ecology, by D. De & D. De, S. Chand Publishing.
4	Chemistry-I, by Gourkrishna Das Mohapatra, VIKAS Publishing House Pvt. Ltd.
5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6	Engineering Chemistry (NPTEL Web-book) by B.L.Tembe, Kamaluddin and M.S. Krishnan
7	Physical Chemistry, by P. W. Atkins
8	Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Pub.
9	Physical Chemistry, P. C. Rakshit, Sarat Book House
10	Organic Chemistry, Volume I, I. L. Finar, Pearson

Course Name:	Mathematics-II		
Course Code:	BS-M201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn how to solve different types of differential equation
2	To know the different types of improper integral
3	To know the Laplace transform
4	Basic concept of graph, digraph, walk, Hamiltonian graph, Euler circuit,
5	Basic concept of tree, binary tree

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Ordinary Differential Equations of First order: ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, In-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree - Equations solvable for p, solvable for x, solvable for y; Clairaut's equations,	8L
2	Higher Order Ordinary Differential Equations: (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI) (ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	8L
3	Improper Integrals: (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L
4	Laplace Transforms and Inverse Laplace Transforms: (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of a function multiplied by t^n and divided by t; LT of unit step and periodic functions; LT of derivatives. (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii) Solutions of initial and boundary value problems by LT	8L
5	Graph Theory: (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	Tree: (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		40L



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Course Outcomes:

After completion of the course, students will be able to:

1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems
3	Use tree and graph algorithms for different problems
4	evaluation of different types of improper integrals

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	An introduction to differential equation, Maity & Ghosh, NCBA
5	Michael Greenberg, Advanced Engineering Mathematics, Pearson
6	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
7	An introduction to Integral Calculus, Maity and Ghosh, NCBA
8	Advanced Differential Equation, M.D Raisinghania
9	An Introduction to Engineering Mathematics-II, G.P.Samanta, New Age Publication

Course Name:	Programming for Problem Solving		
Course Code:	ES-CS201	Category:	Engineering Science
Semester:	Second	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language).
2	To develop the ability to apply knowledge of programming for solution of science & engineering problems.



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs: Basic I/O operations, keywords, data types, variables & memory locations, source code, Syntax and Logical Errors in compilation, object and executable code. Operators and Expressions, operator precedence in C programming Language.	5
2	Conditional Branching and Looping : Concepts of Conditional Branching: if-else, nested if-else , switch-case Concepts of Loops: While, do-while, for loops, Use of break and continue statement.	8
3	Arrays : Concepts of 1-D, 2-D array, array manipulation, Concepts of character array, Strings and their uses. Basic Algorithms using array: Searching (linear and binary search) and Sorting Algorithms (Bubble, Insertion and Selection sort),	9
4	Functions: Functions (including using built in libraries), Parameter passing in functions, function call by value, Recursive functions. Pointers: Idea of pointers, Defining pointers, relation between array and pointer, idea of function call by address, Dynamic memory allocation.	8
5	Structure: Structures, Array of Structures, Self-referential structures. Storage Class and Preprocessor Directives. Disk I/O operations - File handling: open, read, write, close a file.	6
Total		36L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of structured programming language .
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford



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5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Chemistry Laboratory		
Course Code:	BS-CH291	Category:	Basic Science Courses
Semester:	Second	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	The objective of this course is to acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field. The students will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence. The course will enable the student to: • Determine the strength of an unknown solution through conductometric and pH metric titration. • Estimate the chloride ion concentration, alkalinity and hardness in water. • Find out the rate constant of a reaction. • Synthesize polymer molecules.

Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.	3P/ Week
2	pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.	
3	To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).	
4	Determination of dissolved oxygen present in a given water sample.	
5	Determination of viscosity of the given liquid by Ostwald –Viscometer.	
6	Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).	



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7	Chemical kinetics (determination of relative rates of reaction of iodide with H_2O_2 at room temperature).	
8	Determination of acid value (Acidity) of oil.	
9	The adsorption of acetic acid on active charcoal.	
10	Complexometric titration (estimation of hardness of water using EDTA).	
11	Redox titration (estimation of iron using permanganometry).	
12	To determine Alkalinity of a Given Water Sample.	
13	Synthesis of a polymer (Polyacrylamide) and determine its molecular weight by solution viscosity method.	
14	Determination of cell constant and conductance of solutions.	
Total		36P

Course Outcomes:

After completion of the course, students will be able to:

1	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: - Estimate rate constants of reactions from concentration of reactants/products as a function of time - Measure molecular/system properties such as viscosity, conductance of solutions, redox potentials, chloride content of water, etc. - Synthesize a macromolecule and determine its molecular weight by solution viscosity method.

Learning Resources:

1	Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house.
2	A Text book on Experiments and calculations in Engineering Chemistry, by S.S. Dara, S Chand publications.
3	Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited.

Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS291	Category:	Engineering Science
Semester:	Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05



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Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8
4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve basic data manipulation related problems.
4	Apply programming concepts to handle memory allocation and files.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill



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3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Workshop/ Manufacturing Practices		
Course Code:	ES-ME292	Category:	Engineering Sciences
Semester:	Second	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart basic knowledge of various hand tools and their applications in different sections of manufacturing
2	To develop basic manufacturing skills, precision, safety at work place, team working and development of right attitude.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
Lectures and videos:		
	1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods 2. CNC machining, Additive manufacturing 3. Fitting operations & power tools 4. Electrical & Electronics 5. Carpentry 7. Metal casting 8. Welding (arc welding & gas welding), brazing	13L
Workshop Practice:		
1	Machine shop: <i>Typical jobs that may be made in this practice module:</i> - To make a pin from a mild steel rod in a lathe. - To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.	8P

2	Fitting shop: Typical jobs that may be made in this practice module: To make a Gauge from MS plate.	8P
3	Carpentry: Typical jobs that may be made in this practice module: To make wooden joints and/or a pattern or like.	8P
4	Welding shop (Arc welding 4 hrs + gas welding 4 hrs): Typical jobs that may be made in this practice module: ARC WELDING (4 hours): - To join two thick (approx 6mm) MS plates by manual metal arc welding. GAS WELDING (4 hours): - To join two thin mild steel plates or sheets by gas welding.	8P
5	Casting: Typical jobs that may be made in this practice module: One/ two green sand moulds to prepare, and a casting be demonstrated.	8P
6	Smithy: Typical jobs that may be made in this practice module: A simple job of making a square rod from a round bar or like.	4P
7	Electrical & Electronics: - Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable. - Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point. - Simple wiring exercise to be executed to understand the basic electrical circuit. - Simple soldering exercises to be executed to understand the basic process of soldering. - Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.	8P
Total		13L+52P



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Course Outcomes:

After completion of the course, students will be able to:

1	Identify and utilize machine tools for producing components through machining processes
2	Demonstrate fundamental concept of pattern making, and moulding processes for engineering applications.
3	Practice fitting, carpentry, and smithy operations for manufacturing of components.
4	Explain concepts and applications of various types of fabrication processes.
5	Apply basic electrical and electronics engineering knowledge for household applications.

Learning Resources:

1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
4	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998
5	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Name:	Language Laboratory		
Course Code:	HM-HU291	Category:	HM
Semester:	Second	Credit:	1
L-T-P:	0-0-2	Pre-Requisites:	1.Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05
Course Objectives:			
1	To develop Technical Communication Skills. (listening, speaking, reading and writing)		



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Honing 'Listening Skill' and its sub skills through Language Lab Audio device	4P
2	Honing 'Speaking Skill' and its sub skills: Extempore, Public speaking, etc. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/ Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.	6P
3	Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Debate, Role Play etc.)	4P
4	Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.	6P
5	Honing 'Reading Skills' and its sub skills.	2P
6.	Honing 'Writing Skill' and its sub skills by using Language Lab Audio – Visual input; Practice Sessions	2P
Total		24P

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop their intellectual, personal and professional abilities.

Learning Resources:

1.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
6.	Gajendra Singh Chauhan, SmitaKashiramka and L. Thimmesha. Functional English. Cengage, 2019.



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Curriculum for Undergraduate Degree (B.Tech.) in Computer Science and Engineering (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Range of Credits:

As per AICTE, a student covering 160 credits during 4 years of studies as per curriculum of the Institute will be eligible to get Under Graduate B.Tech. degree. A student will be eligible to get B.Tech. degree with Honours, if he/ she completes an additional 20 credits. These could be acquired through MOOCs prescribed by the Institute. Every student admitted to the 4 years B.Tech programme is required to earn a minimum of 100 Activity Points under Mandatory Additional Requirement (MAR), in addition to the required academic grades, for getting B.Tech./ B.Tech. (Honours) degree. Also some non-credit mandatory courses are there included in the curriculum. Like theory courses, students are required to appear in the semester examination for all mandatory courses and must get a minimum of pass marks in those courses to be eligible to get the final degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Humanities and Social Sciences including Management Courses	12	12
2	Basic Science Courses	27	25
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.	25	24
4	Professional Core Courses	51	48
5	Professional Elective Courses relevant to chosen specialization/ branch	18	18
6	Open Elective Courses from other technical and / or emerging subjects	12	18
7	Project Work, Seminar and Internship in Industry or elsewhere	15	15
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	0	Non-Credit
Total		160	160



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D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	BS	Basic Science Courses
5	ES	Engineering Science Courses
6	HM	Humanities and Social Sciences including Management Courses
7	PC	Professional Core Courses
8	PE	Professional Elective Courses
9	OE	Open Elective Courses
10	MC	Mandatory Courses
11	PW	Project/ Internships/ Sessional

E. Courses in Different Categories:

Humanities and Social Sciences including Management Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	II	HM-HU201	English	2	0	0	2
2	IV	HM-HU401	Economics for Engineers	3	0	0	3
3	V	HM-HU501	Introduction to Industrial Management	2	0	0	2
4	VII	HM-HU702	Project Management and Entrepreneurship	3	0	0	3
Total Theory				10	0	0	10
Practical/ Sessional							
1	I	HM-HU191	Language Laboratory	0	0	2	1
2	V	HM-HU591	Soft Skill Development Lab	0	0	2	1
Total Practical/ Sessional				0	0	4	2
Total				10	0	4	12

Basic Science Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	BS-CH101	Chemistry	3	1	0	4
2	I	BS-M101	Mathematics-I	3	1	0	4
3	II	BS-PH201	Physics	3	1	0	4
4	II	BS-M201	Mathematics-II	3	1	0	4
5	III	BS-M304	Numerical Methods	2	0	0	2
6	III	BS-BIO301	Biology	2	0	0	2
7	IV	BS-M401	Mathematics-III	3	0	0	3
Total Theory				19	4	0	23



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Practical/ Sessional							
1	I	BS-CH191	Chemistry Laboratory	0	0	3	1.5
2	II	BS-PH291	Physics Laboratory	0	0	3	1.5
3	III	BS-M394	Numerical Methods Lab	0	0	2	1
Total Practical/ Sessional				0	0	8	4
Total				19	4	8	27

Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	ES-CS101	Programming for Problem Solving	3	0	0	3
2	II	ES-EE201	Basic Electrical and Electronics Engineering	4	0	0	4
3	III	ES-EC301	Principles of Communication Engineering	3	0	0	3
4	III	ES-EC302	Digital Electronics	3	0	0	3
Total Theory				13	0	0	13
Practical/ Sessional							
1	I	ES-CS191	Programming for Problem Solving Laboratory	0	0	4	2
2	I	ES-ME192	Workshop/Manufacturing Practices	1	0	4	3
3	II	ES-EE291	Basic Electrical and Electronics Engineering Laboratory	0	0	4	2
4	II	ES-ME291	Engineering Graphics & Design	1	0	4	3
5	III	ES-EC392	Digital Electronics Lab	0	0	4	2
Total Practical/ Sessional				2	0	20	12
Total				15	1	20	25

Professional Core Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	PC-CS301	Data Structures and Algorithms	3	0	0	3
2	III	PC-CS302	Discrete Mathematics	3	0	0	3
3	IV	PC-CS401	Computer Organization	3	0	0	3
4	IV	PC-CS402	Operating System	3	0	0	3
5	IV	PC-CS403	Design and Analysis of Algorithm	3	0	0	3
6	V	PC-CS501	Computer Architecture	3	0	0	3
7	V	PC-CS502	Object Oriented Programming	3	0	0	3
8	V	PC-CS503	Formal Language and Automata Theory	3	0	0	3
9	VI	PC-CS601	Compiler Design	3	0	0	3



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10	VI	PC-CS602	Data Base Management System	3	0	0	3
11	VI	PC-CS603	Computer Networks	3	0	0	3
<i>Total Theory</i>				33	0	0	33
Practical/ Sessional							
1	III	PC-CS391	Data Structures and Algorithms Lab	0	0	4	2
2	IV	PC-CS491	Computer Organization Lab	0	0	4	2
3	IV	PC-CS492	Operating System Lab	0	0	4	2
4	IV	PC-CS493	Design and Analysis of Algorithm Lab	0	0	4	2
5	IV	PC-CS494	IT Workshop (Using Python) Lab	0	0	4	2
6	V	PC-CS591	Computer Architecture Lab	0	0	4	2
7	V	PC-CS592	Object Oriented Programming Lab	0	0	4	2
8	VI	PC-CS692	Data Base Management System Lab	0	0	4	2
9	VI	PC-CS693	Computer Networks Lab	0	0	4	2
<i>Total Practical/ Sessional</i>				0	0	36	18
Total				33	0	36	51

Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	PE-CS501	Professional Elective-I	3	0	0	3
2	VI	PE-CS601	Professional Elective-II	3	0	0	3
3	VI	PE-CS602	Professional Elective-III	3	0	0	3
4	VII	PE-CS701	Professional Elective-IV	3	0	0	3
5	VII	PE-CS702	Professional Elective-V	3	0	0	3
6	VIII	PE-CS801	Professional Elective-VI	3	0	0	3
Total Theory				18	0	0	18
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				18	0	0	18

Open Elective Courses from other technical and / or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	VI	OE-CS601	Open Elective-I	3	0	0	3
2	VII	OE-CS701	Open Elective-II	3	0	0	3
3	VIII	OE-CS801	Open Elective-III	3	0	0	3
4	VIII	OE-CS802	Open Elective-IV	3	0	0	3
Total Theory				12	0	0	12



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Practical/ Sessional				
<i>Total Practical/ Sessional</i>		0	0	0
Total		12	0	12

Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
Total Theory				0	0	0	0
Practical/ Sessional							
1	VI	PW-CS681	Project-I	0	0	6	3
2	VII	PW-CS781	Project-II	0	0	8	4
3	VII	PW-CS782	Summer Internship	0	0	4	2
4	VIII	PW-CS881	Project-III	0	0	12	6
Total Practical/ Sessional				0	0	30	15
Total				0	0	30	15

Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	MC371	Environmental Sciences	2	0	0	0
2	IV	MC472	Constitution of India	2	0	0	0
3	V	MC571	Aptitude Skill Development-I	2	0	0	0
4	VI	MC671	Aptitude Skill Development-II	2	0	0	0
Total Theory				8	0	0	0
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				8	0	0	0

Curriculum for Undergraduate Degree (B.Tech.) in Computer Science and Engineering (w.e.f. AY: 2020-21)

Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)

Mandatory Induction Program- 3 Weeks Duration

Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-CH101	Chemistry	3	1	0	4
2	BS	BS-M101	Mathematics-I	3	1	0	4
3	ES	ES-CS101	Programming for Problem Solving	3	0	0	3
	Total Theory			9	2	0	11
Practical/ Sessional/ Mandatory Course							
1	BS	BS-CH191	Chemistry Laboratory	0	0	3	1.5
2	ES	ES-CS191	Programming for Problem Solving Laboratory	0	0	4	2
3	ES	ES-ME192	Workshop/Manufacturing Practices	1	0	4	3
4	HM	HM-HU191	Language Laboratory	0	0	2	1
	Total Practical/ Sessional/ Mandatory Course			1	0	13	7.5
Total of First Semester				10	2	13	18.5

Second Semester (First Year)

Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-PH201	Physics	3	1	0	4
2	BS	BS-M201	Mathematics-II	3	1	0	4
3	ES	ES-EE201	Basic Electrical and Electronics Engineering	4	0	0	4
4	HM	HM-HU201	English	2	0	0	2
Total Theory				12	2	0	14
Practical/ Sessional/ Mandatory Course							
1	BS	BS-PH291	Physics Laboratory	0	0	3	1.5
2	ES	ES-EE291	Basic Electrical and Electronics Engineering Laboratory	0	0	4	2
3	ES	ES-ME291	Engineering Graphics & Design	1	0	4	3
Total Practical/ Sessional/ Mandatory Course				1	0	11	6.5
Total of Second Semester				13	0	11	20.5



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Third Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	ES	ES-EC301	Principles of Communication Engineering	3	0	0	3
2	ES	ES-EC302	Digital Electronics	3	0	0	3
3	BS	BS-M304	Numerical Methods	2	0	0	2
4	PC	PC-CS301	Data Structures and Algorithms	3	0	0	3
5	PC	PC-CS302	Discrete Mathematics	3	0	0	3
6	BS	BS-BIO301	Biology	2	0	0	2
7	MC	MC371	Environmental Sciences	1	0	0	0
Total Theory				17	0	0	16
Practical/ Sessional/ Mandatory Course							
1	ES	ES-EC392	Digital Electronics Lab	0	0	4	2
2	PC	PC-CS391	Data Structures and Algorithm Lab	0	0	4	2
3	BS	BS-M394	Numerical Methods Lab	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				0	0	10	5
Total of Third Semester				17	0	10	21

Fourth Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-M401	Mathematics-III	3	0	0	3
2	PC	PC-CS401	Computer Organization	3	0	0	3
3	PC	PC-CS402	Operating System	3	0	0	3
4	PC	PC-CS403	Design and Analysis of Algorithm	3	0	0	3
5	HM	HM-HU401	Economics for Engineers	3	0	0	3
6	MC	MC472	Constitution of India	1	0	0	0
Total Theory				16	0	0	15
Practical/ Sessional/ Mandatory Course							
1	PC	PC-CS491	Computer Organization Lab	0	0	4	2
2	PC	PC-CS492	Operating System Lab	0	0	4	2
3	PC	PC-CS493	Design and Analysis of Algorithm Lab	0	0	4	2
4	PC	PC-CS494	IT Workshop (Using Python) Lab	0	0	4	2
Total Practical/ Sessional/ Mandatory Course				0	0	16	8
Total of Fourth Semester				16	0	16	23



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Fifth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-CS501	Computer Architecture	3	0	0	3
2	PC	PC-CS502	Object Oriented Programming	3	0	0	3
3	PC	PC-CS503	Formal Language and Automata Theory	3	0	0	3
4	PE	PE-CS501	Professional Elective-I	3	0	0	3
5	HM	HM-HU501	Introduction to Industrial Management	2	0	0	2
7	MC	MC571	Aptitude Skill Development-I	2	0	0	0
Total Theory				16	0	0	14
Practical/ Sessional/ Mandatory Course							
1	PC	PC-CS591	Computer Architecture Lab	0	0	4	2
2	PC	PC-CS592	Object Oriented Programming Lab	0	0	4	2
3	HM	HM-HU591	Soft Skills Development Lab	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				0	0	10	5
Total of Fifth Semester				16	0	10	19

PE-CS501	Professional Elective-I
PE-CS501A	Advanced Algorithm
PE-CS501B	Artificial Intelligence
PE-CS501C	Computer Graphics
PE-CS501D	Distributed Systems

Sixth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-CS601	Compiler Design	3	0	0	3
2	PC	PC-CS602	Data Base Management System	3	0	0	3
3	PC	PC-CS603	Computer Networks	3	0	0	3
4	PE	PE-CS601	Professional Elective-II	3	0	0	3
5	PE	PE-CS602	Professional Elective-III	3	0	0	3
6	OE	OE-CS601	Open Elective-I	3	0	0	3
7	MC	MC671	Aptitude Skill Development-II	2	0	0	0
Total Theory				20	0	0	18
Practical/ Sessional/ Mandatory Course							
1	PC	PC-CS692	Database Management System Lab	0	0	4	2
2	PC	PC-CS693	Computer Networks Lab	0	0	4	2
3	PW	PW-CS681	Project-I	0	0	6	3



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Total Practical/ Sessional/ Mandatory Course	0	0	14	7
Total of Sixth Semester	20	0	14	25

List of Elective Courses	
PE-CS601	Professional Elective-II
PE-CS601A	Software Engineering
PE-CS601B	Advanced Computer Architecture
PE-CS601C	Image Processing
PE-CS601D	Machine Learning
PE-CS602	Professional Elective-III
PE-CS602A	Parallel and Distributed Algorithms
PE-CS602B	Data Mining
PE-CS602C	Human Computer Interaction
PE-CS602D	Soft Computing
OE-CS601	Open Elective-I
OE-CS601A	Microprocessor and Microcontroller
OE-CS601B	Micro Electronics and VLSI Design
OE-CS601C	Operation Research
OE-CS601D	Control Systems

Seventh Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-CS701	Professional Elective-IV	3	0	0	3
2	PE	PE-CS702	Professional Elective-V	3	0	0	3
3	OE	OE-CS701	Open Elective-II	3	0	0	3
4	HM	HM-HU702	Project Management and Entrepreneurship	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PW	PW-CS781	Project-II	0	0	8	4
2	PW	PW-CS782	Summer Internship	0	0	4	2
Total Practical/ Sessional/ Mandatory Course				0	0	12	6
Total of Seventh Semester				12	0	12	18

List of Elective Courses	
PE-CS701	Professional Elective-IV
PE-CS701A	Quantum Computing
PE-CS701B	Cloud Computing
PE-CS701C	Multi Agent Intelligent Systems



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PE-CS701D	Neural Networks and Deep Learning
PE-CS702	Professional Elective-V
PE-CS702A	Internet of Things
PE-CS702B	Pattern Recognition
PE-CS702C	Ad-Hoc and Sensor Networks
PE-CS702D	Information Theory and Coding
OE-CS701	Open Elective Courses (Elective-II)
OE-CS701A	Cyber Law and Security Policy
OE-CS701B	E-Commerce and ERP
OE-CS701C	Introduction to Philosophical Thoughts

Eighth Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-CS801	Professional Elective-VI	3	0	0	3
2	OE	OE-CS801	Open Elective-III	3	0	0	3
3	OE	OE-CS802	Open Elective-IV	3	0	0	3
Total Theory				9	0	0	9
Practical/ Sessional/ Mandatory Course							
1	PW	PW-CS881	Project-II	0	0	12	6
Total Practical/ Sessional/ Mandatory Course				0	0	12	6
Total of Eighth Semester				9	0	0	15

List of Elective Courses	
PE-CS801	Professional Elective-VI
PE-CS801A	Mobile Computing
PE-CS801B	Cryptography and Network Security
PE-CS801C	Speech and Natural Language Processing
PE-CS801D	Web and Internet Technology
OE-CS801	Open Elective-III
OE-CS801A	Big Data Analysis
OE-CS801B	Data Analytics and Data Visualization
OE-CS801C	Robotics
OE-CS802	Open Elective-IV
OE-CS802A	Human Resource Development and Organizational Behavior
OE-CS802B	Multimedia Systems
OE-CS802C	Business Analytics

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Part III: Detailed Curriculum

Induction Program (Mandatory)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Duration

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Please refer **Appendix-A** for AICTE guidelines on Mandatory Induction Program.

First Semester

Course Name:	Chemistry		
Course Code:	BS-CH101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	The objective of the Chemistry course is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Atomic and molecular structure <i>Atomic Structure:</i> Dalton's atomic theory; Fundamental of sub atomic particles; Rutherford's atomic model; Bohr's atomic model; Dual nature of electron; Heisenberg's uncertainty principle; Schrodinger wave equation; Orbitals and Quantum numbers; Particle in a box solutions (One dimension) and their applications for simple sample. <i>Molecular Structure:</i> Molecular orbital theory: Postulates of MOT;	10L

	Bonding and anti bonding orbital's; MO diagram of diatomic molecules (H_2 , He_2 , Li_2 , Be_2); Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties (Octahedral and tetrahedral complexes); Band structure of solids and the role of doping on band structures (Band theory, Valence band and conduction band, Conductor, Semiconductor, Insulator, p-Type and n-Type semiconductor).	
2	Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals' interactions; Ideal gas equation, compressibility factor, Real gas equation, Boyles Temperature, Critical state (Critical pressure, critical volume and critical temperature).	4L
3	Periodic properties Mendeleeev's periodic table; Periodic properties (Atomic radii, Ionic radii, Ionization potential, electron affinity, Electronegativity, metallic and non metallic character, oxidizing and reducing character); Polarizability (Fajans' rule); Hard soft acids and bases; molecular geometries (VSEPR theory, Hybridization, sigma and pi bond, determination of hybridization state and structure of molecules); Hydrogen bond (Inter and intra molecular H bond); Effective nuclear charge; oxidation states.	4L
4	Use of free energy in chemical equilibria <i>Thermodynamics</i> : First law of thermodynamics, Internal energy & Enthalpy, Heat capacity, Adiabatic & Isothermal process, Reversible & Irreversible process, Second law of thermodynamics, Entropy, Free energy, Gibbs-Helmholtz equation. <i>Electrochemistry</i> : Electrochemical cell (Electrolytic cell & Galvanic cell), Representation of cell, Free energy and EMF, Reversible and Irreversible cell, Nernst equation and application, Application of EMF measurement on ΔG , ΔH , ΔS , equilibrium constant of a reversible chemical reaction and valency of an ion. Hydrogen Half cell, calomel half cell, Quinhydrone half cell. <i>Water Chemistry</i> : Hydrosphere; Hydrological cycle; Sources of water; Acidity and alkalinity of water; Pollutants of water; Biochemical and Chemical oxygen demand; Removal of dissolved solids from water (Electrodialysis & Reverse osmosis); Hardness of water (Types of hardness, Removal of hardness of water). <i>Corrosion</i> : Oxidation corrosion, Corrosion by gases, Pilling Bedworth rule, Electrochemical corrosion, Hydrogen evolution type & oxygen absorption type of corrosion, Corrosion of bimetals, Waterline corrosion, Crevice corrosion, Pitting corrosion, Stress corrosion, Factors influencing the corrosion, Prevention of corrosion.	10L
5	Spectroscopic techniques and applications Electromagnetic spectrum; Principles of spectroscopy and selection rules; UV/Vis Spectroscopy (Energy diagram of electron excitation, Lambert-Beer's law, Bathochromic and Hypsochromic shift,	5L

	Hyperchromic and hypochromic effect, Instrumental technique, Solvent effect, application); IR spectroscopy [Basic principle, Stretching and bending vibration of AX ₂ type molecule(non linear), Calculation of stretching frequency, Identification of organic compounds by IR spectroscopy, Instrumental technique and application]; NMR spectroscopy (Principle of NMR spectra, chemical shift, shielding and deshielding nucleus, application of NMR).	
6	Stereochemistry Isomerism, Structural isomerism, Metamerism, Tautomerism, Stereoisomerism, Optical activity, Configurations and symmetry and Chirality, Enantiomers and Diastereomers, Conformational analysis, Fischer and Sawhorse and Newman projection (inter conversion), R-, S- and E-, Z- Nomenclature.	5L
7	Organic reactions and synthesis of a drug molecule Introduction to reactions involving <i>Addition Reaction:</i> Nucleophilic addition reaction [Acid catalysed reaction; Base catalysed reaction, Reactions of aldehyde or ketone with hydrocyanic acid, sodium bisulphite, water, Grignard reagent, alcohols], Electrophilic addition reaction [addition of Br ₂ to alkene; addition of hydrogen halide in symmetrical and unsymmetrical alkene (Markownikov rule); addition of Hypohalous acid, sulphuric acid and water to unsymmetrical alkene; addition of hydrogen halide in unsymmetrical alkene in presence of peroxide (Anti Markownikov rule) Ozonolysis reaction. <i>Substitution Reaction:</i> Electrophilic substitution reaction [Chlorination of Benzene; Nitration of Benzene; Friedel-Crafts Reaction (Alkylation, Acylation)], Nucleophilic substitution reaction [S _N 1 and S _N 2 reaction]. <i>Elimination Reaction:</i> E1 elimination and E2 elimination: Hofmann and Saytzev elimination. <i>Nucleophilic addition followed by elimination Reaction:</i> Reaction of carbonyl compound with ammonia, Primary amine. <i>Cyclization reaction:</i> Diels-Alder reaction. <i>Oxidation Reaction:</i> Oxidation of alcohol (Primary, secondary and tertiary alcohol); autoxidation of ether; Oxidation of aldehyde and ketone; Baeyer-Villiger oxidation; Oxidation of aromatic compounds (Oxidation of toluene and its derivatives, benzaldehyde, acetophenone, phenol). <i>Reduction Reaction:</i> Reduction of alkenes; Alkynes; carbonyl compounds (aldehydes and ketones); Carboxylic acid and esters; Bouveault-Blanc reduction; Clemensen reduction; Wolf-Kishner reduction; Meerwein-Ponndorf-Verley reduction; Pinacol-Pinacolone rearrangement; Reduction of aromatic compounds (Benzaldehyde, Benzoic acid, Nitrobenzene, m-dinitrobenzene, Diazonium salt). <i>Name Reactions:</i> Aldol condensation and Mixed Aldol condensation; Claisen-schmidt reaction; Cannizzaro reaction; Crossed Cannizzaro	7L



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	reaction; Kolbe-Schmitt reaction; Gattermann-Koch aldehyde synthesis <i>Synthesis of a commonly used drug molecule: Paracetamol, Aspirin</i>	
Total		45L

Course Outcomes:

After completion of the course, students will be able to:

1	Demonstrate microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2	Illustrate bulk properties and processes using thermodynamic considerations.
3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
4	Articulate periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5	List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2	University Chemistry, by B. H. Mahan
3	Fundamentals of environment and Ecology, by D. De & D. De, S. Chand Publishing.
4	Chemistry-I, by Gourkrishna Das Mohapatra, VIKAS Publishing House Pvt. Ltd.
5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6	Engineering Chemistry (NPTEL Web-book) by B.L.Tembe, Kamaluddin and M.S. Krishnan
7	Physical Chemistry, by P. W. Atkins
8	Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Pub.
9	Physical Chemistry, P. C. Rakshit, Sarat Book House
10	Organic Chemistry, Volume I, I. L. Finar, Pearson

Course Name:	Mathematics-I		
Course Code:	BS-M101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To know Convergence of sequence and series
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function
3	To know the uses of matrix in different areas in engineering
4	To know the use of mean value theorems in engineering fields

5	Use of vector functions in different fields of Engineering

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Determinants and Matrices: (i) Introduction to determinant, properties (proofs of identities are excluded). (ii) Types of matrices, rank of a matrix, inverse of a matrix, Linear systems of equations, Cramer's rule, eigen-values and eigen-vectors, Caley-Hamilton theorem.	6L
2	Differential Calculus (Function of single variable): (i) Indeterminate forms and L'Hospital's rule; Successive differentiation, Leibnitz's theorem. (ii) Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin theorems with remainders; Maxima and minima. (iii) Evolutes and Involutives.	6L
3	Differential Calculus (Function of multi-variables): (i) Concept of limit, continuity and partial differentiation, chain rule, total differential, Jacobian, Euler's theorem on homogeneous function. (ii) Hessian, Maxima and minima; Lagrange's multipliers.	8L
4	Integral Calculus: (i) Line integrals; double integrals, change of order; triple integrals. (ii) Evaluation of surface areas and volumes of revolutions.	6L
5	Vector Calculus: (i) Vector differential operator, scalar and vector point function, gradient, directional derivative, divergence and curl. (ii) Divergence theorem, Green's and Stoke's theorem (Statements only) and applications.	8L
6	Sequence and Series: (i) Sequence, type of a sequence. (ii) Series of positive terms; Geometric and p-series and their convergence criterion; Convergence test of series: Comparison test, D'Alembert's ratio test, Cauchy's root test. (iii) Alternating series; Absolute convergence, Leibnitz's theorem.	6L
Total		40

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply knowledge of differential and integral calculus to determine curvature and evaluation of different types of improper integrals
2	Utilize mean value theorems for solution of engineering problems.
3	Learn matrices, concept of rank, methods of matrix inversion and their applications.
4	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.



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5	Determine eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces to solve physical and engineering problems
6	Solve multiple integrals and utilize it to different physical problems

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	Higher Algebra, S. K. Mapa, Levant Books
5	Advanced Higher Algebra, Chakravorty and Ghosh, U N Dhar Pvt. Ltd.
6	Vector Analysis, Schaum's outline
7	An introduction to Integral calculus, Maity and Ghosh, NCBA
8	An introduction to Differential Calculus, Maity and Ghosh, NCBA
9	An introduction to Engineering mathematics-I, G.P. Samanta, New Age publication
10.	Vector Analysis, Chakravorty and Ghosh, U N Dhar Pvt. Ltd

Course Name:	Programming for Problem Solving		
Course Code:	ES-CS101	Category:	Engineering Science Courses
Semester:	First	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language).
2	To develop the ability to apply knowledge of programming for solution of science & engineering problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs: Basic I/O operations, keywords, data types, variables & memory locations, source code, Syntax and Logical Errors in compilation, object and executable code. Operators and Expressions, operator precedence in C programming Language.	5

2	Conditional Branching and Looping : Concepts of Conditional Branching: if-else, nested if-else , switch-case Concepts of Loops: While, do-while, for loops, Use of break and continue statement.	8
3	Arrays : Concepts of 1-D, 2-D array, array manipulation, Concepts of character array, Strings and their uses. Basic Algorithms using array: Searching (linear and binary search) and Sorting Algorithms (Bubble, Insertion and Selection sort),	9
4	Functions: Functions (including using built in libraries), Parameter passing in functions, function call by value, Recursive functions. Pointers: Idea of pointers, Defining pointers, relation between array and pointer, idea of function call by address, Dynamic memory allocation.	8
5	Structure: Structures, Array of Structures, Self-referential structures. Storage Class and Preprocessor Directives. Disk I/O operations - File handling: open, read, write, close a file.	6
Total		36L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of structured programming language .
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Chemistry Laboratory		
Course Code:	BS-CH191	Category:	Basic Science Courses
Semester:	First	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	The objective of this course is to acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field. The students will be able to understand

	and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence. The course will enable the student to: • Determine the strength of an unknown solution through conductometric and pH metric titration. • Estimate the chloride ion concentration, alkalinity and hardness in water. • Find out the rate constant of a reaction. • Synthesize polymer molecules.

Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.	3P/ Week
2	pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.	
3	To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).	
4	Determination of dissolved oxygen present in a given water sample.	
5	Determination of viscosity of the given liquid by Ostwald – Viscometer.	
6	Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).	
7	Chemical kinetics (determination of relative rates of reaction of iodide with H ₂ O ₂ at room temperature).	
8	Determination of acid value (Acidity) of oil.	
9	The adsorption of acetic acid on active charcoal.	
10	Complexometric titration (estimation of hardness of water using EDTA).	
11	Redox titration (estimation of iron using permanganometry).	
12	To determine Alkalinity of a Given Water Sample.	
13	Synthesis of a polymer (Polyacrylamide) and determine its molecular weight by solution viscosity method.	
14	Determination of cell constant and conductance of solutions.	
Total		36P

Course Outcomes:	
After completion of the course, students will be able to:	
1	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: • Estimate rate constants of reactions from concentration of reactants/products as a



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	function of time • Measure molecular/system properties such as viscosity, conductance of solutions, redox potentials, chloride content of water, etc. • Synthesize a macromolecule and determine its molecular weight by solution viscosity method.

Learning Resources:

1	Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house.
2	A Text book on Experiments and calculations in Engineering Chemistry, by S.S. Dara, S Chand publications.
3	Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited.

Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS191	Category:	Engineering Science Courses
Semester:	First	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8



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4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve basic data manipulation related problems.
4	Apply programming concepts to handle memory allocation and files.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Workshop/ Manufacturing Practices		
Course Code:	ES-ME192	Category:	Engineering Sciences Courses
Semester:	First	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To impart basic knowledge of various hand tools and their applications in different sections of manufacturing
2	To develop basic manufacturing skills, precision, safety at work place, team working and development of right attitude.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
Lectures and videos:		
	1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods 2. CNC machining, Additive manufacturing 3. Fitting operations & power tools 4. Electrical & Electronics 5. Carpentry 7. Metal casting 8. Welding (arc welding & gas welding), brazing	13L
Workshop Practice:		
1	Machine shop: <i>Typical jobs that may be made in this practice module:</i> - To make a pin from a mild steel rod in a lathe. - To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.	8P
2	Fitting shop: <i>Typical jobs that may be made in this practice module:</i> To make a Gauge from MS plate.	8P
3	Carpentry: <i>Typical jobs that may be made in this practice module:</i> To make wooden joints and/or a pattern or like.	8P
4	Welding shop (Arc welding 4 hrs + gas welding 4 hrs): <i>Typical jobs that may be made in this practice module:</i> ARC WELDING (4 hours): - To join two thick (approx 6mm) MS plates by manual metal arc welding. GAS WELDING (4 hours): - To join two thin mild steel plates or sheets by gas welding.	8P
5	Casting: <i>Typical jobs that may be made in this practice module:</i> One/ two green sand moulds to prepare, and a casting be demonstrated.	8P
6	Smithy: <i>Typical jobs that may be made in this practice module:</i> A simple job of making a square rod from a round bar or like.	4P
7	Electrical & Electronics: Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-	8P

	phase wire, wiring cable. • Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point. • Simple wiring exercise to be executed to understand the basic electrical circuit. • Simple soldering exercises to be executed to understand the basic process of soldering. • Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.	
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Identify and utilize machine tools for producing components through machining processes
2	Demonstrate fundamental concept of pattern making, and moulding processes for engineering applications.
3	Practice fitting, carpentry, and smithy operations for manufacturing of components.
4	Explain concepts and applications of various types of fabrication processes.
5	Apply basic electrical and electronics engineering knowledge for household applications.

Learning Resources:

1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpajian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
4	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998
5	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.



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Course Name:	Language Laboratory		
Course Code:	HM-HU191	Category:	Humanities and Social Sciences including Management Courses
Semester:	First	Credit:	1
L-T-P:	0-0-2	Pre-Requisites:	1. Students must have basic command of English to talk about day-to-day events and experiences of life. 2. Comprehend Lectures delivered in English. 3. Read and understand relevant materials written in English.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills. (listening, speaking, reading and writing)

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Honing 'Listening Skill' and its sub skills through Language Lab Audio device	4P
2	Honing 'Speaking Skill' and its sub skills: Extempore, Public speaking, etc. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/ Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.	6P
3	Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Debate, Role Play etc.)	4P
4	Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.	6P
5	Honing 'Reading Skills' and its sub skills.	2P
6.	Honing 'Writing Skill' and its sub skills by using Language Lab Audio –Visual input; Practice Sessions	2P
Total		24P

Course Outcomes:



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After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop their intellectual, personal and professional abilities.

Learning Resources:

1.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
6.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019.

Second Semester



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Course Name:	Physics		
Course Code:	BS-PH201	Category:	Basic Science Courses
Semester:	Second	Credit:	4.0
L-T-P:	3-1-0	Pre-Requisites:	Mathematics Course with Vector Calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	Understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	Describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Module-1: Foundations of Quantum Mechanics Introduction to Quantum Physics: Brief idea about the historical development of quantum mechanics.	(8L) 1
	Black Body Radiation: Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws.	2
	Compton Effect: Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	2
	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation.	2
	Uncertainty Principle: Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero point energy, Numerical problems.	1

2	Module-2: Schrödinger Wave Equation and Its Applications Formulation of Quantum Mechanics: Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of associated problems. Schrödinger Wave Equation: Time independent Schrödinger's equation from time dependent one by the separation of variable method. Applications of Quantum Mechanics: Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator	(8L) 3 1 4
3	Module-3: Dielectric Materials and their Applications Concept of Dielectric and Polarization: Electric field inside a Dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, Atomic polarizability and polarization vector. Inter Relationship among Dielectric Parameters: Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems on relation between polarizability, susceptibility and dielectric constant. Types of Polarization: Electronic polarization and derivation of electronic polarizability, Concept of ionic and orientational polarization (no derivation). Applications of Dielectric: Dielectric breakdown and dielectric strength, Concept of Dielectric loss, Few applications of dielectrics in different fields.	(5L) 1 2 1 1
4	Module-4: Time Varying Fields Electromagnetic Induction: Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in Motors and Generators, Calculation of Induced EMF. Displacement Current: Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	(3L) 2 1
5	Module-5: Electromagnetic Waves Maxwell's Electromagnetic Field Equations: Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators etc.). Plane Electromagnetic Wave in Free Space: Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. Plane Electromagnetic Wave in Medium: Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. Energy in an Electromagnetic Field: Flow of energy associated to	(6L) 2 1 2

	electromagnetic field and Poynting vector.	1
6	Module-6: Laser and Fiber Optics <i>Introduction to Laser:</i> Properties of light sources, Need of suitable light source in communication, Invention of laser, Characteristics and applications of laser. <i>Interaction of Light with Matter:</i> Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them. <i>Components and Working of Laser Systems:</i> Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO ₂ laser). <i>Optical Communication:</i> Introduction, Need for optical communication, Salient features of optical fibers, Amplitude and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth analog/digital communication system <i>Light Guidance in Fibers:</i> Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single and multimode fibers, Step-index and graded-index fibers. <i>Transmission characteristics of optical fibers:</i> Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion, bit rate - length product, Minimization of intermodal dispersion.	(9L) 1 1 2 2 1 2
Total		39L

Course Outcomes:

After completion of the course, students will be able to:

1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various medium of propagations.
4	Understand the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy etc.
6	Explain the workings of various LASERS and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the

	dispersion leading to calculation of Bit Rate of a communication channel..

Learning Resources:	
1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Aurther Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
9	'Understanding Lasers' by Jeff Hecht
10	'An Introduction to Fiber Optics' by Ajoy Ghatak and K. Thyagrajan

Course Name:	Mathematics-II		
Course Code:	BS-M201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn how to solve different types of differential equation
2	To know the different types of improper integral
3	To know the Laplace transform
4	Basic concept of graph,digraph,walk,Hamiltonian graph,Euler circuit,
5	Basic concept of tree,binary tree

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Ordinary Differential Equations of First order: ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, In-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree - Equations solvable for p, solvable for x, solvable for y; Clairaut's equations,	8L
2	Higher Order Ordinary Differential Equations: (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI) (ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	8L

3	Improper Integrals: (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L
4	Laplace Transforms and Inverse Laplace Transforms: (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of a function multiplied by t^n and divided by t ; LT of unit step and periodic functions; LT of derivatives. (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii) Solutions of initial and boundary value problems by LT	8L
5	Graph Theory: (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	Tree: (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		40L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems
3	Use tree and graph algorithms for different problems
4	evaluation of different types of improper integrals

Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Arthur Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
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Course Name:	Basic Electrical and Electronics Engineering		
Course Code:	ES-EE201	Category:	Engineering Sciences Courses
Semester:	Second	Credit:	4
L-T-P:	4-0-0	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:	
1	To provide comprehensive idea about AC and DC circuit analysis
2	To make the students understand about working principals and applications of electric machines
3	To make the students understand the components of low voltage electrical installations
4	To provide basic idea about general structure of electrical power system.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
Module 1	DC Circuits Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5
Module 2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel),	4
Module 3	Three phase system Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2
Module 4	DC Machines Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor	5
Module 5	AC Machines Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency Three-phase induction motor Generation of rotating magnetic fields, Construction and working of a	4



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	three-phase induction motor.	
Module 6	Electrical Installations Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3
Module 7	General structure of electrical power system : Power generation to distribution through overhead lines and underground cables with single line diagram	1
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.

Learning Resources:

1	D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2	C.L. Wadhwa, Basic Electrical Engineering, New Age, 2007.
3	S K Bhattacharya, Basic Electrical and Electronics Engineering, Pearson, 2011
4	Ashfaq Husain and Haroon Ashfaq, Fundamentals of Electrical Engineering, Dhanpat Rai & Co., Delhi, 2007.
5	J.B. Gupta, Basic Electrical Engineering, Kataria& Sons, 2015.
6	L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
7	E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:

1	To make the students understand about the semiconductor.
2	To make the students understand about Diode and its circuit.
3	To make the students understand about different Transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:



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Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Semiconductors: Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5
2	Diode and Diode Circuits: Formation of P-N junction, depletion region, built-in-potential, forward and reverse biased P-N junction, energy band diagrams, V-I characteristics, Zener diode forward and reverse characteristics, Avalanche breakdown and Zener breakdown, junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, PIV, ripple factor, efficiency.	4 3
3	Introduction to Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET): Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier. JFET (N channel only) structure, Drain and Transfer characteristics.	4 2
4	Introduction to OPAMP and Digital Electronics: Introduction to Operational Amplifiers: Characteristics, Inverting and Non-Inverting mode of operation, summing amplifier, difference amplifier. Introduction to binary number; Basic Boolean algebra; Introduction to integrated circuits, Logic gates and truth tables for different logic operations and simple digital circuits using the basic gates.	3 3
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Identify semiconductor materials, draw band-diagrams, distinguish between intrinsic and extrinsic semiconductors, n- and p- type semiconductors, calculate drift and diffusion current components
2	Explain the junction properties and the phenomenon of rectification, draw the I-V characteristics and identify operating points; Calculate ripple factors, efficiency of power supplies.
3	Draw and explain the I-V characteristics of BJTs and FET – both input and output;
4	Understand basics of OPAMP and learn the use of it as amplifier.
5	Explain binary numbers and identify different logic gates and circuit implementation.

Learning Resources:

1	Rakshit and Chattopadhyay: Introduction to Electronics Principle



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2	Malvino: Electronic Principle.
3	Millman & Halkias: Integrated Electronics.
4	Boylestad & Nashelsky: Electronic Devices & Circuit Theory.

Course Name:	English		
Course Code:	HM-HU201	Category:	Humanities and Social Sciences including Management Courses
Semester:	Second	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	1. Students must have basic command of English to talk about day-to-day events and experiences of life. 2. Comprehend Lectures delivered in English. 3. Read and understand relevant materials written in English.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop Technical Communication Skills (speaking, reading and writing).

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1.	TECHNICAL COMMUNICATION: Theory of Communication – Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills	1L
2	VOCABULARY BUILDING: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms	1L
3.	BASIC WRITING SKILLS. Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences in logical order.	1 L



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4	GRAMMAR: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9 L
5	WRITING PRACTICES: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10 L
6.	READING COMPREHENSION: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		24L

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:

1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Universal English. Prof. Prasad Kataria Publications, 2019.
6.	"Communication Skills for Professionals"-Nira Konar, Prentice Hall of India 2nd edition, New Delhi, 2011
7.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019. Course Outcomes The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Name:	Physics Laboratory		
Course Code:	BS-PH291	Category:	Basic Science Courses
Semester:	Second	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	Apply the concepts of physics to carry out experiments on Quantum physics, EMT, Optics and General properties of matter and interpret the same for deduction of results.



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Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Determination of Dispersive Power of the Material of a Prism	3P/ week
2	Determination of wavelength of a monochromatic light by Newton's ring	
3	Determination of Wavelength of the Given LASER Light by Diffraction Method	
4	Determination of Thermo-electric Power of a given Thermocouple	
5	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method	
6	Determination of Hall Coefficient of a Semiconductor	
7	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell	
8	Determination of Unknown Resistance using Carey Foster's Bridge	
9	Determination of Planck Constant using Photocell	
10	Verification of Bohr's Atomic Orbital Theory Through Frank-Hertz Experiment	
11	Determination of Rydberg Constant by Studying Hydrogen Spectrum	
12	Determination of Band Gap of a Semiconductor by Four Probe Method	
13	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure	
14	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method	
15	Determination of Coefficient of Viscosity by Poiseuille's Capillary Flow Method	
Total		39P

Course Outcomes:

After completion of the course, students will be able to:

1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.

Learning Resources:

1	An Advanced Course in Practical Physics, by D. Chattopadhyay, P. C. Rakshit
2	A Manual of Practical Engineering Physics and Material Science, by A S Vasudeva
3	A Textbook of Engineering Physics Practical, by Dr. R Das, Dr. R Kumar, C S Robinson & P K Sahu



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Course Name:	Basic Electrical and Electronics Engineering Lab		
Course Code:	ES-EE291	Category:	Engineering Sciences Courses
Semester:	Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Knowledge of Class XII level Electronics, Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:	
1	Provide working knowledge for the analysis of basic DC and AC circuits
2	Measurement of power in three phase system
3	Provide working knowledge on Electric machines.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	3
2	Calibration of ammeter and Wattmeter.	3
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	3
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method	3
5	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3
6	Determination of Torque –Speed characteristics of separately excited DC motor.	3
Total		18 P

Course Outcomes:	
After completion of the course, students will be able to:	
1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.
3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the different characteristics of separately excited DC motor.

Learning Resources:



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1	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:	
1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.

Course Contents:		
Exp. No.	Description of Topic	Contact Hrs.
1.	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	3
2	a) Study of I-V characteristics of Junction diodes. b) Study of I-V characteristics of Zener diodes.	3
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	3
4	a) Study of I-V characteristics of BJTs. for CB configurations b) Study of I-V characteristics of BJTs. for CE configurations	3
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	3
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	3
Total		18P

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	Realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.
3	Implement half wave and full wave rectifier circuits and can analyse the performance of them.
4	Realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	Realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	Use OPAMP as amplifier and verify the truth tables of different logic gates.



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Learning Resources:

1	Laboratory Manual

Course Name:	Engineering Graphics & Design		
Course Code:	ES-ME291	Category:	Engineering Sciences Courses
Semester:	Second	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To make students aware of importance of engineering drawing and to familiar with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P
5	Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P

7	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1L+4P
8	Sections and Sectional Views Of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1L+4P
9	Overview of Computer Graphics, Customisation & CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	1L+4P
10	Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	2L+8P
11	Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels;	2L+8P



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	floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Familiarize with basics of drawing, dimensioning, scales, curves
2	Comprehend the theory of orthographic projection and its applications
3	Prepare and interpret isometric projection
4	Create and modify 2D drawing using AutoCAD software

Learning Resources:

1	Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6	Corresponding set of CAD Software Theory and User Manuals



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Curriculum for Undergraduate Degree (B.Tech.) in Computer Science and Engineering (Data Science) (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Range of Credits:

As per AICTE, a student covering 160 credits during 4 years of studies as per curriculum of the Institute will be eligible to get Under Graduate B.Tech. degree. A student will be eligible to get B.Tech. degree with Honours, if he/ she completes an additional 20 credits. These could be acquired through MOOCs prescribed by the Institute. Every student admitted to the 4 years B.Tech programme is required to earn a minimum of 100 Activity Points under Mandatory Additional Requirement (MAR), in addition to the required academic grades, for getting B.Tech./ B.Tech. (Honours) degree. Also some non-credit mandatory courses are there included in the curriculum. Like theory courses, students are required to appear in the semester examination for all mandatory courses and must get a minimum of pass marks in those courses to be eligible to get the final degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Humanities and Social Sciences including Management Courses	12	12
2	Basic Science Courses	27	25
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.	24	24
4	Professional Core Courses	52	48
5	Professional Elective Courses relevant to chosen specialization/ branch	18	18
6	Open Elective Courses from other technical and / or emerging subjects	12	18
7	Project Work, Seminar and Internship in Industry or elsewhere	15	15
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	0	Non-Credit
Total		160	160



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D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	BS	Basic Science Courses
5	ES	Engineering Science Courses
6	HM	Humanities and Social Sciences including Management Courses
7	PC	Professional Core Courses
8	PE	Professional Elective Courses
9	OE	Open Elective Courses
10	MC	Mandatory Courses
11	PW	Project/ Internships/ Sessional

E. Courses in Different Categories:

Humanities and Social Sciences including Management Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	II	HM-HU201	English	2	0	0	2
2	IV	HM-HU401	Economics for Engineers	3	0	0	3
3	V	HM-HU501	Introduction to Industrial Management	2	0	0	2
4	VII	HM-HU702	Project Management and Entrepreneurship	3	0	0	3
Total Theory				10	0	0	10
Practical/ Sessional							
1	I	HM-HU191	Language Laboratory	0	0	2	1
2	V	HM-HU591	Soft Skills Development Lab	0	0	2	1
Total Practical/ Sessional				0	0	4	2
Total				10	0	4	12

Basic Science Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	BS-CH101	Chemistry	3	1	0	4
2	I	BS-M101	Mathematics-I	3	1	0	4
3	II	BS-PH201	Physics	3	1	0	4
4	II	BS-M201	Mathematics-II	3	1	0	4
5	III	BS-M304	Numerical Methods	2	0	0	2
6	III	BS-BIO301	Biology	2	0	0	2
7	IV	BS-M401	Mathematics-III	3	0	0	3
Total Theory				19	4	0	23



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Practical/ Sessional							
1	I	BS-CH191	Chemistry Laboratory	0	0	3	1.5
2	II	BS-PH291	Physics Laboratory	0	0	3	1.5
3	III	BS-M394	Numerical Methods Lab	0	0	2	1
Total Practical/ Sessional				0	0	8	4
Total				19	4	8	27

Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.							
Sl No.	Semest er	Course Code	Course Name	Contact Hours			Credit s
				L	T	P	
Theory							
1	I	ES-CS101	Programming for Problem Solving	3	0	0	3
2	II	ES-EE201	Basic Electrical and Electronics Engineering	4	0	0	4
3	III	ES-EC(D)301	Principles of Communication Engineering	2	0	0	2
4	III	ES-EC302	Digital Electronics	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional							
1	I	ES-CS191	Programming for Problem Solving Laboratory	0	0	4	2
2	I	ES-ME192	Workshop/Manufacturing Practices	1	0	4	3
3	II	ES-EE291	Basic Electrical and Electronics Engineering Laboratory	0	0	4	2
4	II	ES-ME291	Engineering Graphics & Design	1	0	4	3
5	III	ES-EC392	Digital Electronics Lab	0	0	4	2
Total Practical/ Sessional				2	0	20	12
Total				13	1	20	24

Professional Core Courses							
Sl No.	Semest er	Course Code	Course Name	Contact Hours			Credit s
				L	T	P	
Theory							
1	III	PC-CS301	Data Structures and Algorithms	3	0	0	3
2	III	PC-CS302	Discrete Mathematics	3	0	0	3
3	IV	PC-CS(D)401	Computer Organization and Architecture	3	0	0	3
4	IV	PC-CS402	Operating System	3	0	0	3
5	IV	PC-CS403	Design and Analysis of Algorithm	3	0	0	3
6	V	PC-CS(D)501	Artificial Intelligence	3	0	0	3
7	V	PC-CS502	Object Oriented Programming	3	0	0	3



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8	V	PC-CS503	Formal Language and Automata Theory	3	0	0	3
9	VI	PC-CS601	Compiler Design	3	0	0	3
10	VI	PC-CS602	Data Base Management System	3	0	0	3
11	VI	PC-CS603	Computer Networks	3	0	0	3
<i>Total Theory</i>				33	0	0	33
Practical/ Sessional							
1	III	PC-CS391	Data Structures and Algorithms Lab	0	0	4	2
2	IV	PC-CS(D)491	Computer Organization and Architecture Lab	0	0	4	2
3	IV	PC-CS492	Operating System Lab	0	0	3	1.5
4	IV	PC-CS493	Design and Analysis of Algorithm Lab	0	0	4	2
5	IV	PC-CS494	IT Workshop (Using Python) Lab	0	0	4	2
6	V	PC-CS(D)591	Artificial Intelligence	0	0	4	2
7	V	PC-CS592	Object Oriented Programming Lab	0	0	4	2
8	V	PC-CS593	Introduction to R Programming	0	0	3	1.5
9	VI	PC-CS692	Data Base Management System Lab	0	0	4	2
10	6	PC-CS693	Computer Networks Lab	0	0	4	2
<i>Total Practical/ Sessional</i>				0	0	38	19
Total				33	0	38	52

Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	PE-CS(D)501	Professional Elective-I	3	0	0	3
2	VI	PE-CS(D)601	Professional Elective-II	3	0	0	3
3	VI	PE-CS(D)602	Professional Elective-III	3	0	0	3
4	VII	PE-CS(D)701	Professional Elective-IV	3	0	0	3
5	VII	PE-CS(D)702	Professional Elective-V	3	0	0	3
6	VIII	PE-CS(D)801	Professional Elective-VI	3	0	0	3
Total Theory				18	0	0	18
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				18	0	0	18



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Open Elective Courses from other technical and/ or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	VI	OE-CS(D)601	Open Elective-I	3	0	0	3
2	VII	OE-CS(D)701	Open Elective-II	3	0	0	3
3	VIII	OE-CS(D)801	Open Elective-III	3	0	0	3
4	VIII	OE-CS(D)802	Open Elective-IV	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				12	0	0	12

Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
Total Theory				0	0	0	0
Practical/ Sessional							
1	VI	PW-CS681	Project-I	0	0	6	3
2	VII	PW-CS781	Project-II	0	0	8	4
3	VII	PW-CS782	Summer Internship	0	0	4	2
4	VIII	PW-CS881	Project-III	0	0	12	6
Total Practical/ Sessional				0	0	30	15
Total				0	0	30	15

Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	MC371	Environmental Sciences	1	0	0	0
2	IV	MC472	Constitution of India	1	0	0	0
3	V	MC571	Aptitude Skill Development-I	2	0	0	0
4	VI	MC671	Aptitude Skill Development-II	2	0	0	0
Total Theory				6	0	0	0
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				6	0	0	0



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Curriculum for Undergraduate Degree (B.Tech.) in Computer Science and Engineering (Data Science) (w.e.f. AY: 2020-21)

Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)							
Mandatory Induction Program- 3 Weeks Duration							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-CH101	Chemistry	3	1	0	4
2	BS	BS-M101	Mathematics-I	3	1	0	4
3	ES	ES-CS101	Programming for Problem Solving	3	0	0	3
	Total Theory			9	2	0	11
Practical/ Sessional/ Mandatory Course							
1	BS	BS-CH191	Chemistry Laboratory	0	0	3	1.5
2	ES	ES-CS191	Programming for Problem Solving Laboratory	0	0	4	2
3	ES	ES-ME192	Workshop/Manufacturing Practices	1	0	4	3
4	HM	HM-HU191	Language Laboratory	0	0	2	1
	Total Practical/ Sessional/ Mandatory Course			1	0	13	7.5
Total of First Semester				10	2	13	18.5

Second Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-PH201	Physics	3	1	0	4
2	BS	BS-M201	Mathematics-II	3	1	0	4
3	ES	ES-EE201	Basic Electrical and Electronics Engineering	4	0	0	4
4	HM	HM-HU201	English	2	0	0	2
Total Theory				12	2	0	14
Practical/ Sessional/ Mandatory Course							
1	BS	BS-PH291	Physics Laboratory	0	0	3	1.5
2	ES	ES-EE291	Basic Electrical and Electronics Engineering Laboratory	0	0	4	2
3	ES	ES-ME291	Engineering Graphics & Design	1	0	4	3
Total Practical/ Sessional/ Mandatory Course				1	0	11	6.5
Total of Second Semester				13	2	11	20.5



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Third Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	ES	ES-EC(D)301	Principles of Communication Engineering	2	0	0	2
2	ES	ES-EC302	Digital Electronics	3	0	0	3
3	BS	BS-M304	Numerical Methods	2	0	0	2
4	PC	PC-CS301	Data Structures and Algorithms	3	0	0	3
5	PC	PC-CS302	Discrete Mathematics	3	0	0	3
6	BS	BS-BIO301	Biology	2	0	0	2
7	MC	MC371	Environmental Sciences	1	0	0	0
Total Theory				16	0	0	15
Practical/ Sessional/ Mandatory Course							
1	ES	ES-EC392	Digital Electronics Lab	0	0	4	2
2	PC	PC-CS391	Data Structures and Algorithm Lab	0	0	4	2
3	BS	BS-M394	Numerical Methods Lab	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				0	0	10	5
Total of Third Semester				16	0	10	20

Fourth Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-M401	Mathematics-III	3	0	0	3
2	PC	PC-CS(D)401	Computer Organization and Architecture	3	0	0	3
3	PC	PC-CS402	Operating System	3	0	0	3
4	PC	PC-CS403	Design and Analysis of Algorithm	3	0	0	3
5	HM	HM-HU401	Economics for Engineers	3	0	0	3
6	MC	MC472	Constitution of India	1	0	0	0
Total Theory				16	0	0	15
Practical/ Sessional/ Mandatory Course							
1	PC	PC-CS(D)491	Computer Organization and Architecture Lab	0	0	4	2
2	PC	PC-CS(D)492	Operating System Lab	0	0	3	1.5
3	PC	PC-CS493	Design and Analysis of Algorithm Lab	0	0	4	2
4	PC	PC-CS494	IT Workshop (Using Python) Lab	0	0	4	2
Total Practical/ Sessional/ Mandatory Course				0	0	15	7.5
Total of Fourth Semester				16	0	15	22.5



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Fifth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-CS(D)501	Artificial Intelligence	3	0	0	3
2	PC	PC-CS502	Object Oriented Programming	3	0	0	3
3	PC	PC-CS503	Formal Language and Automata Theory	3	0	0	3
4	PE	PE-CS(D)501	Professional Elective-I	3	0	0	3
5	HM	HM-HU501	Introduction to Industrial Management	2	0	0	2
6	MC	MC571	Aptitude Skill Development-I	2	0	0	0
Total Theory				16	0	0	14
Practical/ Sessional/ Mandatory Course							
1	PC	PC-CS(D)591	Artificial Intelligence Lab	0	0	4	2
2	PC	PC-CS592	Object Oriented Programming Lab	0	0	4	2
3	PC	PC-CS(D)593	Introduction to R Programming	0	0	3	1.5
4	HM	HM-HU591	Soft Skills Development Lab	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				0	0	13	6.5
Total of Fifth Semester				16	0	13	20.5

PE-CS(D)501	Professional Elective-I
PE-CS(D)501A	Data Mining
PE-CS(D)501B	Data Analysis and Visualization
PE-CS(D)501C	Computer Graphics

Sixth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-CS601	Compiler Design	3	0	0	3
2	PC	PC-CS602	Data Base Management System	3	0	0	3
3	PC	PC-CS603	Computer Networks	3	0	0	3
4	PE	PE-CS(D)601	Professional Elective-II	3	0	0	3
5	PE	PE-CS(D)602	Professional Elective-III	3	0	0	3
6	OE	OE-CS(D)601	Open Elective-I	3	0	0	3
7	MC	MC671	Aptitude Skill Development-II	2	0	0	0
Total Theory				20	0	0	18
Practical/ Sessional/ Mandatory Course							



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1	PC	PC-CS692	Database Management System Lab	0	0	4	2
2	PC	PC-CS693	Computer Networks Lab	0	0	4	2
3	PW	PW-CS681	Project-I	0	0	6	3
<i>Total Practical/ Sessional/ Mandatory Course</i>				0	0	14	7
Total of Sixth Semester				20	0	14	25

List of Elective Courses	
PE-CS(D)601	Professional Elective-II
PE-CS(D)601A	Software Engineering
PE-CS(D)601B	Machine Learning
PE-CS(D)601C	Big Data Analysis
PE-CS(D)602	Professional Elective-III
PE-CS(D)602A	Data Warehousing
PE-CS(D)602B	Soft Computing
PE-CS(D)602C	Sensor Networks
OE-CS(D)601	Open Elective-I
OE-CS(D)601A	Microprocessor and Microcontroller
OE-CS(D)601B	Operational Research
OE-CS(D)601C	Human Resource Development and Organizational Behavior

Seventh Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-CS(D)701	Professional Elective-IV	3	0	0	3
2	PE	PE-CS(D)702	Professional Elective-V	3	0	0	3
3	OE	OE-CS(D)701	Open Elective-II	3	0	0	3
4	HM	HM-HU702	Project Management and Entrepreneurship	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PW	PW-CS781	Project-II	0	0	8	4
2	PW	PW-CS782	Summer Internship	0	0	4	2
Total Practical/ Sessional/ Mandatory Course				0	0	12	6
Total of Seventh Semester				12	0	12	18

List of Elective Courses	
PE-CS(D)701	Professional Elective-IV
PE-CS(D)701A	Cloud Computing
PE-CS(D)701B	Information Theory and Coding
PE-CS(D)701C	Image Processing
PE-CS(D)702	Professional Elective-V
PE-CS(D)702A	Internet of Things
PE-CS(D)702B	Pattern Recognition
PE-CS(D)702C	E-Commerce
OE-CS(D)701	Open Elective-II
OE-CS(D)701A	Block Chain Technology
OE-CS(D)701B	Cyber Law and Cyber Security
OE-CS(D)701C	Optimization Technique

Eighth Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-CS(D)801	Professional Elective-VI	3	0	0	3
2	OE	OE-CS(D)801	Open Elective-III	3	0	0	3
3	OE	OE-CS(D)802	Open Elective-IV	3	0	0	3
Total Theory				9	0	0	9
Practical/ Sessional/ Mandatory Course							
1	PW	PW-CS881	Project-II	0	0	12	6
Total Practical/ Sessional/ Mandatory Course				0	0	12	6
Total of Eighth Semester				9	0	0	15

List of Elective Courses	
PE-CS(D)801	Professional Elective-VI
PE-CS(D)801A	Neural Network and Deep Learning
PE-CS(D)801B	Natural Language Processing
PE-CS(D)801C	Web and Internet Technology
OE-CS(D)801	Open Elective-III
OE-CS(D)801A	Business Analytics
OE-CS(D)801B	Human Computer Interaction
OE-CS(D)801C	Cryptography and Network Security
OE-CS(D)802	Open Elective-IV
OE-CS(D)802A	Web Mining
OE-CS(D)802B	Game Theory
OE-CS(D)802C	Economic Policies in India



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Curriculum for Undergraduate Degree (B.Tech.) in Computer Science and Engineering (Data Science) (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Induction Program (Mandatory)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Duration

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Please refer **Appendix-A** for AICTE guidelines on Mandatory Induction Program.

First Semester

Course Name:	Chemistry		
Course Code:	BS-CH101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	The objective of the Chemistry course is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Atomic and molecular structure <i>Atomic Structure:</i> Dalton's atomic theory; Fundamental of sub atomic particles; Rutherford's atomic model; Bohr's atomic model; Dual nature of electron; Heisenberg's uncertainty principle; Schrodinger wave equation; Orbitals and Quantum numbers; Particle in a box solution (One dimension) and their applications for simple sample. <i>Molecular Structure:</i> Molecular orbital theory: Postulates of MOT;	10L

	Bonding and anti bonding orbital's; MO diagram of diatomic molecules (H_2 , He_2 , Li_2 , Be_2); Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties (Octahedral and tetrahedral complexes); Band structure of solids and the role of doping on band structures (Band theory, Valence band and conduction band, Conductor, Semiconductor, Insulator, p-Type and n-Type semiconductor).	
2	Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals' interactions; Ideal gas equation, compressibility factor, Real gas equation, Boyles Temperature, Critical state (Critical pressure, critical volume and critical temperature).	4L
3	Periodic properties Mendeleev's periodic table; Periodic properties (Atomic radii, Ionic radii, Ionization potential, electron affinity, Electronegativity, metallic and non metallic character, oxidizing and reducing character); Polarizability (Fajans' rule); Hard soft acids and bases; molecular geometries (VSEPR theory, Hybridization, sigma and pi bond, determination of hybridization state and structure of molecules); Hydrogen bond (Inter and intra molecular H bond); Effective nuclear charge; oxidation states.	4L
4	Use of free energy in chemical equilibria <i>Thermodynamics:</i> First law of thermodynamics, Internal energy & Enthalpy, Heat capacity, Adiabatic & Isothermal process, Reversible & Irreversible process, Second law of thermodynamics, Entropy, Free energy, Gibbs-Helmholtz equation. <i>Electrochemistry:</i> Electrochemical cell (Electrolytic cell & Galvanic cell), Representation of cell, Free energy and EMF, Reversible and Irreversible cell, Nernst equation and application, Application of EMF measurement on ΔG , ΔH , ΔS , equilibrium constant of a reversible chemical reaction and valency of an ion. Hydrogen Half-cell, calomel half-cell, Quinhydrone half-cell. <i>Water Chemistry:</i> Hydrosphere; Hydrological cycle; Sources of water; Acidity and alkalinity of water; Pollutants of water; Biochemical and Chemical oxygen demand; Removal of dissolved solids from water (Electrodialysis & Reverse osmosis); Hardness of water (Types of hardness, Removal of hardness of water). <i>Corrosion:</i> Oxidation corrosion, Corrosion by gases, Pilling Bedworth rule, Electrochemical corrosion, Hydrogen evolution type & oxygen absorption type of corrosion, Corrosion of bimetals, Waterline corrosion, Crevice corrosion, Pitting corrosion, Stress corrosion, Factors influencing the corrosion, Prevention of corrosion.	10L
5	Spectroscopic techniques and applications Electromagnetic spectrum; Principles of spectroscopy and selection	5L

	rules; UV/Vis Spectroscopy (Energy diagram of electron excitation, Lambert-Beer's law, Bathochromic and Hypsochromic shift, Hyperchromic and hypochromic effect, Instrumental technique, Solvent effect, application); IR spectroscopy [Basic principle, Stretching and bending vibration of AX ₂ type molecule(non-linear), Calculation of stretching frequency, Identification of organic compounds by IR spectroscopy, Instrumental technique and application]; NMR spectroscopy (Principle of NMR spectra, chemical shift, shielding and deshielding nucleus, application of NMR).	
6	Stereochemistry Isomerism, Structural isomerism, Metamerism, Tautomerism, Stereoisomerism, Optical activity, Configurations and symmetry and Chirality, Enantiomers and Diastereomers, Conformational analysis, Fischer and Sawhorse and Newman projection (inter conversion), R-, S- and E-, Z- Nomenclature.	5L
7	Organic reactions and synthesis of a drug molecule Introduction to reactions involving <i>Addition Reaction:</i> Nucleophilic addition reaction [Acid catalysed reaction; Base catalysed reaction, Reactions of aldehyde or ketone with hydrocyanic acid, sodium bisulphite, water, Grignard reagent, alcohols], Electrophilic addition reaction [addition of Br ₂ to alkene; addition of hydrogen halide in symmetrical and unsymmetrical alkene (Markownikov rule); addition of Hypohalous acid, sulphuric acid and water to unsymmetrical alkene; addition of hydrogen halide in unsymmetrical alkene in presence of peroxide (Anti Markownikov rule) Ozonolysis reaction. <i>Substitution Reaction:</i> Electrophilic substitution reaction [Chlorination of Benzene; Nitration of Benzene; Friedel-Crafts Reaction (Alkylation, Acylation)], Nucleophilic substitution reaction [S _N 1 and S _N 2 reaction]. <i>Elimination Reaction:</i> E1 elimination and E2 elimination: Hofmann and Saytzev elimination. <i>Nucleophilic addition followed by elimination Reaction:</i> Reaction of carbonyl compound with ammonia, Primary amine. <i>Cyclization reaction:</i> Diels-Alder reaction. <i>Oxidation Reaction:</i> Oxidation of alcohol (Primary, secondary and tertiary alcohol); autoxidation of ether; Oxidation of aldehyde and ketone; Baeyer-Villiger oxidation; Oxidation of aromatic compounds (Oxidation of toluene and its derivatives, benzaldehyde, acetophenone, phenol). <i>Reduction Reaction:</i> Reduction of alkenes; Alkynes; carbonyl compounds (aldehydes and ketones); Carboxylic acid and esters; Bouveault-Blanc reduction; Clemensen reduction; Wolf-Kishner	7L



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	reduction; Meerwein-Ponndorf-Verley reduction; Pinacol-Pinacolone rearrangement; Reduction of aromatic compounds (Benzaldehyde, Benzoic acid, Nitrobenzene, m-dinitrobenzene, Diazonium salt). <i>Name Reactions:</i> Aldol condensation and Mixed Aldol condensation; Claisen-schmidt reaction; Cannizzaro reaction; Crossed Cannizzaro reaction; Kolbe-Schmitt reaction; Gattermann-Koch aldehyde synthesis <i>Synthesis of a commonly used drug molecule:</i> Paracetamol, Aspirin	
Total		45L

Course Outcomes:

After completion of the course, students will be able to:

1	Demonstrate microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2	Illustrate bulk properties and processes using thermodynamic considerations.
3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
4	Articulate periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5	List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2	University Chemistry, by B. H. Mahan
3	Fundamentals of environment and Ecology, by D. De & D. De, S. Chand Publishing.
4	Chemistry-I, by Gourkrishna Das Mohapatra, VIKAS Publishing House Pvt. Ltd.
5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6	Engineering Chemistry (NPTEL Web-book) by B.L.Tembe, Kamaluddin and M.S. Krishnan
7	Physical Chemistry, by P. W. Atkins
8	Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Pub.
9	Physical Chemistry, P. C. Rakshit, Sarat Book House
10	Organic Chemistry, Volume I, I. L. Finar, Pearson

Course Name:	Mathematics-I		
Course Code:	BS-M101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05



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Course Objectives:

1	To know Convergence of sequence and series
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function
3	To know the uses of matrix in different areas in engineering
4	To know the use of mean value theorems in engineering fields
5	Use of vector functions in different fields of Engineering

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Determinants and Matrices: (i) Introduction to determinant, properties (proofs of identities are excluded). (ii) Types of matrices, rank of a matrix, inverse of a matrix, Linear systems of equations, Cramer's rule, eigen-values and eigen-vectors, Caley-Hamilton theorem.	6L
2	Differential Calculus (Function of single variable): (i) Indeterminate forms and L'Hospital's rule; Successive differentiation, Leibnitz's theorem. (ii) Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin theorems with remainders; Maxima and minima. (iii) Evolutes and Involutives.	6L
3	Differential Calculus (Function of multi-variables): (i) Concept of limit, continuity and partial differentiation, chain rule, total differential, Jacobian, Euler's theorem on homogeneous function. (ii) Hessian, Maxima and minima; Lagrange's multipliers.	8L
4	Integral Calculus: (i) Line integrals; double integrals, change of order; triple integrals. (ii) Evaluation of surface areas and volumes of revolutions.	6L
5	Vector Calculus: (i) Vector differential operator, scalar and vector point function, gradient, directional derivative, divergence and curl. (ii) Divergence theorem, Green's and Stoke's theorem (Statements only) and applications.	8L
6	Sequence and Series: (i) Sequence, type of a sequence. (ii) Series of positive terms; Geometric and p-series and their convergence criterion; Convergence test of series: Comparison test, D'Alembert's ratio test, Cauchy's root test. (iii) Alternating series; Absolute convergence, Leibnitz's theorem.	6L
Total		40



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Course Outcomes:

After completion of the course, students will be able to:

1	Apply knowledge of differential and integral calculus to determine curvature and evaluation of different types of improper integrals
2	Utilize mean value theorems for solution of engineering problems.
3	Learn matrices, concept of rank, methods of matrix inversion and their applications.
4	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
5	Determine eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces to solve physical and engineering problems
6	Solve multiple integrals and utilize it to different physical problems

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	Higher Algebra, S. K. Mapa, Levant Books
5	Advanced Higher Algebra, Chakravorty and Ghosh, U N Dhar Pvt. Ltd.
6	Vector Analysis, Schaum's outline
7	An introduction to Integral calculus, Maity and Ghosh, NCBA
8	An introduction to Differential Calculus, Maity and Ghosh, NCBA
9	An introduction to Engineering mathematics-I, G.P. Samanta, New Age publication
10.	Vector Analysis, Chakravorty and Ghosh, U N Dhar Pvt. Ltd

Course Name:	Programming for Problem Solving		
Course Code:	ES-CS101	Category:	Engineering Science Courses
Semester:	First	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language).
2	To develop the ability to apply knowledge of programming for solution of science & engineering problems.



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Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs: Basic I/O operations, keywords, data types, variables & memory locations, source code, Syntax and Logical Errors in compilation, object and executable code. Operators and Expressions, operator precedence in C programming Language.	5
2	Conditional Branching and Looping: Concepts of Conditional Branching: if-else, nested if-else, switch-case Concepts of Loops: While, do-while, for loops, use of break and continue statement.	8
3	Arrays: Concepts of 1-D, 2-D array, array manipulation, Concepts of character array, Strings and their uses. Basic Algorithms using array: Searching (linear and binary search) and Sorting Algorithms (Bubble, Insertion and Selection sort),	9
4	Functions: Functions (including using built in libraries), Parameter passing in functions, function call by value, Recursive functions. Pointers: Idea of pointers, Defining pointers, relation between array and pointer, idea of function call by address, Dynamic memory allocation.	8
5	Structure: Structures, Array of Structures, Self-referential structures. Storage Class and Preprocessor Directives. Disk I/O operations - File handling: open, read, write, close a file.	6
Total		36L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the concept of structured programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.

Learning Resources:	
1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford



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5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Chemistry Laboratory		
Course Code:	BS-CH191	Category:	Basic Science Courses
Semester:	First	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	The objective of this course is to acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field. The students will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence. The course will enable the student to: - Determine the strength of an unknown solution through conductometric and pH metric titration. - Estimate the chloride ion concentration, alkalinity and hardness in water. - Find out the rate constant of a reaction. - Synthesize polymer molecules.

Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.	3P/ Week
2	pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.	
3	To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).	
4	Determination of dissolved oxygen present in a given water sample.	
5	Determination of viscosity of the given liquid by Ostwald – Viscometer.	
6	Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).	
7	Chemical kinetics (determination of relative rates of reaction of iodide with H ₂ O ₂ at room temperature).	
8	Determination of acid value (Acidity) of oil.	



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9	The adsorption of acetic acid on active charcoal.	
10	Complexometric titration (estimation of hardness of water using EDTA).	
11	Redox titration (estimation of iron using permanganometry).	
12	To determine Alkalinity of a Given Water Sample.	
13	Synthesis of a polymer (Polyacrylamide) and determine its molecular weight by solution viscosity method.	
14	Determination of cell constant and conductance of solutions.	
Total		36P

Course Outcomes:

After completion of the course, students will be able to:

1	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: - Estimate rate constants of reactions from concentration of reactants/products as a function of time - Measure molecular/system properties such as viscosity, conductance of solutions, redox potentials, chloride content of water, etc. - Synthesize a macromolecule and determine its molecular weight by solution viscosity method.

Learning Resources:

1	Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house.
2	A Text book on Experiments and calculations in Engineering Chemistry, by S.S. Dara, S Chand publications.
3	Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited.

Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS191	Category:	Engineering Science Courses
Semester:	First	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8
4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve basic data manipulation related problems.
4	Apply programming concepts to handle memory allocation and files.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India



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Course Name:	Workshop/ Manufacturing Practices		
Course Code:	ES-ME192	Category:	Engineering Sciences Courses
Semester:	First	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart basic knowledge of various hand tools and their applications in different sections of manufacturing
2	To develop basic manufacturing skills, precision, safety at work place, team working and development of right attitude.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
Lectures and videos:		
	1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods 2. CNC machining, Additive manufacturing 3. Fitting operations & power tools 4. Electrical & Electronics 5. Carpentry 7. Metal casting 8. Welding (arc welding & gas welding), brazing	13L
Workshop Practice:		
1	Machine shop: <i>Typical jobs that may be made in this practice module:</i> - To make a pin from a mild steel rod in a lathe. - To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.	8P
2	Fitting shop: <i>Typical jobs that may be made in this practice module:</i> To make a Gauge from MS plate.	8P
3	Carpentry: <i>Typical jobs that may be made in this practice module:</i> To make wooden joints and/or a pattern or like.	8P
4	Welding shop (Arc welding 4 hrs + gas welding 4 hrs): <i>Typical jobs that may be made in this practice module:</i> ARC WELDING (4 hours): To join two thick (approx 6mm) MS plates by manual metal	8P



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	arc welding. GAS WELDING (4 hours): To join two thin mild steel plates or sheets by gas welding.	
5	Casting: Typical jobs that may be made in this practice module: One/ two green sand moulds to prepare, and a casting be demonstrated.	8P
6	Smithy: Typical jobs that may be made in this practice module: A simple job of making a square rod from a round bar or like.	4P
7	Electrical & Electronics: - Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable. - Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point. - Simple wiring exercise to be executed to understand the basic electrical circuit. - Simple soldering exercises to be executed to understand the basic process of soldering. - Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.	8P
Total		13L+52 P

Course Outcomes:

After completion of the course, students will be able to:

1	Identify and utilize machine tools for producing components through machining processes
2	Demonstrate fundamental concept of pattern making, and moulding processes for engineering applications.
3	Practice fitting, carpentry, and smithy operations for manufacturing of components.
4	Explain concepts and applications of various types of fabrication processes.
5	Apply basic electrical and electronics engineering knowledge for household applications.

Learning Resources:

1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and



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	publishers private limited, Mumbai.
2	Kalpajian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998
5	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Name: Language Laboratory			
Course Code:	HM-HU191	Category:	Humanities and Social Sciences including Management Courses
Semester:	First	Credit:	1
L-T-P:	0-0-2	Pre-Requisites:	1. Students must have basic command of English to talk about day-to-day events and experiences of life. 2. Comprehend Lectures delivered in English. 3. Read and understand relevant materials written in English.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To develop Technical Communication Skills. (listening, speaking, reading and writing)

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Honing 'Listening Skill' and its sub skills through Language Lab Audio device	4P
2	Honing 'Speaking Skill' and its sub skills: Extempore, Public speaking, etc. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/ Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.	6P



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3	Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Debate, Role Play etc.)	4P
4	Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.	6P
5	Honing 'Reading Skills' and its sub skills.	2P
6.	Honing 'Writing Skill' and its sub skills by using Language Lab Audio –Visual input; Practice Sessions	2P
Total		24P

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop their intellectual, personal and professional abilities.

Learning Resources:

1.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
6.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019.

Second Semester

Course Name:	Physics		
Course Code:	BS-PH201	Category:	Basic Science Courses
Semester:	Second	Credit:	4.0
L-T-P:	3-1-0	Pre-Requisites:	Mathematics Course with Vector Calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	Understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	Describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Module-1: Foundations of Quantum Mechanics Introduction to Quantum Physics: Brief idea about the historical development of quantum mechanics.	(8L) 1
	Black Body Radiation: Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws.	2
	Compton Effect: Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	2
	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation.	2
	Uncertainty Principle: Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero point energy, Numerical problems.	1

2	Module-2: Schrödinger Wave Equation and Its Applications Formulation of Quantum Mechanics: Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of associated problems. Schrödinger Wave Equation: Time independent Schrödinger's equation from time dependent one by the separation of variable method. Applications of Quantum Mechanics: Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator	(8L) 3 1 4
3	Module-3: Dielectric Materials and their Applications Concept of Dielectric and Polarization: Electric field inside a Dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, Atomic polarizability and polarization vector. Inter Relationship among Dielectric Parameters: Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems on relation between polarizability, susceptibility and dielectric constant. Types of Polarization: Electronic polarization and derivation of electronic polarizability, Concept of ionic and orientational polarization (no derivation). Applications of Dielectric: Dielectric breakdown and dielectric strength, Concept of Dielectric loss, Few applications of dielectrics in different fields.	(5L) 1 2 1 1
4	Module-4: Time Varying Fields Electromagnetic Induction: Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in Motors and Generators, Calculation of Induced EMF. Displacement Current: Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	(3L) 2 1
5	Module-5: Electromagnetic Waves Maxwell's Electromagnetic Field Equations: Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators etc.). Plane Electromagnetic Wave in Free Space: Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. Plane Electromagnetic Wave in Medium: Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. Energy in an Electromagnetic Field: Flow of energy associated to electromagnetic field and Poynting vector.	(6L) 2 1 2 1



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6	Module-6: Laser and Fiber Optics <i>Introduction to Laser:</i> Properties of light sources, Need of suitable light source in communication, Invention of laser, Characteristics and applications of laser. <i>Interaction of Light with Matter:</i> Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them. <i>Components and Working of Laser Systems:</i> Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO ₂ laser). <i>Optical Communication:</i> Introduction, Need for optical communication, Salient features of optical fibers, Amplitude and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth analog/digital communication system <i>Light Guidance in Fibers:</i> Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single and multimode fibers, Step-index and graded-index fibers. <i>Transmission characteristics of optical fibers:</i> Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion, bit rate - length product, Minimization of intermodal dispersion.	(9L) 1 1 2 2 1 2
Total		39L

Course Outcomes:

After completion of the course, students will be able to:

1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various medium of propagations.
4	Understand the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy etc.
6	Explain the workings of various LASERS and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the dispersion leading to calculation of Bit Rate of a communication channel..

Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths

2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Aurthur Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
9	'Understanding Lasers' by Jeff Hecht
10	'An Introduction to Fiber Optics' by Ajoy Ghatak and K. Thyagrajan

Course Name:	Mathematics-II		
Course Code:	BS-M201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn how to solve different types of differential equation
2	To know the different types of improper integral
3	To know the Laplace transform
4	Basic concept of graph, digraph, walk, Hamiltonian graph, Euler circuit,
5	Basic concept of tree, binary tree

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Ordinary Differential Equations of First order: ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, In-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree - Equations solvable for p, solvable for x, solvable for y; Clairaut's equations,	8L
2	Higher Order Ordinary Differential Equations: (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI) (ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	8L
3	Improper Integrals: (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L



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4	Laplace Transforms and Inverse Laplace Transforms: (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of a function multiplied by t^n and divided by t ; LT of unit step and periodic functions; LT of derivatives. (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii) Solutions of initial and boundary value problems by LT	8L
5	Graph Theory: (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	Tree: (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		40L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems
3	Use tree and graph algorithms for different problems
4	evaluation of different types of improper integrals

Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Aurthur Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
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Course Name:	Basic Electrical and Electronics Engineering		
Course Code:	ES-EE201	Category:	Engineering Sciences Courses
Semester:	Second	Credit:	4
L-T-P:	4-0-0	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:	
1	To provide comprehensive idea about AC and DC circuit analysis
2	To make the students understand about working principals and applications of electric machines
3	To make the students understand the components of low voltage electrical installations
4	To provide basic idea about general structure of electrical power system.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
Module 1	DC Circuits Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5
Module 2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel),	4
Module 3	Three phase system Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2
Module 4	DC Machines Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor	5
Module 5	AC Machines Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and	4



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	efficiency Three-phase induction motor Generation of rotating magnetic fields, Construction and working of a three-phase induction motor.	
Module 6	Electrical Installations Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3
Module 7	General structure of electrical power system : Power generation to distribution through overhead lines and underground cables with single line diagram	1
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.

Learning Resources:

1	D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2	C.L. Wadhwa, Basic Electrical Engineering, New Age, 2007.
3	S K Bhattacharya, Basic Electrical and Electronics Engineering, Pearson, 2011
4	Ashfaq Husain and Haroon Ashfaq, Fundamentals of Electrical Engineering, Dhanpat Rai & Co., Delhi, 2007.
5	J.B. Gupta, Basic Electrical Engineering, Kataria & Sons, 2015.
6	L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
7	E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:

1	To make the students understand about the semiconductor.
2	To make the students understand about Diode and its circuit.
3	To make the students understand about different Transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Semiconductors: Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5
2	Diode and Diode Circuits: Formation of P-N junction, depletion region, built-in-potential, forward and reverse biased P-N junction, energy band diagrams, V-I characteristics, Zener diode forward and reverse characteristics, Avalanche breakdown and Zener breakdown., junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, PIV, ripple factor, efficiency.	4 3
3	Introduction to Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET): Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier. JFET (N channel only) structure, Drain and Transfer characteristics.	4 2
4	Introduction to OPAMP and Digital Electronics: Introduction to Operational Amplifiers: Characteristics, Inverting and Non-Inverting mode of operation, summing amplifier, difference amplifier. Introduction to binary number; Basic Boolean algebra; Introduction to integrated circuits, Logic gates and truth tables for different logic operations and simple digital circuits using the basic gates.	3 3
Total		24

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify semiconductor materials, draw band-diagrams, distinguish between intrinsic and extrinsic semiconductors, n- and p- type semiconductors, calculate drift and diffusion current components
2	Explain the junction properties and the phenomenon of rectification, draw the I-V characteristics and identify operating points; Calculate ripple factors, efficiency of power supplies.
3	Draw and explain the I-V characteristics of BJTs and FET – both input and output;
4	Understand basics of OPAMP and learn the use of it as amplifier.
5	Explain binary numbers and identify different logic gates and circuit implementation.

Learning Resources:	
1	Rakshit and Chattopadhyay: Introduction to Electronics Principle
2	Malvino: Electronic Principle.
3	Millman & Halkias: Integrated Electronics.
4	Boylestad & Nashelsky: Electronic Devices & Circuit Theory.

Course Name:	English		
Course Code:	HM-HU201	Category:	Humanities and Social Sciences including Management Courses
Semester:	Second	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	1. Students must have basic command of English to talk about day-to-day events and experiences of life. 2. Comprehend Lectures delivered in English. 3. Read and understand relevant materials written in English.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop Technical Communication Skills (speaking, reading and writing).

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1.	TECHNICAL COMMUNICATION: Theory of Communication – Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills	1L
2	VOCABULARY BUILDING: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms	1L
3.	BASIC WRITING SKILLS. Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences	1 L



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	in logical order.	
4	GRAMMAR: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9 L
5	WRITING PRACTICES: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10 L
6.	READING COMPREHENSION: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		24L

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:

1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Universal English. Prof. Prasad Kataria Publications, 2019.
6.	"Communication Skills for Professionals"-Nira Konar, Prentice Hall of India 2nd edition, New Delhi, 2011
7.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019. Course Outcomes The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Name:	Physics Laboratory		
Course Code:	BS-PH291	Category:	Basic Science Courses
Semester:	Second	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	Apply the concepts of physics to carry out experiments on Quantum physics, EMT, Optics and General properties of matter and interpret the same for deduction of results.

Course Contents: (Choose 10 experiments from the following)

Module No.	Description of Topic	Contact Hrs.
1	Determination of Dispersive Power of the Material of a Prism	3P/ week
2	Determination of wavelength of a monochromatic light by Newton's ring	
3	Determination of Wavelength of the Given LASER Light by Diffraction Method	
4	Determination of Thermo-electric Power of a given Thermocouple	
5	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method	
6	Determination of Hall Coefficient of a Semiconductor	
7	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell	
8	Determination of Unknown Resistance using Carey Foster's Bridge	
9	Determination of Planck Constant using Photocell	
10	Verification of Bohr's Atomic Orbital Theory Through Frank-Hertz Experiment	
11	Determination of Rydberg Constant by Studying Hydrogen Spectrum	
12	Determination of Band Gap of a Semiconductor by Four Probe Method	
13	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure	
14	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method	
15	Determination of Coefficient of Viscosity by Poiseuille's Capillary Flow Method	
Total		39P

Course Outcomes:

After completion of the course, students will be able to:

1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.



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Learning Resources:	
1	An Advanced Course in Practical Physics, by D. Chattopadhyay, P. C. Rakshit
2	A Manual of Practical Engineering Physics and Material Science, by A S Vasudeva
3	A Textbook of Engineering Physics Practical, by Dr. R Das, Dr. R Kumar, C S Robinson & P K Sahu

Course Name:	Basic Electrical and Electronics Engineering Lab		
Course Code:	ES-EE291	Category:	Engineering Sciences Courses
Semester:	Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Knowledge of Class XII level Electronics, Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:	
1	Provide working knowledge for the analysis of basic DC and AC circuits
2	Measurement of power in three phase system
3	Provide working knowledge on Electric machines.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	3
2	Calibration of ammeter and Wattmeter.	3
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	3
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method	3
5	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3
6	Determination of Torque –Speed characteristics of separately excited DC motor.	3
Total		18 P

Course Outcomes:	
After completion of the course, students will be able to:	
1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.



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3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the different characteristics of separately excited DC motor.

Learning Resources:

1	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:	
1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.

Course Contents:		
Exp. No.	Description of Topic	Contact Hrs.
1.	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	3
2	a) Study of I-V characteristics of Junction diodes. b) Study of I-V characteristics of Zener diodes.	3
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	3
4	a) Study of I-V characteristics of BJTs. for CB configurations b) Study of I-V characteristics of BJTs. for CE configurations	3
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	3
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	3
Total		18P

Course Outcomes:

After completion of the course, students will be able to:

1	Identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	Realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.



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3	Implement half wave and full wave rectifier circuits and can analyse the performance of them.
4	Realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	Realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	Use OPAMP as amplifier and verify the truth tables of different logic gates.

Learning Resources:

1	Laboratory Manual

Course Name:	Engineering Graphics & Design		
Course Code:	ES-ME291	Category:	Engineering Sciences Courses
Semester:	Second	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To make students aware of importance of engineering drawing and to familiar with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P

5	Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P
7	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1L+4P
8	Sections and Sectional Views Of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1L+4P
9	Overview of Computer Graphics, Customisation & CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	1L+4P
10	Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and	2L+8P



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	scale multi views of dwelling;	
11	Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	2L+8P
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Familiarize with basics of drawing, dimensioning, scales, curves
2	Comprehend the theory of orthographic projection and its applications
3	Prepare and interpret isometric projection
4	Create and modify 2D drawing using AutoCAD software

Learning Resources:

1	Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6	Corresponding set of CAD Software Theory and User Manuals



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Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Range of Credits:

As per AICTE, a student covering 160 credits during 4 years of studies as per curriculum of the Institute will be eligible to get Under Graduate B.Tech. degree. A student will be eligible to get B.Tech. degree with Honours, if he/ she completes an additional 20 credits. These could be acquired through MOOCs prescribed by the Institute. Every student admitted to the 4 years B.Tech programme is required to earn a minimum of 100 Activity Points under Mandatory Additional Requirement (MAR), in addition to the required academic grades, for getting B.Tech./ B.Tech. (Honours) degree. Also some non-credit mandatory courses are there included in the curriculum. Like theory courses, students are required to appear in the semester examination for all mandatory courses and must get a minimum of pass marks in those courses to be eligible to get the final degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Humanities and Social Sciences including Management Courses	11	12
2	Basic Science Courses	27	25
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.	23.5	24
4	Professional Core Courses	50	48
5	Professional Elective Courses relevant to chosen specialization/ branch	18	18
6	Open Elective Courses from other technical and / or emerging subjects	16	18
7	Project Work, Seminar and Internship in Industry or elsewhere	14.5	15
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	0	Non-Credit
Total		160	160



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D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	BS	Basic Science Courses
5	ES	Engineering Science Courses
6	HM	Humanities and Social Sciences including Management Courses
7	PC	Professional Core Courses
8	PE	Professional Elective Courses
9	OE	Open Elective Courses
10	MC	Mandatory Courses
11	PW	Project/ Internships/ Sessional

E. Courses in Different Categories:

Humanities and Social Sciences including Management Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	HM-HU101	English	2	0	0	2
2	VI	HM-HU601	Economics for Engineers	3	0	0	3
3	VI	HM-HU602	Value and Ethics in Profession	2	0	0	2
4	VII	HM-HU701	Principles of Management	2	0	0	2
Total Theory				9	0	0	9
Practical/ Sessional							
1	II	HM-HU291	Language Laboratory	0	0	2	1
2	IV	HM-HU491	Soft Skill Development Lab	0	0	2	1
Total Practical/ Sessional				0	0	4	2
Total				9	0	4	11

Basic Science Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	BS-PH101	Physics	3	1	0	4
2	I	BS-M101	Mathematics-I	3	1	0	4
3	II	BS-CH201	Chemistry	3	1	0	4
4	II	BS-M201	Mathematics-II	3	1	0	4



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5	III	BS-M302	Mathematics-III	3	0	0	3
6	IV	BS-M404	Numerical Methods	2	0	0	2
7	IV	BS-BIO401	Biology	2	0	0	2
<i>Total Theory</i>				19	4	0	23
Practical/ Sessional							
1	I	BS-PH191	Physics Laboratory	0	0	3	1.5
2	II	BS-CH291	Chemistry Laboratory	0	0	3	1.5
3	III	BS-M494	Numerical Methods Lab	0	0	2	1
<i>Total Practical/ Sessional</i>				0	0	8	4
Total				19	4	8	27

Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credi ts
				L	T	P	
Theory							
1	I	ES-EE101	Basic Electrical and Electronics Engineering	3	1	0	4
2	II	ES-CS201	Programming for Problem Solving	3	0	0	3
3	III	ES-CS301	Data Structure & Algorithm	3	0	0	3
4	IV	ES-CS401	Operating System	3	0	0	3
Total Theory				12	1	0	13
Practical/ Sessional							
1	I	ES-EE191	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5
2	I	ES-ME191	Engineering Graphics & Design	1	0	4	3
3	II	ES-CS291	Programming for Problem Solving Lab	0	0	4	2
4	II	ES-ME292	Workshop/Manufacturing Practices	1	0	4	3
	III	ES-CS391	Data Structure Lab	0	0	2	1
Total Practical/ Sessional				2	0	17	10.5
Total				14	1	17	23.5

Professional Core Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	PC-EC301	Electron Devices	3	0	0	3



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2	III	PC-EC302	Analog Electronic Circuits	3	0	0	3
3	III	PC-EC303	Signals and Systems	3	0	0	3
4	III	PC-EC304	Network Theory	3	0	0	3
5	IV	PC-EC401	Analog Communication	3	0	0	3
6	IV	PC-EC402	Digital System Design	3	0	0	3
7	IV	PC-EC403	Microprocessors & Microcontrollers	3	0	0	3
8	V	PC-EC501	Electromagnetic Waves and Transmission Line	3	0	0	3
9	V	PC-EC502	Computer Architecture	3	0	0	3
10	V	PC-EC503	Digital Communication & Stochastic Process	3	0	0	3
11	V	PC-EC504	Digital Signal Processing	3	0	0	3
12	VI	PC-EC601	Control System	3	0	0	3
13	VI	PC-EC602	Computer Network	3	0	0	3
<i>Total Theory</i>				39	0	0	39
Practical/ Sessional							
1	III	PC-EC391	Electronic Devices Lab	0	0	2	1
2	III	PC-EC392	Analog Electronic Circuits Lab	0	0	2	1
3	IV	PC-EC491	Analog Communication Lab	0	0	2	1
4	IV	PC-EC492	Digital System Design Lab	0	0	2	1
5	IV	PC-EC493	Microprocessors & Microcontrollers Lab	0	0	2	1
6	V	PC-EC591	Electromagnetic Waves and Transmission Line Lab	0	0	2	1
7	V	PC-EC592	Computer Architecture Lab	0	0	2	1
8	V	PC-EC593	Digital Communication Lab	0	0	2	1
9	V	PC-EC594	Digital Signal Processing Lab	0	0	2	1
10	VI	PC-EC691	Control System Lab	0	0	2	1
11	VI	PC-EC692	Computer Network Lab	0	0	2	1
<i>Total Practical/ Sessional</i>				0	0	22	11
Total				38	0	22	50

Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	PE-EC501	Professional Elective-I	3	0	0	3
2	VI	PE-EC601	Professional Elective-II	3	0	0	3



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3	VII	PE-EC701	Professional Elective-III	3	0	0	3
4	VII	PE-EC702	Professional Elective-IV	3	0	0	3
5	VIII	PE-EC801	Professional Elective-V	3	0	0	3
6	VIII	PE-EC802	Professional Elective-VI	3	0	0	3
<i>Total Theory</i>				18	0	0	18
Practical/ Sessional							
<i>Total Practical/ Sessional</i>				0	0	0	0
Total				18	0	0	18

Open Elective Courses from other technical and / or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	OE-EC501	Open Elective-I	3	0	0	3
2	VI	OE-EC601	Open Elective-II	3	0	0	3
3	VII	OE-EC701	Open Elective-III	3	0	0	3
4	VII	OE-EC702	Open Elective-IV	3	0	0	3
5	VIII	OE-EC801	Open Elective-V	3	0	0	3
Total Theory				15	0	0	15
Practical/ Sessional							
1	VI	OE-EC691	Open Elective-II (Lab)	0	0	2	1
Total Practical/ Sessional				0	0	2	1
Total				15	0	0	16

Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1							
Total Theory				0	0	0	0
Practical/ Sessional							
1	VI	PW-EC681	Mini Project/ Electronic Design Workshop	0	0	4	2
2	VII	PW-EC781	Industrial Training	During Semester Break (6 th & 7 th)			1
3	VII	PW-EC782	Project-I	0	0	6	3



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4	VIII	PW-EC881	Project-II	0	0	15	7.5
5	VIII	PW-EC882	Comprehensive Viva Voce	0	0	0	1
<i>Total Practical/ Sessional</i>				0	0	25	14.5
Total				0	0	25	14.5

Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	MC371	Environmental Sciences	2	0	0	0
2	IV	MC472	Constitution of India	2	0	0	0
3	V	MC571	Aptitude Skill Development-I	2	0	0	0
4	V	MC573	Essence of Indian Traditional Knowledge	2	0	0	0
5	VI	MC671	Aptitude Skill Development-II	2	0	0	0
Total Theory				10	0	0	0
Practical/ Sessional							
1							
Total Practical/ Sessional				0	0	0	0
Total				10	0	0	0



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Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)							
Mandatory Induction Program- 3 Weeks Duration							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-PH101	Physics	3	1	0	4
2	BS	BS-M101	Mathematics-I	3	1	0	4
3	ES	ES-EE101	Basic Electrical and Electronics Engineering	3	1	0	4
4	HM	HM-HU101	English	2	0	0	2
	Total Theory			11	3	0	14
Practical/ Sessional/ Mandatory Course							
1	BS	BS-PH191	Physics Laboratory	0	0	3	1.5
2	ES	ES-EE191	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5
3	ES	ES-ME191	Engineering Graphics & Design	1	0	4	3
	Total Practical/ Sessional/ Mandatory Course			1	0	10	6
Total of First Semester				12	3	10	20

Second Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-CH201	Chemistry	3	1	0	4
2	BS	BS-M201	Mathematics-II	3	1	0	4
3	ES	ES-CS201	Programming for Problem Solving	3	0	0	3
Total Theory				9	2	0	11
Practical/ Sessional/ Mandatory Course							
1	BS	BS-CH291	Chemistry Laboratory	0	0	3	1.5
2	ES	ES-CS291	Programming for Problem Solving Lab	0	0	4	2
3	ES	ES-ME292	Workshop/Manufacturing Practices	1	0	4	3
4	HM	HM-HU291	Language Laboratory	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				1	0	13	7.5
Total of Second Semester				10	2	13	18.5



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Third Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC301	Electron Devices	3	0	0	3
2	PC	PC-EC302	Analog Electronic Circuits	3	0	0	3
3	PC	PC-EC303	Signals and Systems	3	0	0	3
4	PC	PC-EC304	Network Theory	3	0	0	3
5	ES	ES-CS301	Data Structure & Algorithm	3	0	0	3
6	BS	BS-M302	Mathematics-III	3	0	0	3
Total Theory				18	0	0	18
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC391	Electronic Devices Lab.	0	0	2	1
2	PC	PC-EC392	Analog Electronic Circuits Lab	0	0	2	1
3	ES	ES-CS391	Data Structure Lab	0	0	2	1
4	MC	MC371	Environmental Sciences	2	0	0	0
Total Practical/ Sessional/ Mandatory Course				2	0	6	3
Total of Third Semester				20	0	6	21

Fourth Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC401	Analog Communication	3	0	0	3
2	PC	PC-EC402	Digital System Design	3	0	0	3
3	PC	PC-EC403	Microprocessors & Microcontrollers	3	0	0	3
4	ES	ES-CS401	Operating System	3	0	0	3
5	BS	BS-M404	Numerical Methods	2	0	0	2
6	BS	BS-BIO401	Biology	2	0	0	2
Total Theory				16	0	0	16
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC491	Analog Communication Lab	0	0	2	1
2	PC	PC-EC492	Digital System Design Lab	0	0	2	1
3	PC	PC-EC493	Microprocessors & Microcontrollers Lab	0	0	2	1
4	BS	BS-M494	Numerical Methods Lab	0	0	2	1
5	HM	HM-HU491	Soft Skill Development Lab	0	0	2	1
6	MC	MC472	Constitution of India	2	0	0	0



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<i>Total Practical/ Sessional/ Mandatory Course</i>	2	0	10	5
Total of Fourth Semester	18	0	10	21

Fifth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC501	Electromagnetic Waves and Transmission Line	3	0	0	3
2	PC	PC-EC502	Computer Architecture	3	0	0	3
3	PC	PC-EC503	Digital Communication & Stochastic Process	3	0	0	3
4	PC	PC-EC504	Digital Signal Processing	3	0	0	3
5	PE	PE-EC501	Professional Elective-I	3	0	0	3
6	OE	OE-EC501	Open Elective-I	3	0	0	3
Total Theory				18	0	0	18
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC591	Electromagnetic Waves and Transmission Line Lab	0	0	2	1
2	PC	PC-EC592	Computer Architecture Lab	0	0	2	1
3	PC	PC-EC593	Digital Communication Lab	0	0	2	1
4	PC	PC-EC594	Digital Signal Processing Lab	0	0	2	1
5	MC	MC571	Aptitude Skill Development-I	2	0	0	0
6	MC	MC573	Essence of Indian Traditional Knowledge	2	0	0	0
Total Practical/ Sessional/ Mandatory Course				4	0	8	4
Total of Fifth Semester				22	0	8	22

List of Elective Courses	
PE-EC501	Professional Elective-I
PE-EC501A	Nano Electronics
PE-EC501B	Speech and Audio Processing
PE-EC501C	Power Electronics
PE-EC501D	Scientific Computing
OE-EC501	Open Elective-I
OE-EC501A	Soft Skill and interpersonal communication
OE-EC501B	Cyber law and intellectual Property right
OE-EC501C	Human Resource Management



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Sixth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC601	Control System	3	0	0	3
2	PC	PC-EC602	Computer Network	3	0	0	3
3	PE	PE-EC601	Professional Elective-II	3	0	0	3
4	OE	OE-EC601	Open Elective-II	3	0	0	3
5	HM	HM-HU601	Economics for Engineers	3	0	0	3
6	HM	HM-HU602	Value and Ethics in Profession	2	0	0	2
Total Theory				17	0	0	17
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC691	Control System Lab	0	0	2	1
2	PC	PC-EC692	Computer Network Lab	0	0	2	1
3	OE	OE-EC691	Open Elective-II (Lab)	0	0	2	1
4	PW	PW-EC681	Mini Project/ Electronic Design Workshop	0	0	4	2
5	MC	MC671	Aptitude Skill Development-II	2	0	0	0
Total Practical/ Sessional/ Mandatory Course				2	0	10	5
Total of Sixth Semester				19	0	10	22

List of Elective Courses	
PE-EC601	Professional Elective-II
PE-EC601A	Introduction to MEMS
PE-EC601B	Bio-Medical Electronics
PE-EC601C	CMOS VLSI Design
PE-EC601D	Information Theory and Coding
OE-EC601	Open Elective-II
OE-EC601A	Electronic Measurement and Instrumentation
OE-EC601B	Design and Analysis of Algorithm
OE-EC601C	Object Oriented Programming
OE-EC691	Open Elective-II (Lab)
OE-EC691A	Electronic Measurement and Instrumentation Lab
OE-EC691B	Algorithm Lab
OE-EC691C	Object Oriented Programming Lab



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Seventh Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-EC701	Professional Elective-III	3	0	0	3
2	PE	PE-EC702	Professional Elective-IV	3	0	0	3
3	OE	OE-EC701	Open Elective-III	3	0	0	3
4	OE	OE-EC702	Open Elective-IV	3	0	0	3
5	HM	HM-HU701	Principles of Management	2	0	0	2
Total Theory				14	0	0	14
Practical/ Sessional/ Mandatory Course							
1	PW	PW-EC781	Industrial Training	During Semester Break(6 th & 7 th)			1
2	PW	PW-EC782	Project-I	0	0	6	3
Total Practical/ Sessional/ Mandatory Course				0	0	6	4
Total of Seventh Semester				14	0	6	18

List of Elective Courses	
PE-EC701	Professional Elective-III
PE-EC701A	Microwave Theory and Techniques
PE-EC701B	Error Correcting Codes
PE-EC701C	Industrial Automation and Control
PE-EC702	Professional Elective-IV
PE-EC702A	Embedded System
PE-EC702B	Wireless Sensor Networks
PE-EC702C	Renewable Energy
OE-EC701	Open Elective-III
OE-EC701A	Adaptive Signal Processing
OE-EC701B	Digital Image and Video Processing
OE-EC701C	Neural Network and Fuzzy Logic Control
OE-EC701D	Big Data Analysis
OE-EC702	Open Elective-IV
OE-EC702A	Web Technology
OE-EC702B	Cyber Security
OE-EC702C	Operation Research and Optimization Techniques (or AI based Optimization Techniques)
OE-EC702D	Entrepreneurship



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Eighth Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-EC801	Professional Elective-V	3	0	0	3
2	PE	PE-EC802	Professional Elective-VI	3	0	0	3
3	OE	OE-EC801	Open Elective-V	3	0	0	3
Total Theory				9	0	0	9
Practical/ Sessional/ Mandatory							
1	PW	PW-EC881	Project-II	0	0	15	7.5
2	PW	PW-EC882	Comprehensive Viva Voce				1
Total Practical/ Sessional/ Mandatory Course				0	0	15	8.5
Total of Eighth Semester				9	0	15	17.5

List of Elective Courses	
PE-EC801	Professional Elective-V
PE-EC801A	Antennas and Propagation
PE-EC801B	Fiber Optic Communication
PE-EC801C	Satellite Communication
PE-EC802	Professional Elective-VI
PE-EC802A	Mixed Signal Design
PE-EC802B	Mobile Communication & Network
PE-EC802C	VLSI Design Automation
OE-EC801	Open Elective-V
OE-EC801A	Internet of Things (IoT)
OE-EC801B	Artificial Intelligence
OE-EC801C	Organisational Behaviour



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Curriculum for Undergraduate Degree (B.Tech.) in Electronics and Communication Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Induction Program (Mandatory)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Duration

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Please refer **Appendix-A** for AICTE guidelines on Mandatory Induction Program.

First Semester

Course Name:	Physics		
Course Code:	BS-PH101	Category:	Basic Science Course
Semester:	First	Credit:	4.0
L-T-P:	3-1-0	Pre-Requisites:	Mathematics course with vector calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	Understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	Describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Module-1: Foundations of Quantum Mechanics	(8L)
	Introduction to Quantum Physics: Brief idea about the historical development of quantum mechanics.	1
	Black Body Radiation: Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws.	2
	Compton Effect: Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	2
	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation.	2
	Uncertainty Principle: Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero point energy, Numerical problems.	1
2	Module-2: Schrödinger Wave Equation and Its Applications	(8L)
	Formulation of Quantum Mechanics: Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of associated problems.	3
	Schrödinger Wave Equation: Time independent Schrödinger's equation from time dependent one by the separation of variable method.	1
	Applications of Quantum Mechanics: Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator	4
3	Module-3: Dielectric Materials and their Applications	(5L)
	Concept of Dielectric and Polarization: Electric field inside a Dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, Atomic polarizability and polarization vector.	1
	Inter Relationship among Dielectric Parameters: Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems on relation between polarizability, susceptibility and dielectric constant.	2
	Types of Polarization: Electronic polarization and derivation of electronic	1



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	polarizability, Concept of ionic and orientational polarization (no derivation). Applications of Dielectric: Dielectric breakdown and dielectric strength, Concept of Dielectric loss, Few applications of dielectrics in different fields.	1
4	Module-4: Time Varying Fields Electromagnetic Induction: Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in Motors and Generators, Calculation of Induced EMF. Displacement Current: Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	(3L) 2 1
5	Module-5: Electromagnetic Waves Maxwell's Electromagnetic Field Equations: Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators etc.). Plane Electromagnetic Wave in Free Space: Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. Plane Electromagnetic Wave in Medium: Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. Energy in an Electromagnetic Field: Flow of energy associated to electromagnetic field and Poynting vector.	(6L) 2 1 2 1
6	Module-6: Laser and Fiber Optics Introduction to Laser: Properties of light sources, Need of suitable light source in communication, Invention of laser, Characteristics and applications of laser. Interaction of Light with Matter: Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them. Components and Working of Laser Systems: Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO ₂ laser). Optical Communication: Introduction, Need for optical communication, Salient features of optical fibers, Amplitude and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth analog/digital communication system Light Guidance in Fibers: Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single and multimode fibers, Step-index and graded-index fibers. Transmission characteristics of optical fibers: Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion,	(9L) 1 1 2 2 1 2



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	bit rate - length product, Minimization of intermodal dispersion.	
Total		39L

Course Outcomes:

After completion of the course, students will be able to:

1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various medium of propagations.
4	Understand the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy etc.
6	Explain the workings of various LASERs and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the dispersion leading to calculation of Bit Rate of a communication channel..

Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Aurther Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
9	'Understanding Lasers' by Jeff Hecht
10	'An Introduction to Fiber Optics' by Ajoy Ghatak and K. Thyagrajan

Course Name:	Mathematics-I		
Course Code:	BS-M101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know Convergence of sequence and series
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function
3	To know the uses of matrix in different areas in engineering
4	To know the use of mean value theorems in engineering fields
5	Use of vector functions in different fields of Engineering

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Determinants and Matrices: (i) Introduction to determinant, properties (proofs of identities are excluded). (ii) Types of matrices, rank of a matrix, inverse of a matrix, Linear systems of equations, Cramer's rule, eigen-values and eigen-vectors, Caley-Hamilton theorem.	6L
2	Differential Calculus (Function of single variable): (i) Indeterminate forms and L'Hospital's rule; Successive differentiation, Leibnitz's theorem. (ii) Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin theorems with remainders; Maxima and minima. (iii) Evolutes and Involute.	6L
3	Differential Calculus (Function of multi-variables): (i) Concept of limit, continuity and partial differentiation, chain rule, total differential, Jacobian, Euler's theorem on homogeneous function. (ii) Hessian, Maxima and minima; Lagrange's multipliers.	8L
4	Integral Calculus: (i) Line integrals; double integrals, change of order; triple integrals. (ii) Evaluation of surface areas and volumes of revolutions.	6L
5	Vector Calculus: (i) Vector differential operator, scalar and vector point function, gradient, directional derivative, divergence and curl. (ii) Divergence theorem, Green's and Stoke's theorem (Statements only) and applications.	8L
6	Sequence and Series: (i) Sequence, type of a sequence. (ii) Series of positive terms; Geometric and p-series and their convergence criterion; Convergence test of series: Comparison test, D'Alembert's rati test, Cauchy's root test. (iii) Alternating series; Absolute convergence, Leibnitz's theorem.	6L
Total		40



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Course Outcomes:

After completion of the course, students will be able to:

1	Apply knowledge of differential and integral calculus to determine curvature and evaluation of different types of improper integrals
2	Utilize mean value theorems for solution of engineering problems.
3	Learn matrices, concept of rank, methods of matrix inversion and their applications.
4	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
5	Determine eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces to solve physical and engineering problems
6	Solve multiple integrals and utilize it to different physical problems

Course Name:	Basic Electrical and Electronics Engineering		
Course Code:	ES-EE101	Category:	ES
Semester:	First	Credit:	4
L-T-P:	4-0-0	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:

1	To provide comprehensive idea about AC and DC circuit analysis
2	To make the students understand about working principals and applications of electric machines
3	To make the students understand the components of low voltage electrical installations
4	To provide basic idea about general structure of electrical power system.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
Module 1	DC Circuits Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5

Module 2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel),	4
Module 3	Three phase system Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2
Module 4	DC Machines Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor	5
Module 5	AC Machines Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency Three-phase induction motor Generation of rotating magnetic fields, Construction and working of a three-phase induction motor.	4
Module 6	Electrical Installations Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3
Module 7	General structure of electrical power system: Power generation to distribution through overhead lines and underground cables with single line diagram	1
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.



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Learning Resources:

1	D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2	C.L. Wadhwa, Basic Electrical Engineering, New Age, 2007.
3	S K Bhattacharya, Basic Electrical and Electronics Engineering, Pearson, 2011
4	Ashfaq Husain and Haroon Ashfaq, Fundamentals of Electrical Engineering, Dhanpat Rai & Co., Delhi, 2007.
5	J.B. Gupta, Basic Electrical Engineering, Kataria& Sons, 2015.
6	L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
7	E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:

1	To make the students understand about the semiconductor.
2	To make the students understand about Diode and its circuit.
3	To make the students understand about different Transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Semiconductors: Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5
2	Diode and Diode Circuits: Formation of P-N junction, depletion region, built-in-potential, forward and reverse biased P-N junction, energy band diagrams, V-I characteristics, Zener diode forward and reverse characteristics, Avalanche breakdown and zener breakdown., junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, PIV, ripple factor, efficiency.	4 3
3	Introduction to Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET): Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier. JFET (N channel only) structure, Drain and Transfer characteristics.	4 2



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4	Introduction to OPAMP and Digital Electronics: Introduction to Operational Amplifiers: Characteristics, Inverting and Non-Inverting mode of operation, summing amplifier, difference amplifier.	3
	Introduction to binary number; Basic Boolean algebra; Introduction to integrated circuits, Logic gates and truth tables for different logic operations and simple digital circuits using the basic gates.	3
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	identify semiconductor materials, draw band-diagrams, distinguish between intrinsic and extrinsic semiconductors, n- and p- type semiconductors, calculate drift and diffusion current components
2	explain the junction properties and the phenomenon of rectification, draw the I-V characteristics and identify operating points; Calculate ripple factors, efficiency of power supplies.
3	draw and explain the I-V characteristics of BJTs and FET – both input and output;
4	understand basics of OPAMP and learn the use of it as amplifier.
5	Explain binary numbers and identify different logic gates and circuit implementation.

Learning Resources:

1	Rakshit and Chattopadhyay: Introduction to Electronics Principle
2	Malvino: Electronic Principle.
3	Millman & Halkias: Integrated Electronics.
4	Boyelstad & Nashelsky: Electronic Devices & Circuit Theory.

Course Name:	English		
Course Code:	HM-HU101	Category:	HM
Semester:	First	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills (speaking, reading and writing).



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	TECHNICAL COMMUNICATION: Theory of Communication – Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills	1L
2	VOCABULARY BUILDING: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms	1L
3.	BASIC WRITING SKILLS. Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences in logical order.	1 L
4	GRAMMAR: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9 L
5	WRITING PRACTICES: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10 L
6.	READING COMPREHENSION: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		24L

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:

1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007



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3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Universal English. Prof. Prasad Kataria Publications, 2019.
6.	"Communication Skills for Professionals"-Nira Konar, Prentice Hall of India 2nd edition, New Delhi, 2011
7.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019. Course Outcomes The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Name:	Physics Laboratory		
Course Code:	BS-PH191	Category:	Basic Science Courses
Semester:	First	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	Apply the concepts of physics to carry out experiments on Quantum physics, EMT, Optics and General properties of matter and interpret the same for deduction of results.

Course Contents: (Choose 10 experiments from the following)

Module No.	Description of Topic	Contact Hrs.
1	Determination of Dispersive Power of the Material of a Prism	3P/ week
2	Determination of wavelength of a monochromatic light by Newton's ring	
3	Determination of Wavelength of the Given LASER Light by Diffraction Method	
4	Determination of Thermo-electric Power of a given Thermocouple	
5	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method	
6	Determination of Hall Coefficient of a Semiconductor	
7	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell	
8	Determination of Unknown Resistance using Carey Foster's Bridge	
9	Determination of Planck Constant using Photocell	
10	Verification of Bohr's Atomic Orbital Theory Through Frank-Hertz Experiment	
11	Determination of Rydberg Constant by Studying Hydrogen Spectrum	
12	Determination of Band Gap of a Semiconductor by Four Probe Method	



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13	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure	
14	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method	
15	Determination of Coefficient of Viscosity by Poiseuille's Capillary Flow Method	
Total		39P

Course Outcomes:

After completion of the course, students will be able to:

1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.

Learning Resources:

1	An Advanced Course in Practical Physics, by D. Chattopadhyay , P. C. Rakshit
2	A Manual of Practical Engineering Physics and Material Science, by A S Vasudeva
3	A Textbook of Engineering Physics Practical, by Dr. R Das, Dr. R Kumar, C S Robinson & P K Sahu

Course Name:	Basic Electrical and Electronics Engineering Lab		
Course Code:	ES-EE191	Category:	ES
Semester:	First	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:

1	Provide working knowledge for the analysis of basic DC and AC circuits
2	Measurement of power in three phase system
3	Provide working knowledge on Electric machines.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	3
2	Calibration of ammeter and Wattmeter.	3
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	3
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method	3
5	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3
6	Determination of Torque –Speed characteristics of separately excited DC motor.	3
Total		18 P

Course Outcomes:

After completion of the course, students will be able to:

1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.
3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the different characteristics of separately excited DC motor.

Learning Resources:

1	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:

1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.



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Course Contents:

Exp. No.	Description of Topic	Contact Hrs.
1.	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	3
2	a) Study of I-V characteristics of Junction diodes. b) Study of I-V characteristics of Zener diodes.	3
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	3
4	a) Study of I-V characteristics of BJTs. for CB configurations b) Study of I-V characteristics of BJTs. for CE configurations	3
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	3
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	3
Total		18P

Course Outcomes:

After completion of the course, students will be able to:

1	identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.
3	implement half wave and full wave rectifier circuits and can analyse the performance of them.
4	realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	use OPAMP as amplifier and verify the truth tables of different logic gates.

Learning Resources:

1	Laboratory Manual



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Course Name:	Engineering Graphics & Design		
Course Code:	ES-ME191	Category:	Engineering Sciences
Semester:	First	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make students aware of importance of engineering drawing and to familiar with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P
5	Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P
7	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1L+4P

8	Sections and Sectional Views Of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1L+4P
9	Overview of Computer Graphics, Customisation & CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	1L+4P
10	Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	2L+8P
11	Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing	2L+8P



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	practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Familiarize with basics of drawing, dimensioning, scales, curves
2	Comprehend the theory of orthographic projection and its applications
3	Prepare and interpret isometric projection
4	Create and modify 2D drawing using AutoCAD software

Learning Resources:

1	Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6	Corresponding set of CAD Software Theory and User Manuals



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Second Semester

Course Name:	Chemistry		
Course Code:	BS-CH201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The objective of the Chemistry course is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Atomic and molecular structure <i>Atomic Structure:</i> Dalton's atomic theory; Fundamental of sub atomic particles; Rutherford's atomic model; Bohr's atomic model; Dual nature of electron; Heisenberg's uncertainty principle; Schrodinger wave equation; Orbitals and Quantum numbers; Particle in a box solutions (One dimension) and their applications for simple sample. <i>Molecular Structure:</i> Molecular orbital theory: Postulates of MOT; Bonding and anti bonding orbital's; MO diagram of diatomic molecules (H_2 , He_2 , Li_2 , Be_2); Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties (Octahedral and tetrahedral complexes); Band structure of solids and the role of doping on band structures (Band theory, Valence band and conduction band, Conductor, Semiconductor, Insulator, p-Type and n-Type semiconductor).	10L
2	Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals' interactions; Ideal gas equation, compressibility factor, Real gas equation, Boyles Temperature, Critical state (Critical pressure, critical volume and critical temperature).	4L

3	Periodic properties Mendeleev's periodic table; Periodic properties (Atomic radii, Ionic radii, Ionization potential, electron affinity, Electronegativity, metallic and non metallic character, oxidizing and reducing character); Polarizability (Fajans' rule); Hard soft acids and bases; molecular geometries (VSEPR theory, Hybridization, sigma and pi bond, determination of hybridization state and structure of molecules); Hydrogen bond (Inter and intra molecular H bond); Effective nuclear charge; oxidation states.	4L
4	Use of free energy in chemical equilibria <i>Thermodynamics:</i> First law of thermodynamics, Internal energy & Enthalpy, Heat capacity, Adiabatic & Isothermal process, Reversible & Irreversible process, Second law of thermodynamics, Entropy, Free energy, Gibbs-Helmholtz equation. <i>Electrochemistry:</i> Electrochemical cell (Electrolytic cell & Galvanic cell), Representation of cell, Free energy and EMF, Reversible and Irreversible cell, Nernst equation and application, Application of EMF measurement on ΔG, ΔH, ΔS, equilibrium constant of a reversible chemical reaction and valency of an ion. Hydrogen Half cell, calomel half cell, Quinhydrone half cell. <i>Water Chemistry:</i> Hydrosphere; Hydrological cycle; Sources of water; Acidity and alkalinity of water; Pollutants of water; Biochemical and Chemical oxygen demand; Removal of dissolved solids from water (Electrodialysis & Reverse osmosis); Hardness of water (Types of hardness, Removal of hardness of water). <i>Corrosion:</i> Oxidation corrosion, Corrosion by gases, Pilling Bedworth rule, Electrochemical corrosion, Hydrogen evolution type & oxygen absorption type of corrosion, Corrosion of bimetals, Waterline corrosion, Crevice corrosion, Pitting corrosion, Stress corrosion, Factors influencing the corrosion, Prevention of corrosion.	10L
5	Spectroscopic techniques and applications Electromagnetic spectrum; Principles of spectroscopy and selection rules; UV/Vis Spectroscopy (Energy diagram of electron excitation, Lambert-Beer's law, Bathochromic and Hypsochromic shift, Hyperchromic and hypochromic effect, Instrumental technique, Solvent effect, application); IR spectroscopy [Basic principle, Stretching and bending vibration of AX₂ type molecule(non linear), Calculation of stretching frequency, Identification of organic compounds by IR spectroscopy, Instrumental technique and application]; NMR spectroscopy (Principle of NMR spectra, chemical shift, shielding and deshielding nucleus, application of NMR).	5L

6	Stereochemistry Isomerism, Structural isomerism, Metamerism, Tautomerism, Stereoisomerism, Optical activity, Configurations and symmetry and Chirality, Enantiomers and Diastereomers, Conformational analysis, Fischer and Sawhorse and Newman projection (inter conversion), R-, S- and E-, Z- Nomenclature.	5L
7	Organic reactions and synthesis of a drug molecule Introduction to reactions involving <i>Addition Reaction:</i> Nucleophilic addition reaction [Acid catalysed reaction; Base catalysed reaction, Reactions of aldehyde or ketone with hydrocyanic acid, sodium bisulphite, water, Grignard reagent, alcohols], Electrophilic addition reaction [addition of Br ₂ to alkene; addition of hydrogen halide in symmetrical and unsymmetrical alkene (Markownikov rule); addition of Hypohalous acid, sulphuric acid and water to unsymmetrical alkene; addition of hydrogen halide in unsymmetrical alkene in presence of peroxide (Anti Markownikov rule) Ozonolysis reaction. <i>Substitution Reaction:</i> Electrophilic substitution reaction [Chlorination of Benzene; Nitration of Benzene; Friedel-Crafts Reaction (Alkylation, Acylation)], Nucleophilic substitution reaction [S _N 1 and S _N 2 reaction]. <i>Elimination Reaction:</i> E1 elimination and E2 elimination: Hofmann and Saytzev elimination. <i>Nucleophilic addition followed by elimination Reaction:</i> Reaction of carbonyl compound with ammonia, Primary amine. <i>Cyclization reaction:</i> Diels-Alder reaction. <i>Oxidation Reaction:</i> Oxidation of alcohol (Primary, secondary and tertiary alcohol); autoxidation of ether; Oxidation of aldehyde and ketone; Baeyer-Villiger oxidation; Oxidation of aromatic compounds (Oxidation of toluene and its derivatives, benzaldehyde, acetophenone, phenol). <i>Reduction Reaction:</i> Reduction of alkenes; Alkynes; carbonyl compounds (aldehydes and ketones); Carboxylic acid and esters; Bouveault-Blanc reduction; Clemensen reduction; Wolf-Kishner reduction; Meerwein-Ponndorf-Verley reduction; Pinacol-Pinacolone rearrangement; Reduction of aromatic compounds (Benzaldehyde, Benzoic acid, Nitrobenzene, m-dinitrobenzene, Diazonium salt). <i>Name Reactions:</i> Aldol condensation and Mixed Aldol condensation; Claisen-schmidt reaction; Cannizaro reaction; Crossed Cannizaro reaction; Kolbe-Schmitt reaction; Gattermann-Koch aldehyde synthesis <i>Synthesis of a commonly used drug molecule:</i> Paracetamol, Aspirin	7L



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Total	45L

Course Outcomes:

After completion of the course, students will be able to:

1	Demonstrate microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2	Illustrate bulk properties and processes using thermodynamic considerations.
3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
4	Articulate periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5	List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2	University Chemistry, by B. H. Mahan
3	Fundamentals of environment and Ecology, by D. De & D. De, S. Chand Publishing.
4	Chemistry-I, by Gourkrishna Das Mohapatra, VIKAS Publishing House Pvt. Ltd.
5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6	Engineering Chemistry (NPTEL Web-book) by B.L.Tembe, Kamaluddin and M.S. Krishnan
7	Physical Chemistry, by P. W. Atkins
8	Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Pub.
9	Physical Chemistry, P. C. Rakshit, Sarat Book House
10	Organic Chemistry, Volume I, I. L. Finar, Pearson

Course Name:	Mathematics-II		
Course Code:	BS-M201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To learn how to solve different types of differential equation
2	To know the different types of improper integral
3	To know the Laplace transform
4	Basic concept of graph, digraph, walk, Hamiltonian graph, Euler circuit,
5	Basic concept of tree, binary tree

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Ordinary Differential Equations of First order: ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, In-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree Equations solvable for p , solvable for x , solvable for y ; Clairaut's equations,	8L
2	Higher Order Ordinary Differential Equations: (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI) (ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	8L
3	Improper Integrals: (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L
4	Laplace Transforms and Inverse Laplace Transforms: (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of a function multiplied by t^n and divided by t ; LT of unit step and periodic functions; LT of derivatives. (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii) Solutions of initial and boundary value problems by LT	8L
5	Graph Theory: (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	Tree: (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		40L



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Course Outcomes:

After completion of the course, students will be able to:

1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems
3	Use tree and graph algorithms for different problems
4	evaluation of different types of improper integrals

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	An introduction to differential equation, Maity & Ghosh, NCBA
5	Michael Greenberg, Advanced Engineering Mathematics, Pearson
6	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
7	An introduction to Integral Calculus, Maity and Ghosh, NCBA
8	Advanced Differential Equation, M.D Raisinghanian
9	An Introduction to Engineering Mathematics-II, G.P.Samanta, New Age Publication

Course Name:	Programming for Problem Solving		
Course Code:	ES-CS201	Category:	Engineering Science
Semester:	Second	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language).
2	To develop the ability to apply knowledge of programming for solution of science & engineering problems.



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudocode with examples. From algorithms to programs: Basic I/O operations, keywords, data types, variables & memory locations, source code, Syntax and Logical Errors in compilation, object and executable code. Operators and Expressions, operator precedence in C programming Language.	5
2	Conditional Branching and Looping : Concepts of Conditional Branching: if-else, nested if-else , switch-case Concepts of Loops: While, do-while, for loops, Use of break and continue statement.	8
3	Arrays : Concepts of 1-D, 2-D array, array manipulation, Concepts of character array, Strings and their uses. Basic Algorithms using array: Searching (linear and binary search) and Sorting Algorithms (Bubble, Insertion and Selection sort),	9
4	Functions: Functions (including using built in libraries), Parameter passing in functions, function call by value, Recursive functions. Pointers: Idea of pointers, Defining pointers, relation between array and pointer, idea of function call by address, Dynamic memory allocation.	8
5	Structure: Structures, Array of Structures, Self-referential structures. Storage Class and Preprocessor Directives. Disk I/O operations - File handling: open, read, write, close a file.	6
Total		36L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of structured programming language .
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Chemistry Laboratory		
Course Code:	BS-CH291	Category:	Basic Science Courses
Semester:	Second	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	The objective of this course is to acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field. The students will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence. The course will enable the student to: - Determine the strength of an unknown solution through conductometric and pH metric titration. - Estimate the chloride ion concentration, alkalinity and hardness in water. - Find out the rate constant of a reaction. - Synthesize polymer molecules.

Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.	3P/ Week
2	pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.	
3	To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).	
4	Determination of dissolved oxygen present in a given water sample.	
5	Determination of viscosity of the given liquid by Ostwald –Viscometer.	
6	Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).	
7	Chemical kinetics (determination of relative rates of reaction of iodide with H ₂ O ₂ at room temperature).	
8	Determination of acid value (Acidity) of oil.	



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9	The adsorption of acetic acid on active charcoal.	
10	Complexometric titration (estimation of hardness of water using EDTA).	
11	Redox titration (estimation of iron using permanganometry).	
12	To determine Alkalinity of a Given Water Sample.	
13	Synthesis of a polymer (Polyacrylamide) and determine its molecular weight by solution viscosity method.	
14	Determination of cell constant and conductance of solutions.	
Total		36P

Course Outcomes:

After completion of the course, students will be able to:

1	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: - Estimate rate constants of reactions from concentration of reactants/products as a function of time - Measure molecular/system properties such as viscosity, conductance of solutions, redox potentials, chloride content of water, etc. - Synthesize a macromolecule and determine its molecular weight by solution viscosity method.

Learning Resources:

1	Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house.
2	A Text book on Experiments and calculations in Engineering Chemistry, by S.S. Dara, S Chand publications.
3	Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited.

Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS291	Category:	Engineering Science
Semester:	Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05



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Approved by AICTE & affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal

243 G.T. Road (N), Liluah, Howrah- 711204, West Bengal, India

Ph: +91 33 26549315/17 Fax +91 33 26549318 Web: www.mckvie.edu.in

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8
4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve basic data manipulation related problems.
4	Apply programming concepts to handle memory allocation and files.



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Course Name:	Workshop/ Manufacturing Practices		
Course Code:	ES-ME292	Category:	Engineering Sciences
Semester:	Second	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart basic knowledge of various hand tools and their applications in different sections of manufacturing
2	To develop basic manufacturing skills, precision, safety at work place, team working and development of right attitude.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
Lectures and videos:		
	1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods 2. CNC machining, Additive manufacturing 3. Fitting operations & power tools 4. Electrical & Electronics 5. Carpentry 7. Metal casting 8. Welding (arc welding & gas welding), brazing	13L
Workshop Practice:		
1	Machine shop: <i>Typical jobs that may be made in this practice module:</i> - To make a pin from a mild steel rod in a lathe. - To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.	8P
2	Fitting shop: <i>Typical jobs that may be made in this practice module:</i> To make a Gauge from MS plate.	8P
3	Carpentry: <i>Typical jobs that may be made in this practice module:</i> To make wooden joints and/or a pattern or like.	8P

4	Welding shop (Arc welding 4 hrs + gas welding 4 hrs): Typical jobs that may be made in this practice module: ARC WELDING (4 hours): - To join two thick (approx 6mm) MS plates by manual metal arc welding. GAS WELDING (4 hours): - To join two thin mild steel plates or sheets by gas welding.	8P
5	Casting: Typical jobs that may be made in this practice module: One/ two green sand moulds to prepare, and a casting be demonstrated.	8P
6	Smithy: Typical jobs that may be made in this practice module: A simple job of making a square rod from a round bar or like.	4P
7	Electrical & Electronics: - Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable. - Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point. - Simple wiring exercise to be executed to understand the basic electrical circuit. - Simple soldering exercises to be executed to understand the basic process of soldering. - Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.	8P
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Identify and utilize machine tools for producing components through machining processes
2	Demonstrate fundamental concept of pattern making, and moulding processes for engineering applications.
3	Practice fitting, carpentry, and smithy operations for manufacturing of components.
4	Explain concepts and applications of various types of fabrication processes.



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5	Apply basic electrical and electronics engineering knowledge for household applications.

Learning Resources:

1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
4	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998
5	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Name:	Language Laboratory		
Course Code:	HM-HU291	Category:	HM
Semester:	Second	Credit:	1
L-T-P:	0-0-2	Pre-Requisites:	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills. (listening, speaking, reading and writing)

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Honing 'Listening Skill' and its sub skills through Language Lab Audio device	4P
2	Honing 'Speaking Skill' and its sub skills: Extempore, Public speaking, etc. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/ Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.	6P



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3	Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Debate, Role Play etc.)	4P
4	Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.	6P
5	Honing 'Reading Skills' and its sub skills.	2P
6.	Honing 'Writing Skill' and its sub skills by using Language Lab Audio – Visual input; Practice Sessions	2P
Total		24P

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop their intellectual, personal and professional abilities.

Learning Resources:

1.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
6.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019.

Curriculum for Undergraduate Degree (B.Tech.) in Electronics and Communication (VLSI Design) (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Range of Credits:

As per AICTE, a student covering 160 credits during 4 years of studies as per curriculum of the Institute will be eligible to get Under Graduate B.Tech. degree. A student will be eligible to get B.Tech. degree with Honours, if he/ she completes an additional 20 credits. These could be acquired through MOOCs prescribed by the Institute. Every student admitted to the 4 years B.Tech programme is required to earn a minimum of 100 Activity Points under Mandatory Additional Requirement (MAR), in addition to the required academic grades, for getting B.Tech./ B.Tech. (Honours) degree. Also some non-credit mandatory courses are there included in the curriculum. Like theory courses, students are required to appear in the semester examination for all mandatory courses and must get a minimum of pass marks in those courses to be eligible to get the final degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Humanities and Social Sciences including Management Courses	12	12
2	Basic Science Courses	24	25
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.	23.5	24
4	Professional Core Courses	53	48
5	Professional Elective Courses relevant to chosen specialization/ branch	19	18
6	Open Elective Courses from other technical and / or emerging subjects	14	18
7	Project Work, Seminar and Internship in Industry or elsewhere	14.5	15
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	0	Non-Credit
Total		160	160



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D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	BS	Basic Science Courses
5	ES	Engineering Science Courses
6	HM	Humanities and Social Sciences including Management Courses
7	PC	Professional Core Courses
8	PE	Professional Elective Courses
9	OE	Open Elective Courses
10	MC	Mandatory Courses
11	PW	Project/ Internships/ Sessional

E. Courses in Different Categories:

Humanities and Social Sciences including Management Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	HM-HU101	English	2	0	0	2
2	V	HM-HU501	Value & Ethics in Profession	2	0	0	2
3	VII	HM-HU701	Economics of Engineers	3	0	0	3
4	VIII	HM-HU801	Organizational Behaviour	3	0	0	3
Total Theory				10	0	0	10
Practical/ Sessional							
1	II	HM-HU291	Language Laboratory	0	0	2	1
2	IV	HM-HU491	Soft Skill Development Lab	0	0	2	1
Total Practical/ Sessional				0	0	4	2
Total				10	0	4	12

Basic Science Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	BS-PH101	Physics	3	1	0	4
2	I	BS-M101	Mathematics-I	3	1	0	4
3	II	BS-CH201	Chemistry	3	1	0	4



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4	II	BS-M201	Mathematics-II	3	1	0	4
5	III	BS-M304	Numerical Methods	2	0	0	2
6	IV	BS-BIO401	Biology	2	0	0	2
<i>Total Theory</i>				16	4	0	20
Practical/ Sessional							
1	I	BS-PH191	Physics Laboratory	0	0	3	1.5
2	II	BS-CH291	Chemistry Laboratory	0	0	3	1.5
3	III	BS-M394	Numerical Methods Lab	0	0	2	1
<i>Total Practical/ Sessional</i>				0	0	8	4
Total				16	4	8	24

Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	ES-EE101	Basic Electrical and Electronics Engineering	3	1	0	4
2	II	ES-CS201	Programming for Problem Solving	3	0	0	3
3	III	ES-CS301	Data Structure and Algorithm	3	0	0	3
4	III	ES-CS302	Discrete Mathematics	3	0	0	3
Total Theory				12	1	0	13
Practical/ Sessional							
1	I	ES-EE191	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5
2	I	ES-ME191	Engineering Graphics & Design	1	0	4	3
3	II	ES-CS291	Programming for Problem Solving Lab	0	0	4	2
4	II	ES-ME291	Workshop/Manufacturing Practices	1	0	4	3
5	III	ES-CS391	Data Structure Lab	0	0	2	1
Total Practical/ Sessional				2	0	18	10.5
Total				14	1	18	23.5



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Professional Core Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	PC-EC302	Analog Electronic Circuits	3	0	0	3
2	III	PC-EC303	Signals and Systems	3	0	0	3
3	III	PC-EC304	Network Theory	3	0	0	3
4	IV	PC-EC402	Digital System Design	3	0	0	3
5	IV	PC-EC403	Microprocessors & Microcontrollers	3	0	0	3
6	IV	PC-EC(V)401	Analog and Digital Communication	3	0	0	3
7	IV	PC-EC(V)402	Control System	3	0	0	3
8	V	PC-EC(V)501	Analog VLSI Circuits	3	0	0	3
9	V	PC-EC(V)502	Computer Architecture	3	0	0	3
10	V	PC-EC501	Electromagnetic Waves and Transmission Line	3	0	0	3
11	V	PC-EC504	Digital Signal Processing	3	0	0	3
12	VI	PC-EC(V)601	Microelectronics Fabrication	3	0	0	3
13	VI	PC-EC(V)602	Digital VLSI	3	0	0	3
14	VII	PC-EC(V)701	Embedded Systems	3	0	0	3
Total Theory				42	0	0	42
Practical/ Sessional							
1	III	PC-EC392	Analog Electronic Circuits Lab.	0	0	2	1
2	III	PC-EC394	Network Theory lab	0	0	2	1
3	IV	PC-EC492	Digital System Design Lab.	0	0	2	1
4	IV	PC-EC493	Microprocessors & Microcontrollers Lab	0	0	2	1
5	IV	PC-EC(V)491	Analog and Digital Communication Lab	0	0	2	1
6	V	PC-EC(V)591	Analog VLSI Circuits Lab	0	0	2	1
7	V	PC-EC(V)592	Computer Architecture Lab	0	0	2	1
8	V	PC-EC591	Electromagnetic Waves and Transmission Line Laboratory	0	0	2	1
9	V	PC-EC594	Digital Signal Processing Lab	0	0	2	1
10	VI	PC-EC(V)692	Digital VLSI Lab	0	0	2	1
11	VII	PC-EC(V)791	Embedded Systems laboratory	0	0	2	1
Total Practical/ Sessional				0	0	22	11
Total				42	0	22	53



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Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	PE-EC(V)501	Professional Elective-I	3	0	0	3
2	VI	PE-EC(V)601	Professional Elective-II	3	0	0	3
3	VI	PE-EC(V)602	Professional Elective-III	3	0	0	3
4	VII	PE-EC(V)701	Professional Elective-IV	3	0	0	3
5	VIII	PE-EC(V)801	Professional Elective-V	3	0	0	3
6	VIII	PE-EC(V)802	Professional Elective-VI	3	0	0	3
Total Theory				18	0	0	18
Practical/ Sessional							
1	VI	PE-EC(V)691	Professional Elective-II (Lab)	0	0	2	1
Total Practical/ Sessional				0	0	2	1
Total				18	0	2	19

Open Elective Courses from other technical and / or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	IV	OE-EC(V)401	Open Elective-I	3	0	0	3
2	VI	OE-EC(V)601	Open Elective-II	3	0	0	3
3	VII	OE-EC(V)701	Open Elective-III	3	0	0	3
4	VIII	OE-EC(V)801	Open Elective-IV	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional							
1	IV	OE-EC(V)491	Open Elective -I (Lab)	0	0	2	1
2	VI	OE-EC(V)691	Open Elective-II (Lab)	0	0	2	1
Total Practical/ Sessional				0	0	4	2
Total				12	0	4	14



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Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
Total Theory				0	0	0	0
Practical/ Sessional							
1	VI	PW-EC(V)681	Mini Project	0	0	3	1.5
2	VII	PW-EC(V)781	Design Laboratory	0	0	4	2
3	VII	PW-EC(V)782	Project-I	0	0	6	3
4	VII	PW-EC(V)783	Seminar	0	0	2	1
5	VII	PW-EC(V)784	Industrial Training	During Semester Break(6 th & 7 th)			1
6	VIII	PW-EC(V)881	Project-II	0	0	10	5
7	VIII	PW-EC(V)882	Comprehensive Viva Voce				1
Total Practical/ Sessional				0	0	25	14.5
Total				0	0	25	14.5

Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
Total Theory				0	0	0	0
Practical/ Sessional							
1	III	MC371	Environmental Sciences	2	0	0	0
2	IV	MC472	Constitution of India	2	0	0	0
3	V	MC571	Aptitude Skill Development-I	2	0	0	0
4	V	MC573	Essence of Indian Traditional Knowledge	2	0	0	0
5	VI	MC671	Aptitude Skill Development-II	2	0	0	0
Total Practical/ Sessional				10	0	0	0
Total				10	0	0	0



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Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)							
Mandatory Induction Program- 3 Weeks Duration							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-PH101	Physics	3	1	0	4
2	BS	BS-M101	Mathematics-I	3	1	0	4
3	ES	ES-EE101	Basic Electrical and Electronics Engineering	3	1	0	4
4	HM	HM-HU101	English	2	0	0	2
Total Theory				11	3	0	14
Practical/ Sessional/ Mandatory Course							
1	BS	BS-PH191	Physics Laboratory	0	0	3	1.5
2	ES	ES-EE191	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5
3	ES	ES-ME191	Engineering Graphics & Design	1	0	4	3
Total Practical/ Sessional/ Mandatory Course				1	0	11	6
Total of First Semester				12	3	11	20

Second Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-CH201	Chemistry	3	1	0	4
2	BS	BS-M201	Mathematics-II	3	1	0	4
3	ES	ES-CS201	Programming for Problem Solving	3	0	0	3
Total Theory				9	2	0	11
Practical/ Sessional/ Mandatory Course							
1	BS	BS-CH291	Chemistry Laboratory	0	0	3	1.5
2	ES	ES-CS291	Programming for Problem Solving Lab	0	0	4	2



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3	ES	ES-ME291	Workshop/Manufacturing Practices	1	0	4	3
4	HM	HM-HU291	Language Laboratory	0	0	2	1
<i>Total Practical/ Sessional/ Mandatory Course</i>				1	0	13	7.5
Total of Second Semester				10	2	13	18.5

Third Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC302	Analog Electronic Circuits	3	0	0	3
2	PC	PC-EC303	Signals and Systems	3	0	0	3
3	PC	PC-EC304	Network Theory	3	0	0	3
4	ES	ES-CS301	Data Structure and Algorithm	3	0	0	3
5	ES	ES-CS302	Discrete Mathematics	3	0	0	3
6	BS	BS-M304	Numerical Methods	2	0	0	2
Total Theory				17	0	0	17
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC392	Analog Electronic Circuits Lab.	0	0	2	1
2	PC	PC-EC394	Network Theory lab	0	0	2	1
3	ES	ES-CS391	Data Structure Lab	0	0	2	1
4	BS	BS-M394	Numerical Methods Lab	0	0	2	1
5	MC	MC371	Environmental Sciences	2	0	0	0
Total Practical/ Sessional/ Mandatory Course				2	0	8	4
Total of Third Semester				19	0	8	21

Fourth Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC402	Digital System Design	3	0	0	3
2	PC	PC-EC403	Microprocessors & Microcontrollers	3	0	0	3
3	PC	PC-EC(V)401	Analog and Digital Communication	3	0	0	3
4	PC	PC-EC(V)402	Control System	3	0	0	3
5	OE	OE-EC(V)401	Open Elective-I	3	0	0	3
6	BS	BS-BIO401	Biology	2	0	0	2
Total Theory				17	0	0	17

Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC492	Digital System Design Lab.	0	0	2	1
2	PC	PC-EC493	Microprocessors & Microcontrollers Lab	0	0	2	1
3	PC	PC-EC(V)491	Analog and Digital Communication Lab	0	0	2	1
4	OE	OE-EC(V)491	Open Elective-I (Lab)	0	0	2	1
5	HM	HM-HU491	Soft Skill Development Lab	0	0	2	1
6	MC	MC472	Constitution of India	2	0	0	0
<i>Total Practical/ Sessional/ Mandatory Course</i>				2	0	10	5
Total of Fourth Semester				19	0	10	22

List of Elective Courses	
OE-EC(V)401	Open Elective-I
OE- EC(V)401A	Python Programming
OE- EC(V)401B	Object Oriented Programming
OE-EC(V)491	Open Elective-I (Lab)
OE- EC(V)491A	Python Programming laboratory
OE- EC(V)491B	Object Oriented Programming laboratory

Fifth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC(V)501	Analog VLSI Circuits	3	0	0	3
2	PC	PC-EC(V)502	Computer Architecture	3	0	0	3
3	PC	PC-EC501	Electromagnetic Waves and Transmission Line	3	0	0	3
4	PC	PC-EC504	Digital Signal Processing	3	0	0	3
5	PE	PE-EC(V)501	Professional Elective-I	3	0	0	3
6	HM	HM-HU501	Value & Ethics in Profession	2	0	0	2
Total Theory				17	0	0	17
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC(V)591	Analog VLSI Circuits Lab	0	0	2	1
2	PC	PC-EC(V)592	Computer Architecture Lab	0	0	2	1
3	PC	PC-EC591	Electromagnetic Waves and Transmission Line Laboratory	0	0	2	1
4	PC	PC-EC594	Digital Signal Processing Lab	0	0	2	1



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5	MC	MC571	Aptitude Skill Development-I	2	0	0	0
6	MC	MC573	Essence of Indian Traditional Knowledge	2	0	0	0
<i>Total Practical/ Sessional/ Mandatory Course</i>				4	0	8	4
Total of Fifth Semester				21	0	8	21

List of Elective Courses	
PE-EC(V)501	Professional Elective-I
PE-EC(V)501A	Microelectronic and Optoelectronic Devices
PE-EC(V)501B	Advanced Microprocessors

Sixth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC(V)601	Microelectronics Fabrication	3	0	0	3
2	PC	PC-EC(V)602	Digital VLSI	3	0	0	3
3	PE	PE-EC(V)601	Professional Elective-II	3	0	0	3
4	PE	PE-EC(V)602	Professional Elective-III	3	0	0	3
5	OE	OE- EC(V)601	Open Elective-II	3	0	0	3
Total Theory				15	0	0	15
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC(V)692	Digital VLSI Lab	0	0	2	1
2	PE	PE-EC(V)691	Professional Elective-II (Lab)	0	0	2	1
3	OE	OE-EC(V)691	Open Elective-II (Lab)	0	0	2	1
4	PW	PW-EC(V)681	Mini Project	0	0	3	1.5
5	MC	MC671	Aptitude Skill Development-II	2	0	0	0
Total Practical/ Sessional/ Mandatory Course				2	0	9	4.5
Total of Sixth Semester				17	0	9	19.5

List of Elective Courses	
PE-EC(V)601	Professional Elective-II
PE- EC(V)601A	Computer Network
PE- EC(V)601B	Instrumentation and Measurement
PE-EC(V)602	Professional Elective-III
PE-EC(V)602A	Sensors and Transducers
PE-EC(V)602B	MEMS



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OE-EC(V)601	Open Elective-II
OE-EC(V)601A	Artificial Intelligence using R/Python
OE-EC(V)601B	Machine Learning using R/Python
PE-EC(V)691	Professional Elective-II (Lab)
PE-EC(V)691A	Computer Network Laboratory
PE-EC(V)691B	Instrumentation and Measurement Laboratory
OE-EC(V)691	Open Elective-II (Lab)
OE-EC(V)691A	Artificial Intelligence using R/Python Laboratory
OE-EC(V)691B	Machine Learning using R/Python Laboratory

Seventh Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EC(V)701	Embedded Systems	3	0	0	3
2	PE	PE-EC(V)701	Professional Elective-IV	3	0	0	3
4	OE	OE-EC(V)701	Open Elective-III	3	0	0	3
5	HM	HM-HU701	Economics of Engineers	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EC(V)791	Embedded Systems laboratory	0	0	2	1
2	PW	PW-EC(V)781	Design Laboratory	0	0	4	2
3	PW	PW-EC(V)782	Project -I	0	0	6	3
4	PW	PW-EC(V)783	Seminar	0	0	2	1
5	PW	PW-EC(V)784	Industrial Training	During Semester Break(6 th & 7 th)			1
Total Practical/ Sessional/ Mandatory Course				0	0	14	8
Total of Seventh Semester				12	0	14	20

List of Elective Courses	
PE-EC(V)701	Professional Elective-IV
PE-EC(V)701A	VLSI Design Automation
PE-EC(V)701B	Nano Electronics
OE-EC(V)701	Open Elective-III
OE-EC(V)701A	Web Technology
OE-EC(V)701B	Cyber Security
OE-EC(V)701C	Operation Research and Optimisation Technique (or AI based Optimization Techniques)

Eighth Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-EC(V)801	Professional Elective-V	3	0	0	3
2	PE	PE-EC(V)802	Professional Elective-VI	3	0	0	3
3	OE	OE-EC(V)801	Open Elective-IV	3	0	0	3
4	HM	HM-HU801	Organizational Behaviour	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PW	PW-EC(V)881	Project-II	0	0	10	5
2	PW	PW-EC(V)882	Comprehensive Viva Voce	0	0	0	1
Total Practical/ Sessional/ Mandatory Course				0	0	10	6
Total of Eighth Semester				12	0	10	18

List of Elective Courses	
PE-EC(V)801	Professional Elective-V
PE-EC(V)801A	Low Power VLSI
PE-EC(V)801B	Processor Architecture for VLSI Design
PE-EC(V)802	Professional Elective-VI
PE-EC(V)802A	Renewable Energy
PE-EC(V)802B	Speech & Audio Processing
OE-EC(V)801	Open Elective-IV
OE-EC(V)801A	Internet of Things (IoT)
OE-EC(V)801B	Big Data
OE-EC(V)801C	Entrepreneurship



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Curriculum for Undergraduate Degree (B.Tech.) in Electronics and Communication (VLSI Design) (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Induction Program (Mandatory)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Duration

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Please refer **Appendix-A** for AICTE guidelines on Mandatory Induction Program.

First Semester

Course Name:	Physics		
Course Code:	BS-PH101	Category:	Basic Science Course
Semester:	First	Credit:	4.0
L-T-P:	3-1-0	Pre-Requisites:	Mathematics course with vector calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	Understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	Describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Module-1: Foundations of Quantum Mechanics	(8L)
	Introduction to Quantum Physics: Brief idea about the historical development of quantum mechanics.	1
	Black Body Radiation: Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws.	2
	Compton Effect: Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	2
	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation.	2
	Uncertainty Principle: Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero point energy, Numerical problems.	1
2	Module-2: Schrödinger Wave Equation and Its Applications	(8L)
	Formulation of Quantum Mechanics: Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of associated problems.	3
	Schrödinger Wave Equation: Time independent Schrödinger's equation from time dependent one by the separation of variable method.	1
	Applications of Quantum Mechanics: Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator	4
3	Module-3: Dielectric Materials and their Applications	(5L)
	Concept of Dielectric and Polarization: Electric field inside a Dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, Atomic polarizability and polarization vector.	1
	Inter Relationship among Dielectric Parameters: Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems on relation between polarizability, susceptibility and dielectric constant.	2
	Types of Polarization: Electronic polarization and derivation of electronic	1

	polarizability, Concept of ionic and orientational polarization (no derivation). Applications of Dielectric: Dielectric breakdown and dielectric strength, Concept of Dielectric loss, Few applications of dielectrics in different fields.	1
4	Module-4: Time Varying Fields Electromagnetic Induction: Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in Motors and Generators, Calculation of Induced EMF. Displacement Current: Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	(3L) 2 1
5	Module-5: Electromagnetic Waves Maxwell's Electromagnetic Field Equations: Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators etc.). Plane Electromagnetic Wave in Free Space: Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. Plane Electromagnetic Wave in Medium: Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. Energy in an Electromagnetic Field: Flow of energy associated to electromagnetic field and Poynting vector.	(6L) 2 1 2 1
6	Module-6: Laser and Fiber Optics Introduction to Laser: Properties of light sources, Need of suitable light source in communication, Invention of laser, Characteristics and applications of laser. Interaction of Light with Matter: Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them. Components and Working of Laser Systems: Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO ₂ laser). Optical Communication: Introduction, Need for optical communication, Salient features of optical fibers, Amplitude and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth analog/digital communication system Light Guidance in Fibers: Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single and multimode fibers, Step-index and graded-index fibers. Transmission characteristics of optical fibers: Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion,	(9L) 1 1 2 2 1 2



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	bit rate - length product, Minimization of intermodal dispersion.	
Total		39L

Course Outcomes:

After completion of the course, students will be able to:

1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various medium of propagations.
4	Understand the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy etc.
6	Explain the workings of various LASERs and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the dispersion leading to calculation of Bit Rate of a communication channel..

Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Aurthur Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
9	'Understanding Lasers' by Jeff Hecht
10	'An Introduction to Fiber Optics' by Ajoy Ghatak and K. Thyagrajan

Course Name:	Mathematics-I		
Course Code:	BS-M101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To know Convergence of sequence and series
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function
3	To know the uses of matrix in different areas in engineering
4	To know the use of mean value theorems in engineering fields
5	Use of vector functions in different fields of Engineering

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Determinants and Matrices: (i) Introduction to determinant, properties (proofs of identities are excluded). (ii) Types of matrices, rank of a matrix, inverse of a matrix, Linear systems of equations, Cramer's rule, eigen-values and eigen-vectors, Caley-Hamilton theorem.	6L
2	Differential Calculus (Function of single variable): (i) Indeterminate forms and L'Hospital's rule; Successive differentiation, Leibnitz's theorem. (ii) Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin theorems with remainders; Maxima and minima. (iii) Evolutes and Involutives.	6L
3	Differential Calculus (Function of multi-variables): (i) Concept of limit, continuity and partial differentiation, chain rule, total differential, Jacobian, Euler's theorem on homogeneous function. (ii) Hessian, Maxima and minima; Lagrange's multipliers.	8L
4	Integral Calculus: (i) Line integrals; double integrals, change of order; triple integrals. (ii) Evaluation of surface areas and volumes of revolutions.	6L
5	Vector Calculus: (i) Vector differential operator, scalar and vector point function, gradient, directional derivative, divergence and curl. (ii) Divergence theorem, Green's and Stoke's theorem (Statements only) and applications.	8L
6	Sequence and Series: (i) Sequence, type of a sequence. (ii) Series of positive terms; Geometric and p-series and their convergence criterion; Convergence test of series: Comparison test, D'Alembert's rati test, Cauchy's root test. (iii) Alternating series; Absolute convergence, Leibnitz's theorem.	6L



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Total	40

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply knowledge of differential and integral calculus to determine curvature and evaluation of different types of improper integrals
2	Utilize mean value theorems for solution of engineering problems.
3	Learn matrices, concept of rank, methods of matrix inversion and their applications.
4	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
5	Determine eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces to solve physical and engineering problems
6	Solve multiple integrals and utilize it to different physical problems

Course Name:	Basic Electrical and Electronics Engineering		
Course Code:	ES-EE101	Category:	ES
Semester:	First	Credit:	4
L-T-P:	4-0-0	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:	
1	To provide comprehensive idea about AC and DC circuit analysis
2	To make the students understand about working principals and applications of electric machines
3	To make the students understand the components of low voltage electrical installations
4	To provide basic idea about general structure of electrical power system.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
Module 1	DC Circuits Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5

Module 2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel),	4
Module 3	Three phase system Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2
Module 4	DC Machines Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor	5
Module 5	AC Machines Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency Three-phase induction motor Generation of rotating magnetic fields, Construction and working of a three-phase induction motor.	4
Module 6	Electrical Installations Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3
Module 7	General structure of electrical power system: Power generation to distribution through overhead lines and underground cables with single line diagram	1
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.



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Learning Resources:	
1	D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2	C.L. Wadhwa, Basic Electrical Engineering, New Age, 2007.
3	S K Bhattacharya, Basic Electrical and Electronics Engineering, Pearson, 2011
4	Ashfaq Husain and Haroon Ashfaq, Fundamentals of Electrical Engineering, Dhanpat Rai & Co., Delhi, 2007.
5	J.B. Gupta, Basic Electrical Engineering, Kataria& Sons, 2015.
6	L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
7	E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:	
1	To make the students understand about the semiconductor.
2	To make the students understand about Diode and its circuit.
3	To make the students understand about different Transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Semiconductors: Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5
2	Diode and Diode Circuits: Formation of P-N junction, depletion region, built-in-potential, forward and reverse biased P-N junction, energy band diagrams, V-I characteristics, Zener diode forward and reverse characteristics, Avalanche breakdown and zener breakdown., junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, PIV, ripple factor, efficiency.	4 3
3	Introduction to Bipolar Junction Transistor(BJT) and Field Effect Transistor (FET): Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier.	4 2



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	JFET (N channel only) structure, Drain and Transfer characteristics.	
4	Introduction to OPAMP and Digital Electronics: Introduction to Operational Amplifiers: Characteristics, Inverting and Non-Inverting mode of operation, summing amplifier, difference amplifier.	3
	Introduction to binary number; Basic Boolean algebra; Introduction to integrated circuits, Logic gates and truth tables for different logic operations and simple digital circuits using the basic gates.	3
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	identify semiconductor materials, draw band-diagrams, distinguish between intrinsic and extrinsic semiconductors, n- and p- type semiconductors, calculate drift and diffusion current components
2	explain the junction properties and the phenomenon of rectification, draw the I-V characteristics and identify operating points; Calculate ripple factors, efficiency of power supplies.
3	draw and explain the I-V characteristics of BJTs and FET – both input and output;
4	understand basics of OPAMP and learn the use of it as amplifier.
5	Explain binary numbers and identify different logic gates and circuit implementation.

Learning Resources:

1	Rakshit and Chattopadhyay: Introduction to Electronics Principle
2	Malvino: Electronic Principle.
3	Millman & Halkias: Integrated Electronics.
4	Boyelstad & Nashelsky: Electronic Devices & Circuit Theory.

Course Name:	English		
Course Code:	HM-HU101	Category:	HM
Semester:	First	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills (speaking, reading and writing).



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	TECHNICAL COMMUNICATION: Theory of Communication – Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills	1L
2	VOCABULARY BUILDING: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms	1L
3.	BASIC WRITING SKILLS. Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences in logical order.	1 L
4	GRAMMAR: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9 L
5	WRITING PRACTICES: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10 L
6.	READING COMPREHENSION: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		24L

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:

1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001



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4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Universal English. Prof. Prasad Kataria Publications, 2019.
6.	"Communication Skills for Professionals"-Nira Konar, Prentice Hall of India 2nd edition, New Delhi, 2011
7.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019. Course Outcomes The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Name:	Physics Laboratory		
Course Code:	BS-PH191	Category:	Basic Science Courses
Semester:	First	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	Apply the concepts of physics to carry out experiments on Quantum physics, EMT, Optics and General properties of matter and interpret the same for deduction of results.

Course Contents: (Choose 10 experiments from the following)

Module No.	Description of Topic	Contact Hrs.
1	Determination of Dispersive Power of the Material of a Prism	3P/ week
2	Determination of wavelength of a monochromatic light by Newton's ring	
3	Determination of Wavelength of the Given LASER Light by Diffraction Method	
4	Determination of Thermo-electric Power of a given Thermocouple	
5	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method	
6	Determination of Hall Coefficient of a Semiconductor	
7	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell	
8	Determination of Unknown Resistance using Carey Foster's Bridge	
9	Determination of Planck Constant using Photocell	
10	Verification of Bohr's Atomic Orbital Theory Through Frank-Hertz Experiment	
11	Determination of Rydberg Constant by Studying Hydrogen Spectrum	
12	Determination of Band Gap of a Semiconductor by Four Probe Method	
13	Determination of Young's Modulus of Elasticity of the Material of a Bar by the	



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	Method of Flexure	
14	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method	
15	Determination of Coefficient of Viscosity by Poiseuille's Capillary Flow Method	
Total		39P

Course Outcomes:

After completion of the course, students will be able to:

1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.

Learning Resources:

1	An Advanced Course in Practical Physics, by D. Chattopadhyay , P. C. Rakshit
2	A Manual of Practical Engineering Physics and Material Science, by A S Vasudeva
3	A Textbook of Engineering Physics Practical, by Dr. R Das, Dr. R Kumar, C S Robinson & P K Sahu

Course Name:	Basic Electrical and Electronics Engineering Lab		
Course Code:	ES-EE191	Category:	ES
Semester:	First	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:

1	Provide working knowledge for the analysis of basic DC and AC circuits
2	Measurement of power in three phase system



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3	Provide working knowledge on Electric machines.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	3
2	Calibration of ammeter and Wattmeter.	3
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	3
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method	3
5	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3
6	Determination of Torque –Speed characteristics of separately excited DC motor.	3
Total		18 P

Course Outcomes:	
After completion of the course, students will be able to:	
1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.
3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the different characteristics of separately excited DC motor.

Learning Resources:	
1	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:	
1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.



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Course Contents:

Exp. No.	Description of Topic	Contact Hrs.
1.	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	3
2	a) Study of I-V characteristics of Junction diodes. b) Study of I-V characteristics of Zener diodes.	3
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	3
4	a) Study of I-V characteristics of BJTs. for CB configurations b) Study of I-V characteristics of BJTs. for CE configurations	3
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	3
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	3
Total		18P

Course Outcomes:

After completion of the course, students will be able to:

1	identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.
3	implement half wave and full wave rectifier circuits and can analyse the performance of them.
4	realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	use OPAMP as amplifier and verify the truth tables of different logic gates.

Learning Resources:

1	Laboratory Manual



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Course Name:	Engineering Graphics & Design		
Course Code:	ES-ME191	Category:	Engineering Sciences
Semester:	First	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make students aware of importance of engineering drawing and to familiar with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P
5	Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P
7	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1L+4P

8	Sections and Sectional Views Of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1L+4P
9	Overview of Computer Graphics, Customisation & CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	1L+4P
10	Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	2L+8P
11	Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing	2L+8P



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	practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Familiarize with basics of drawing, dimensioning, scales, curves
2	Comprehend the theory of orthographic projection and its applications
3	Prepare and interpret isometric projection
4	Create and modify 2D drawing using AutoCAD software

Learning Resources:

1	Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6	Corresponding set of CAD Software Theory and User Manuals

Second Semester

Course Name:	Chemistry		
Course Code:	BS-CH201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The objective of the Chemistry course is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Atomic and molecular structure <i>Atomic Structure:</i> Dalton's atomic theory; Fundamental of sub atomic particles; Rutherford's atomic model; Bohr's atomic model; Dual nature of electron; Heisenberg's uncertainty principle; Schrodinger wave equation; Orbitals and Quantum numbers; Particle in a box solutions (One dimension) and their applications for simple sample. <i>Molecular Structure:</i> Molecular orbital theory: Postulates of MOT; Bonding and anti bonding orbital's; MO diagram of diatomic molecules (H ₂ , He ₂ , Li ₂ , Be ₂); Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties (Octahedral and tetrahedral complexes); Band structure of solids and the role of doping on band structures (Band theory, Valence band and conduction band, Conductor, Semiconductor, Insulator, p-Type and n-Type semiconductor).	10L
2	Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals' interactions; Ideal gas equation, compressibility factor, Real gas equation, Boyles Temperature, Critical state (Critical pressure, critical volume and critical temperature).	4L

3	Periodic properties Mendeleev's periodic table; Periodic properties (Atomic radii, Ionic radii, Ionization potential, electron affinity, Electronegativity, metallic and non metallic character, oxidizing and reducing character); Polarizability (Fajans' rule); Hard soft acids and bases; molecular geometries (VSEPR theory, Hybridization, sigma and pi bond, determination of hybridization state and structure of molecules); Hydrogen bond (Inter and intra molecular H bond); Effective nuclear charge; oxidation states.	4L
4	Use of free energy in chemical equilibria <i>Thermodynamics:</i> First law of thermodynamics, Internal energy & Enthalpy, Heat capacity, Adiabatic & Isothermal process, Reversible & Irreversible process, Second law of thermodynamics, Entropy, Free energy, Gibbs-Helmholtz equation. <i>Electrochemistry:</i> Electrochemical cell (Electrolytic cell & Galvanic cell), Representation of cell, Free energy and EMF, Reversible and Irreversible cell, Nernst equation and application, Application of EMF measurement on ΔG, ΔH, ΔS, equilibrium constant of a reversible chemical reaction and valency of an ion. Hydrogen Half cell, calomel half cell, Quinhydrone half cell. <i>Water Chemistry:</i> Hydrosphere; Hydrological cycle; Sources of water; Acidity and alkalinity of water; Pollutants of water; Biochemical and Chemical oxygen demand; Removal of dissolved solids from water (Electrodialysis & Reverse osmosis); Hardness of water (Types of hardness, Removal of hardness of water). <i>Corrosion:</i> Oxidation corrosion, Corrosion by gases, Pilling Bedworth rule, Electrochemical corrosion, Hydrogen evolution type & oxygen absorption type of corrosion, Corrosion of bimetals, Waterline corrosion, Crevice corrosion, Pitting corrosion, Stress corrosion, Factors influencing the corrosion, Prevention of corrosion.	10L
5	Spectroscopic techniques and applications Electromagnetic spectrum; Principles of spectroscopy and selection rules; UV/Vis Spectroscopy (Energy diagram of electron excitation, Lambert-Beer's law, Bathochromic and Hypsochromic shift, Hyperchromic and hypochromic effect, Instrumental technique, Solvent effect, application); IR spectroscopy [Basic principle, Stretching and bending vibration of AX₂ type molecule(non linear), Calculation of stretching frequency, Identification of organic compounds by IR spectroscopy, Instrumental technique and application]; NMR spectroscopy (Principle of NMR spectra, chemical shift, shielding and deshielding nucleus, application of NMR).	5L

6	Stereochemistry Isomerism, Structural isomerism, Metamerism, Tautomerism, Stereoisomerism, Optical activity, Configurations and symmetry and Chirality, Enantiomers and Diastereomers, Conformational analysis, Fischer and Sawhorse and Newman projection (inter conversion), R-, S- and E-, Z- Nomenclature.	5L
7	Organic reactions and synthesis of a drug molecule Introduction to reactions involving <i>Addition Reaction:</i> Nucleophilic addition reaction [Acid catalysed reaction; Base catalysed reaction, Reactions of aldehyde or ketone with hydrocyanic acid, sodium bisulphite, water, Grignard reagent, alcohols], Electrophilic addition reaction [addition of Br ₂ to alkene; addition of hydrogen halide in symmetrical and unsymmetrical alkene (Markownikov rule); addition of Hypohalous acid, sulphuric acid and water to unsymmetrical alkene; addition of hydrogen halide in unsymmetrical alkene in presence of peroxide (Anti Markownikov rule) Ozonolysis reaction. <i>Substitution Reaction:</i> Electrophilic substitution reaction [Chlorination of Benzene; Nitration of Benzene; Friedel-Crafts Reaction (Alkylation, Acylation)], Nucleophilic substitution reaction [S _N 1 and S _N 2 reaction]. <i>Elimination Reaction:</i> E1 elimination and E2 elimination: Hofmann and Saytzev elimination. <i>Nucleophilic addition followed by elimination Reaction:</i> Reaction of carbonyl compound with ammonia, Primary amine. <i>Cyclization reaction:</i> Diels-Alder reaction. <i>Oxidation Reaction:</i> Oxidation of alcohol (Primary, secondary and tertiary alcohol); autoxidation of ether; Oxidation of aldehyde and ketone; Baeyer-Villiger oxidation; Oxidation of aromatic compounds (Oxidation of toluene and its derivatives, benzaldehyde, acetophenone, phenol). <i>Reduction Reaction:</i> Reduction of alkenes; Alkynes; carbonyl compounds (aldehydes and ketones); Carboxylic acid and esters; Bouveault-Blanc reduction; Clemensen reduction; Wolf-Kishner reduction; Meerwein-Pondorf-Verley reduction; Pinacol-Pinacolone rearrangement; Reduction of aromatic compounds (Benzaldehyde, Benzoic acid, Nitrobenzene, m-dinitrobenzene, Diazonium salt). <i>Name Reactions:</i> Aldol condensation and Mixed Aldol condensation; Claisen-schmidt reaction; Cannizaro reaction; Crossed Cannizaro reaction; Kolbe-Schmitt reaction; Gattermann-Koch aldehyde synthesis <i>Synthesis of a commonly used drug molecule:</i> Paracetamol, Aspirin	7L
Total		45L



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Course Outcomes:

After completion of the course, students will be able to:

1	Demonstrate microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2	Illustrate bulk properties and processes using thermodynamic considerations.
3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
4	Articulate periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5	List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2	University Chemistry, by B. H. Mahan
3	Fundamentals of environment and Ecology, by D. De & D. De, S. Chand Publishing.
4	Chemistry-I, by Gourkrishna Das Mohapatra, VIKAS Publishing House Pvt. Ltd.
5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6	Engineering Chemistry (NPTEL Web-book) by B.L.Tembe, Kamaluddin and M.S. Krishnan
7	Physical Chemistry, by P. W. Atkins
8	Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Pub.
9	Physical Chemistry, P. C. Rakshit, Sarat Book House
10	Organic Chemistry, Volume I, I. L. Finar, Pearson

Course Name:	Mathematics-II		
Course Code:	BS-M201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To learn how to solve different types of differential equation
2	To know the different types of improper integral
3	To know the Laplace transform
4	Basic concept of graph, digraph, walk, Hamiltonian graph, Euler circuit,
5	Basic concept of tree, binary tree

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Ordinary Differential Equations of First order: ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, In-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree - Equations solvable for p, solvable for x, solvable for y; Clairaut's equations,	8L
2	Higher Order Ordinary Differential Equations: (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI) (ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	8L
3	Improper Integrals: (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L
4	Laplace Transforms and Inverse Laplace Transforms: (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of a function multiplied by t^n and divided by t; LT of unit step and periodic functions; LT of derivatives (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii) Solutions of initial and boundary value problems by LT	8L
5	Graph Theory: (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	Tree: (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		40L



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Course Outcomes:

After completion of the course, students will be able to:

1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems
3	Use tree and graph algorithms for different problems
4	evaluation of different types of improper integrals

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	An introduction to differential equation, Maity & Ghosh, NCBA
5	Michael Greenberg, Advanced Engineering Mathematics, Pearson
6	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
7	An introduction to Integral Calculus, Maity and Ghosh, NCBA
8	Advanced Differential Equation, M.D Raisinghanian
9	An Introduction to Engineering Mathematics-II, G.P.Samanta, New Age Publication

Course Name:	Programming for Problem Solving		
Course Code:	ES-CS201	Category:	Engineering Science
Semester:	Second	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language).
2	To develop the ability to apply knowledge of programming for solution of science & engineering problems.



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Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudocode with examples. From algorithms to programs: Basic I/O operations, keywords, data types, variables & memory locations, source code, Syntax and Logical Errors in compilation, object and executable code. Operators and Expressions, operator precedence in C programming Language.	5
2	Conditional Branching and Looping : Concepts of Conditional Branching: if-else, nested if-else , switch-case Concepts of Loops: While, do-while, for loops, Use of break and continue statement.	8
3	Arrays : Concepts of 1-D, 2-D array, array manipulation, Concepts of character array, Strings and their uses. Basic Algorithms using array: Searching (linear and binary search) and Sorting Algorithms (Bubble, Insertion and Selection sort),	9
4	Functions: Functions (including using built in libraries), Parameter passing in functions, function call by value, Recursive functions. Pointers: Idea of pointers, Defining pointers, relation between array and pointer, idea of function call by address, Dynamic memory allocation.	8
5	Structure: Structures, Array of Structures, Self-referential structures. Storage Class and Preprocessor Directives. Disk I/O operations - File handling: open, read, write, close a file.	6
Total		36L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the concept of structured programming language .
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.

Learning Resources:	
1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Chemistry Laboratory		
Course Code:	BS-CH291	Category:	Basic Science Courses
Semester:	Second	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	The objective of this course is to acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field. The students will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence. The course will enable the student to: - Determine the strength of an unknown solution through conductometric and pH metric titration. - Estimate the chloride ion concentration, alkalinity and hardness in water. - Find out the rate constant of a reaction. - Synthesize polymer molecules.

Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.	3P/ Week
2	pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.	
3	To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).	
4	Determination of dissolved oxygen present in a given water sample.	
5	Determination of viscosity of the given liquid by Ostwald –Viscometer.	
6	Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).	
7	Chemical kinetics (determination of relative rates of reaction of iodide with H ₂ O ₂ at room temperature).	
8	Determination of acid value (Acidity) of oil.	



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9	The adsorption of acetic acid on active charcoal.	
10	Complexometric titration (estimation of hardness of water using EDTA).	
11	Redox titration (estimation of iron using permanganometry).	
12	To determine Alkalinity of a Given Water Sample.	
13	Synthesis of a polymer (Polyacrylamide) and determine its molecular weight by solution viscosity method.	
14	Determination of cell constant and conductance of solutions.	
Total		36P

Course Outcomes:

After completion of the course, students will be able to:

1	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: - Estimate rate constants of reactions from concentration of reactants/products as a function of time - Measure molecular/system properties such as viscosity, conductance of solutions, redox potentials, chloride content of water, etc. - Synthesize a macromolecule and determine its molecular weight by solution viscosity method.

Learning Resources:

1	Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house.
2	A Text book on Experiments and calculations in Engineering Chemistry, by S.S. Dara, S Chand publications.
3	Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited.

Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS291	Category:	Engineering Science
Semester:	Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.



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2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8
4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the concept of programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve basic data manipulation related problems.
4	Apply programming concepts to handle memory allocation and files.



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Course Name:	Workshop/ Manufacturing Practices		
Course Code:	ES-ME292	Category:	Engineering Sciences
Semester:	Second	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart basic knowledge of various hand tools and their applications in different sections of manufacturing
2	To develop basic manufacturing skills, precision, safety at work place, team working and development of right attitude.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
Lectures and videos:		
	1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods 2. CNC machining, Additive manufacturing 3. Fitting operations & power tools 4. Electrical & Electronics 5. Carpentry 7. Metal casting 8. Welding (arc welding & gas welding), brazing	13L
Workshop Practice:		
1	Machine shop: <i>Typical jobs that may be made in this practice module:</i> - To make a pin from a mild steel rod in a lathe. - To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.	8P
2	Fitting shop: <i>Typical jobs that may be made in this practice module:</i> To make a Gauge from MS plate.	8P
3	Carpentry: <i>Typical jobs that may be made in this practice module:</i> To make wooden joints and/or a pattern or like.	8P
4	Welding shop (Arc welding 4 hrs + gas welding 4 hrs): <i>Typical jobs that may be made in this practice module:</i> ARC WELDING (4 hours):	8P

	- To join two thick (approx 6mm) MS plates by manual metal arc welding. GAS WELDING (4 hours): - To join two thin mild steel plates or sheets by gas welding.	
5	Casting: Typical jobs that may be made in this practice module: One/ two green sand moulds to prepare, and a casting be demonstrated.	8P
6	Smithy: Typical jobs that may be made in this practice module: A simple job of making a square rod from a round bar or like.	4P
7	Electrical & Electronics: - Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable. - Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point. - Simple wiring exercise to be executed to understand the basic electrical circuit. - Simple soldering exercises to be executed to understand the basic process of soldering. - Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.	8P
Total		13L+52P

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify and utilize machine tools for producing components through machining processes
2	Demonstrate fundamental concept of pattern making, and moulding processes for engineering applications.
3	Practice fitting, carpentry, and smithy operations for manufacturing of components.
4	Explain concepts and applications of various types of fabrication processes.
5	Apply basic electrical and electronics engineering knowledge for household applications.



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Learning Resources:

1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
4	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998
5	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Name:	Language Laboratory		
Course Code:	HM-HU291	Category:	HM
Semester:	Second	Credit:	1
L-T-P:	0-0-2	Pre-Requisites:	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills. (listening, speaking, reading and writing)

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Honing 'Listening Skill' and its sub skills through Language Lab Audio device	4P
2	Honing 'Speaking Skill' and its sub skills: Extempore, Public speaking, etc. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/ Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.	6P
3	Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Debate, Role Play etc.)	4P



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4	Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.	6P
5	Honing 'Reading Skills' and its sub skills.	2P
6.	Honing 'Writing Skill' and its sub skills by using Language Lab Audio – Visual input; Practice Sessions	2P
Total		24P

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop their intellectual, personal and professional abilities.

Learning Resources:

1.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
6.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage , 2019.



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Curriculum for Undergraduate Degree (B.Tech.) in Electrical Engineering (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Range of Credits:

As per AICTE, a student covering 160 credits during 4 years of studies as per curriculum of the Institute will be eligible to get Under Graduate B.Tech. degree. A student will be eligible to get B.Tech. degree with Honours, if he/ she completes an additional 20 credits. These could be acquired through MOOCs prescribed by the Institute. Every student admitted to the 4 years B.Tech programme is required to earn a minimum of 100 Activity Points under Mandatory Additional Requirement (MAR), in addition to the required academic grades, for getting B.Tech./ B.Tech. (Honours) degree. Also some non-credit mandatory courses are there included in the curriculum. Like theory courses, students are required to appear in the semester examination for all mandatory courses and must get a minimum of pass marks in those courses to be eligible to get the final degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Humanities and Social Sciences including Management Courses	11	12
2	Basic Science Courses	27	25
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.	19.5	24
4	Professional Core Courses	53.5	48
5	Professional Elective Courses relevant to chosen specialization/ branch	15	18
6	Open Elective Courses from other technical and / or emerging subjects	18	18
7	Project Work, Seminar and Internship in Industry or elsewhere	16	15
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	Non-Credit	Non-Credit
Total		160	160



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D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	BS	Basic Science Courses
5	ES	Engineering Science Courses
6	HM	Humanities and Social Sciences including Management Courses
7	PC	Professional Core Courses
8	PE	Professional Elective Courses
9	OE	Open Elective Courses
10	MC	Mandatory Courses
11	PW	Project/ Internships/ Sessional

E. Courses in Different Categories:

Humanities and Social Sciences including Management Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	II	HM-HU201	English	2	0	0	2
2	IV	HM-HU402	Values and Ethics in profession	2	0	0	2
3	V	HM-HU502	Economics for Engineers	3	0	0	3
4	VII	HM-HU703	Principle of Management	2	0	0	2
Total Theory				9	0	0	9
Practical/ Sessional							
1	I	HM-HU191	Language Laboratory	0	0	2	1
2	VI	HM-HU691	Soft Skill Development I	0	0	2	1
Total Practical/ Sessional				0	0	4	2
Total				9	0	4	11



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Basic Science Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	BS-CH101	Chemistry	3	1	0	4
2	I	BS-M101	Mathematics-I	3	1	0	4
3	II	BS-PH201	Physics	3	1	0	4
4	II	BS-M201	Mathematics-II	3	1	0	4
5	III	BS-M302	Mathematics-III	3	0	0	3
6	III	BS-M304	Numerical Methods	2	0	0	2
7	III	BS-BIO301	Biology	2	0	0	2
Total Theory				19	4	0	23
Practical/ Sessional							
1	I	BS-CH191	Chemistry Laboratory	0	0	3	1.5
2	II	BS-PH291	Physics Laboratory	0	0	3	1.5
3	III	BS-M394	Numerical Methods Laboratory	0	0	2	1
Total Practical/ Sessional				1	0	6	4
Total				20	4	6	27

Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	ES-CS101	Programming for Problem Solving	3	0	0	3
2	II	ES-EE201	Basic Electrical & Electronics Engineering	4	0	0	4
3	IV	ES-ME401	Engineering Mechanics	3	0	0	3
Total Theory				10	0	0	10
Practical/ Sessional							
1	I	ES-CS191	Programming for Problem Solving Lab	0	0	4	2
2	I	ES-ME192	Workshop/ Manufacturing Practices	1	0	4	3
3	II	ES-EE291	Basic Electrical & Electronics Engineering Lab	0	0	3	1.5
4	II	ES-ME291	Engineering Graphics & Design	1	0	4	3
Total Practical/ Sessional				3	0	18	9.5
Total				12	0	15	19.5

Professional Core Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	PC-EE301	Electric Circuit Theory	3	1	0	4
2	III	PC-EE302	Analog Electronics	3	0	0	3
3	III	PC-EE303	Electromagnetic field theory	3	0	0	3
4	IV	PC-EE401	Electric machine-I	3	1	0	4
5	IV	PC-EE402	Digital Electronics	3	0	0	3
6	IV	PC-EE403	Electrical and Electronics Measurement	3	0	0	3
7	V	PC-EE501	Electric machine-II	3	1	0	4
8	V	PC-EE502	Power System-I	3	1	0	4
9	V	PC-EE503	Control system	3	0	0	3
10	VI	PC-EE601	Power Electronics	3	1	0	4
11	VI	PC-EE602	Power System-II	3	1	0	4
12	VII	PC-EE701	Electric Drives	3	0	0	3
Total Theory				36	6	0	42
Practical/ Sessional							
1	III	PC-EE391	Electric Circuit Theory Laboratory	0	0	2	1
2	III	PC-EE392	Analog Electronics Laboratory	0	0	2	1
3	IV	PC-EE491	Electric Machine-I Laboratory	0	0	2	1
4	IV	PC-EE492	Digital Electronics Laboratory	0	0	2	1
5	IV	PC-EE493	Electrical and Electronics Measurement Laboratory	0	0	3	1.5
6	V	PC-EE591	Electric Machine-II Laboratory	0	0	2	1
7	V	PC-EE592	Power System-I Laboratory	0	0	2	1
8	V	PC-EE593	Control system Laboratory	0	0	2	1
9	VI	PC-EE601	Power Electronics Laboratory	0	0	2	1
10	VI	PC-EE692	Power System-II Laboratory	0	0	2	1
11	VII	PC-EE791	Electric Drives Lab	0	0	2	1
Total Practical/ Sessional				0	0	23	11.5
Total				39	6	23	53.5



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Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	VI	PE-EE601	Professional Elective-I	3	0	0	3
2	VII	PE-EE701	Professional Elective-II	3	0	0	3
3	VII	PE-EE702	Professional Elective-III	3	0	0	3
4	VIII	PE-EE801	Professional Elective-IV	3	0	0	3
5	VIII	PE-EE802	Professional Elective-V	3	0	0	3
Total				15	0	0	15

Open Elective Courses from other technical and / or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	OE-EE501	Open Elective-I	3	0	0	3
2	VI	OE-EE601	Open Elective-II	3	0	0	3
3	VI	OE-EE602	Open Elective-III	3	0	0	3
4	VII	OE-EE701	Open Elective-IV	3	0	0	3
5	VIII	OE-EE801	Open Elective-V	3	0	0	3
Total Theory				15	0	0	15
Practical/ Sessional							
1	V	OE-EE591	Open Elective-I	0	0	2	1
2	VI	OE-EE691	Open Elective-II	0	0	2	1
3	VII	OE-EE791	Open Elective-IV	0	0	2	1
Total Practical/ Sessional				0	0	6	3
Total				15	0	6	18

Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Practical/ Sessional							
1	V	PW-EE581	Technical Seminar	0	0	0	1
2	VII	PW-EE781	Electrical & Electronic Design Laboratory-I	1	0	2	2
3	VII	PW-EE782	Project Stage-I	0	0	4	2
4	VII	PW-EE783	Industrial Training Evaluation	0	0	0	1



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5	VIII	PW-EE881	Electrical & Electronic design Laboratory-II	0	0	2	1
6	VIII	PW-EE882	Project Stage-II	0	0	16	8
7	VIII	PW-EE883	Comprehensive Viva Voce	0	0	0	1
Total				1	0	24	16

Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	MC372	Indian Constitution	2	0	0	0
2	IV	MC471	Environmental Science	2	0	0	0
3	V	MC571	Aptitude Skill Development-I	2	0	0	0
4	VI	MC671	Aptitude Skill Development-II	2	0	0	0
Total				8	0	0	0



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Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)							
Mandatory Induction Program- 3 Weeks Duration							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-CH101	Chemistry	3	1	0	4
2	BS	BS-M101	Mathematics-I	3	1	0	4
3	ES	ES-CS101	Programming for Problem Solving	3	0	0	3
Total Theory				9	2	0	11
Practical/ Sessional/ Mandatory Course							
1	BS	BS-CH191	Chemistry Laboratory	0	0	3	1.5
2	ES	ES-CS191	Programming for Problem Solving Lab	0	0	4	2
3	ES	ES-ME192	Workshop/ Manufacturing Practices	1	0	4	3
4	HM	HM-HU191	Language Laboratory	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				1	0	13	7.5
Total of First Semester				10	2	13	18.5

Second Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-PH201	Physics	3	1	0	4
2	BS	BS-M201	Mathematics-II	3	1	0	4
3	ES	ES-EE201	Basic Electrical & Electronics Engineering	4	0	0	4
4	HM	HM-HU201	English	2	0	0	2
Total Theory				12	2	0	14
Practical/ Sessional/ Mandatory Course							
1	BS	BS-PH291	Physics Laboratory	0	0	3	1.5
2	ES	ES-EE291	Basic Electrical & Electronics Engineering Lab	0	0	3	1.5



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3	ES	ES-ME291	Engineering Graphics & Design	1	0	4	3
<i>Total Practical/ Sessional/ Mandatory Course</i>				1	0	10	6
Total of Second Semester				14	2	10	20

Third Semester (Second Year)

Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EE301	Electric Circuit Theory	3	1	0	4
2	PC	PC-EE302	Analog Electronics	3	0	0	3
3	PC	PC-EE303	Electromagnetic field theory	3	0	0	3
4	BS	BS-M302	Mathematics-III	3	0	0	3
5	BS	BS-M304	Numerical Methods	2	0	0	2
6	BS	BS-BIO301	Biology	2	0	0	2
7	MC	MC372	Indian Constitution	2	0	0	0
Total Theory				18	1	0	17
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EE391	Electric Circuit Theory Laboratory	0	0	2	1
2	PC	PC-EE392	Analog Electronics Laboratory	0	0	2	1
3	ES	BS-M394	Numerical Methods Laboratory	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				0	0	6	3
Total of Third Semester				18	1	6	20

Fourth Semester (Second Year)

Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EE401	Electric Machine-I	3	1	0	4
2	PC	PC-EE402	Digital Electronics	3	0	0	3
3	PC	PC-EE403	Electrical and Electronics Measurement	3	0	0	3
4	ES	ES-ME301	Engineering Mechanics	3	0	0	3
5	HM	HM-HU402	Values and Ethics in Profession	2	0	0	2
6	MC	MC471	Environmental Science	2	0	0	0
Total Theory				16	1	0	15
Practical/ Sessional/ Mandatory Course							



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1	PC	PC-EE491	Electric Machine-I Laboratory	0	0	2	1
2	PC	PC-EE492	Digital Electronics Laboratory	0	0	2	1
3	PC	PC-EE493	Electrical and Electronics Measurement Laboratory	0	0	3	1.5
<i>Total Practical/ Sessional/ Mandatory Course</i>				0	0	7	3.5
Total of Fourth Semester				16	1	7	18.5

Fifth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EE501	Electric Machine-II	3	1	0	4
2	PC	PC-EE502	Power System-I	3	1	0	4
3	PC	PC-EE503	Control System	3	0	0	3
4	OE	OE-EE501	Open Elective-I	3	0	0	3
5	HM	HM-HU502	Economics for Engineers	3	0	0	3
6	MC	MC571	Aptitude Skill Development-I	2	0	0	0
Total Theory				17	2	0	17
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EE591	Electric Machine-II Laboratory	0	0	2	1
2	PC	PC-EE592	Power System-I Laboratory	0	0	2	1
3	PC	PC-EE593	Control System Laboratory	0	0	2	1
4	OE	OE-EE591	Open Elective I Laboratory	0	0	2	1
5	PW	PW-EE581	Technical Seminar	0	0	0	1
Total Practical/ Sessional/ Mandatory Course				0	0	8	5
Total of Fifth Semester				17	2	8	22

List of Elective Courses	
OE-EE501	Open Elective-I
OE-EE501A	Microprocessor & Microcontroller
OE-EE501B	Digital Signal Processing (DSP)
OE-EE591	Open Elective-I Laboratory
OE-EE591A	Microprocessor & Microcontroller Laboratory
OE-EE591B	Digital Signal Processing (DSP) Laboratory



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Sixth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EE601	Power Electronics	3	1	0	4
2	PC	PC-EE602	Power System-II	3	1	0	4
3	PE	PE-EE601	Professional Elective-I	3	0	0	3
4	OE	OE-EE601	Open Elective-II	3	0	0	3
5	OE	OE-EE602	Open Elective-III	3	0	0	3
6	MC	MC671	Aptitude Skill Development-II	2	0	0	0
Total Theory				17	2	0	17
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EE691	Power Electronics Laboratory	0	0	2	1
2	PC	PC-EE692	Power System-II Laboratory	0	0	2	1
3	OE	OE-EE691	Open Elective-II Laboratory	0	0	2	1
4	HM	HM-HU691	Soft Skill Development II	0	0	2	1
Total Practical/ Sessional/ Mandatory Course				0	0	8	4
Total of Sixth Semester				17	2	8	21

List of Elective Courses	
PE-EE601	Professional Elective-I
PE-EE601A	Advanced Control system
PE-EE601B	Computational Electromagnetics
PE-EE601C	Renewable & Non-conventional Energy
OE-EE601	Open Elective-II
OE-EE601A	Data Structure & Algorithm
OE-EE601B	Computer Organization
OE-EE602	Open Elective-III
OE-EE602A	Electronic Devices
OE-EE602B	Analog & Digital Communication
OE-EE602C	VLSI System
OE-EE691	Open Elective-II Laboratory
OE-EE691A	Data Structure & Algorithm Laboratory
OE-EE691B	Computer Organization Laboratory



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Seventh Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-EE701	Electric Drives	3	0	0	3
2	PE	PE-EE701	Professional Elective-II	3	0	0	3
3	PE	PE-EE702	Professional Elective-III	3	0	0	3
4	OE	OE-EE701	Open Elective-IV	3	0	0	3
5	HM	HM-HU703	Principle of Management	2	0	0	2
Total Theory				14	0	0	14
Practical/ Sessional/ Mandatory Course							
1	PC	PC-EE791	Electric Drives Lab	0	0	2	1
2	OE	OE-EE791	Open Elective-IV Laboratory	0	0	2	1
3	PW	PW-EE781	Electrical & Electronic design Laboratory-I	1	0	2	2
4	PW	PW-EE782	Project Stage-I	0	0	4	2
5	PW	PW-EE783	Industrial Training Evaluation	0	0	0	1
Total Practical/ Sessional/ Mandatory Course				1	0	10	7
Total of Seventh Semester				15	0	10	21

List of Elective Courses	
PE-EE701	Professional Elective-II
PE-EE701A	Advanced Power system
PE-EE701B	Advanced Electric Machine
PE-EE701C	Sensors & Transducers
PE-EE702	Professional Elective-III
PE-EE702A	Biomedical Instrumentation
PE-EE702B	Power Generation and Economics
PE-EE702C	Illumination Engineering
OE-EE701	Open Elective-IV
OE-EE701A	Software Engineering
OE-EE701B	Data Base Management System
OE-EE701C	Object Oriented Programming
OE-EE791	Open Elective-IV Laboratory
OE-EE791A	Software Engineering Laboratory
OE-EE791B	Data Base Management System Laboratory
OE-EE791C	Object Oriented Programming Laboratory



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Eighth Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-EE801	Professional Elective-IV	3	0	0	3
2	PE	PE-EE802	Professional Elective-V	3	0	0	3
3	OE	OE-EE801	Open Elective-V	3	0	0	3
Total Theory				9	0	0	9
Practical/ Sessional/ Mandatory Course							
1	PW	PW-EE881	Electrical & Electronic design Laboratory-II	0	0	2	1
2	PW	PW-EE882	Project stage-II	0	0	16	8
3	PW	PW-EE883	Comprehensive Viva Voce	0	0	0	1
Total Practical/ Sessional/ Mandatory Course				0	0	16	10
Total of Eighth Semester				9	0	16	19

List of Elective Courses	
PE-EE801	Professional Elective-IV
PE-EE801A	Power Quality & Deregulation
PE-EE801B	Power Plant Engineering
PE-EE801C	High Voltage Engineering
PE-EE802	Professional Elective-V
PE-EE802A	Utilization of Electric Power
PE-EE802B	Process Control
PE-EE802C	Electrical Energy Conservation and Auditing
OE-EE801	Open Elective-V
OE-EE801A	Internet of Thing
OE-EE801B	Big Data Analysis
OE-EE801C	Computer Network
OE-EE801D	AI & Soft Computing
OE-EE801E	Optimization Technique



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Curriculum for Undergraduate Degree (B.Tech.) in Electrical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Induction Program (Mandatory)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Duration

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Please refer **Appendix-A** for AICTE guidelines on Mandatory Induction Program.

First Semester

Course Name:	Chemistry		
Course Code:	BS-CH101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	The objective of the Chemistry course is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Atomic and molecular structure <i>Atomic Structure:</i> Dalton's atomic theory; Fundamental of sub atomic particles; Rutherford's atomic model; Bohr's atomic model; Dual nature of electron; Heisenberg's uncertainty principle; Schrodinger wave equation; Orbitals and Quantum numbers; Particle in a box solutions (One dimension) and their applications for simple sample. <i>Molecular Structure:</i> Molecular orbital theory: Postulates of MOT; Bonding and anti bonding orbital's; MO diagram of diatomic molecules (H_2, He_2, Li_2, Be_2); Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties (Octahedral and tetrahedral complexes); Band structure of solids and the role of doping on band structures (Band theory, Valence band and conduction band, Conductor, Semiconductor, Insulator, p-Type and n-Type semiconductor).	10L
2	Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals' interactions; Ideal gas equation, compressibility factor, Real gas equation, Boyles Temperature, Critical state (Critical pressure, critical volume and critical temperature).	4L
3	Periodic properties Mendeleev's periodic table; Periodic properties (Atomic radii, Ionic radii, Ionization potential, electron affinity, Electronegativity, metallic and non metallic character, oxidizing and reducing character); Polarizability (Fajans' rule); Hard soft acids and bases; molecular geometries (VSEPR theory, Hybridization, sigma and pi bond, determination of hybridization state and structure of molecules); Hydrogen bond (Inter and intra molecular H bond); Effective nuclear charge; oxidation states.	4L
4	Use of free energy in chemical equilibria <i>Thermodynamics:</i> First law of thermodynamics, Internal energy & Enthalpy, Heat capacity, Adiabatic & Isothermal process, Reversible & Irreversible process, Second law of thermodynamics, Entropy, Free energy, Gibbs-Helmholtz equation. <i>Electrochemistry:</i> Electrochemical cell (Electrolytic cell & Galvanic cell), Representation of cell, Free energy and EMF, Reversible and Irreversible cell, Nernst equation and application, Application of EMF measurement on ΔG, ΔH, ΔS, equilibrium constant of a reversible chemical reaction and valency of an ion. Hydrogen Half cell, calomel half cell, Quinhydrone half cell. <i>Water Chemistry:</i> Hydrosphere; Hydrological cycle; Sources of water; Acidity and alkalinity of water; Pollutants of water; Biochemical and	10L

	Chemical oxygen demand; Removal of dissolved solids from water (Electrodialysis & Reverse osmosis); Hardness of water (Types of hardness, Removal of hardness of water). <i>Corrosion:</i> Oxidation corrosion, Corrosion by gases, Pilling Bedworth rule, Electrochemical corrosion, Hydrogen evolution type & oxygen absorption type of corrosion, Corrosion of bimetals, Waterline corrosion, Crevice corrosion, Pitting corrosion, Stress corrosion, Factors influencing the corrosion, Prevention of corrosion.	
5	Spectroscopic techniques and applications Electromagnetic spectrum; Principles of spectroscopy and selection rules; UV/Vis Spectroscopy (Energy diagram of electron excitation, Lambert-Beer's law, Bathochromic and Hypsochromic shift, Hyperchromic and hypochromic effect, Instrumental technique, Solvent effect, application); IR spectroscopy [Basic principle, Stretching and bending vibration of AX₂ type molecule(non linear), Calculation of stretching frequency, Identification of organic compounds by IR spectroscopy, Instrumental technique and application]; NMR spectroscopy (Principle of NMR spectra, chemical shift, shielding and deshielding nucleus, application of NMR).	5L
6	Stereochemistry Isomerism, Structural isomerism, Metamerism, Tautomerism, Stereoisomerism, Optical activity, Configurations and symmetry and Chirality, Enantiomers and Diastereomers, Conformational analysis, Fischer and Sawhorse and Newman projection (inter conversion), R-, S- and E-, Z- Nomenclature.	5L
7	Organic reactions and synthesis of a drug molecule Introduction to reactions involving <i>Addition Reaction:</i> Nucleophilic addition reaction [Acid catalysed reaction; Base catalysed reaction, Reactions of aldehyde or ketone with hydrocyanic acid, sodium bisulphite, water, Grignard reagent, alcohols], Electrophilic addition reaction [addition of Br₂ to alkene; addition of hydrogen halide in symmetrical and unsymmetrical alkene (Markownikov rule); addition of Hypohalous acid, sulphuric acid and water to unsymmetrical alkene; addition of hydrogen halide in unsymmetrical alkene in presence of peroxide (Anti Markownikov rule) Ozonolysis reaction. <i>Substitution Reaction:</i> Electrophilic substitution reaction [Chlorination of Benzene; Nitration of Benzene; Friedel-Crafts Reaction (Alkylation, Acylation)], Nucleophilic substitution reaction [S_N1 and S_N2 reaction]. <i>Elimination Reaction:</i> E1 elimination and E2 elimination: Hofmann and Saytzev elimination.	7L



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	<i>Nucleophilic addition followed by elimination Reaction:</i> Reaction of carbonyl compound with ammonia, Primary amine. <i>Cyclization reaction:</i> Diels-Alder reaction. <i>Oxidation Reaction:</i> Oxidation of alcohol (Primary, secondary and tertiary alcohol); autoxidation of ether; Oxidation of aldehyde and ketone; Baeyer-Villiger oxidation; Oxidation of aromatic compounds (Oxidation of toluene and its derivatives, benzaldehyde, acetophenone, phenol). <i>Reduction Reaction:</i> Reduction of alkenes; Alkynes; carbonyl compounds (aldehydes and ketones); Carboxylic acid and esters; Bouveault-Blanc reduction; Clemensen reduction; Wolf-Kishner reduction; Meerwein-Pondorf-Verley reduction; Pinacol-Pinacolone rearrangement; Reduction of aromatic compounds (Benzaldehyde, Benzoic acid, Nitrobenzene, m-dinitrobenzene, Diazonium salt). <i>Name Reactions:</i> Aldol condensation and Mixed Aldol condensation; Claisen-schmidt reaction; Cannizzaro reaction; Crossed Cannizzaro reaction; Kolbe-Schmitt reaction; Gattermann-Koch aldehyde synthesis <i>Synthesis of a commonly used drug molecule:</i> Paracetamol, Aspirin	
Total		45L

Course Outcomes:

After completion of the course, students will be able to:

1	Demonstrate microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2	Illustrate bulk properties and processes using thermodynamic considerations.
3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
4	Articulate periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5	List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2	University Chemistry, by B. H. Mahan
3	Fundamentals of environment and Ecology, by D. De & D. De, S. Chand Publishing.
4	Chemistry-I, by Gourkrishna Das Mohapatra, VIKAS Publishing House Pvt. Ltd.
5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6	Engineering Chemistry (NPTEL Web-book) by B.L.Tembe, Kamaluddin and M.S. Krishnan
7	Physical Chemistry, by P. W. Atkins
8	Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Pub.
9	Physical Chemistry, P. C. Rakshit, Sarat Book House



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10	Organic Chemistry, Volume I, I. L. Finar, Pearson

Course Outcomes:

After completion of the course, students will be able to:

1	The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.
2	Quantum theory is more than 100 years old and to understand phenomena at nanometer levels; one has to base the description of all chemical processes at molecular levels. The course will enable the student to: - Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. - Rationalise bulk properties and processes using thermodynamic considerations. - Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques. - Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity. - List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
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Course Name:	Mathematics-I		
Course Code:	BS-M101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know Convergence of sequence and series
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function
3	To know the uses of matrix in different areas in engineering
4	To know the use of mean value theorems in engineering fields
5	Use of vector functions in different fields of Engineering

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Determinants and Matrices: (i) Introduction to determinant, properties (proofs of identities are excluded). (ii) Types of matrices, rank of a matrix, inverse of a matrix, Linear systems of equations, Cramer's rule, eigen-values and eigen-vectors, Caley-Hamilton theorem.	6L
2	Differential Calculus (Function of single variable): (i) Indeterminate forms and L'Hospital's rule; Successive differentiation, Leibnitz's theorem. (ii) Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin theorems with remainders; Maxima and minima. (iii) Evolutes and Involutives.	6L
3	Differential Calculus (Function of multi-variables): (i) Concept of limit, continuity and partial differentiation, chain rule, total differential, Jacobian, Euler's theorem on homogeneous function. (ii) Hessian, Maxima and minima; Lagrange's multipliers.	8L
4	Integral Calculus: (i) Line integrals; double integrals, change of order; triple integrals. (ii) Evaluation of surface areas and volumes of revolutions.	6L



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5	Vector Calculus: (i) Vector differential operator, scalar and vector point function, gradient, directional derivative, divergence and curl. (ii) Divergence theorem, Green's and Stoke's theorem (Statements only) and applications.	8L
6	Sequence and Series: (i) Sequence, type of a sequence. (ii) Series of positive terms; Geometric and p-series and their convergence criterion; Convergence test of series: Comparison test, D'Alembert's ratio test, Cauchy's root test. (iii) Alternating series; Absolute convergence, Leibnitz's theorem.	6L
Total		40

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply knowledge of differential and integral calculus to determine curvature and evaluation of different types of improper integrals
2	Utilize mean value theorems for solution of engineering problems.
3	Learn matrices, concept of rank, methods of matrix inversion and their applications.
4	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
5	Determine eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces to solve physical and engineering problems
6	Solve multiple integrals and utilize it to different physical problems

Course Name:		Programming for Problem Solving	
Course Code:	ES-CS101	Category:	Engineering Science
Semester:	First	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To facilitate students with the basic concept of a programming language (C programming language).
2	To develop the ability to apply knowledge of programming for solution of science & engineering problems.



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs: Basic I/O operations, keywords, data types, variables & memory locations, source code, Syntax and Logical Errors in compilation, object and executable code. Operators and Expressions, operator precedence in C programming Language.	5
2	Conditional Branching and Looping : Concepts of Conditional Branching: if-else, nested if-else , switch-case Concepts of Loops: While, do-while, for loops, Use of break and continue statement.	8
3	Arrays : Concepts of 1-D, 2-D array, array manipulation, Concepts of character array, Strings and their uses. Basic Algorithms using array: Searching (linear and binary search) and Sorting Algorithms (Bubble, Insertion and Selection sort),	9
4	Functions: Functions (including using built in libraries), Parameter passing in functions, function call by value, Recursive functions. Pointers: Idea of pointers, Defining pointers, relation between array and pointer, idea of function call by address, Dynamic memory allocation.	8
5	Structure: Structures, Array of Structures, Self-referential structures. Storage Class and Preprocessor Directives. Disk I/O operations - File handling: open, read, write, close a file.	6
Total		36L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of structured programming language .
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.



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Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Chemistry Laboratory		
Course Code:	BS-CH191	Category:	Basic Science Courses
Semester:	First	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	The objective of this course is to acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field. The students will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence. The course will enable the student to: • Determine the strength of an unknown solution through conductometric and pH metric titration. • Estimate the chloride ion concentration, alkalinity and hardness in water. • Find out the rate constant of a reaction. • Synthesize polymer molecules.

Course Contents: (Choose 10 experiments from the following)

Module No.	Description of Topic	Contact Hrs.
1	Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.	3P/Week
2	pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.	

3	To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).	
4	Determination of dissolved oxygen present in a given water sample.	
5	Determination of viscosity of the given liquid by Ostwald –Viscometer.	
6	Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).	
7	Chemical kinetics (determination of relative rates of reaction of iodide with H ₂ O ₂ at room temperature).	
8	Determination of acid value (Acidity) of oil.	
9	The adsorption of acetic acid on active charcoal.	
10	Complexometric titration (estimation of hardness of water using EDTA).	
11	Redox titration (estimation of iron using permanganometry).	
12	To determine Alkalinity of a Given Water Sample.	
13	Synthesis of a polymer (Polyacrylamide) and determine its molecular weight by solution viscosity method.	
14	Determination of cell constant and conductance of solutions.	
Total		36P

Course Outcomes:

After completion of the course, students will be able to:

1	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: • Estimate rate constants of reactions from concentration of reactants/products as a function of time • Measure molecular/system properties such as viscosity, conductance of solutions, redox potentials, chloride content of water, etc. • Synthesize a macromolecule and determine its molecular weight by solution viscosity method.

Learning Resources:

1	Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house.
2	A Text book on Experiments and calculations in Engineering Chemistry, by S.S. Dara, S Chand publications.
3	Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited.



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Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS191	Category:	Engineering Science
Semester:	First	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8
4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P



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Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve basic data manipulation related problems.
4	Apply programming concepts to handle memory allocation and files.

Course Name:	Workshop/ Manufacturing Practices		
Course Code:	ES-ME192	Category:	Engineering Sciences
Semester:	First	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To impart basic knowledge of various hand tools and their applications in different sections of manufacturing
2	To develop basic manufacturing skills, precision, safety at work place, team working and development of right attitude.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
Lectures and videos:		
	1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods 2. CNC machining, Additive manufacturing 3. Fitting operations & power tools 4. Electrical & Electronics 5. Carpentry 7. Metal casting 8. Welding (arc welding & gas welding), brazing	13L
Workshop Practice:		
1	Machine shop: <i>Typical jobs that may be made in this practice module:</i> - To make a pin from a mild steel rod in a lathe. - To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.	8P

2	Fitting shop: Typical jobs that may be made in this practice module: To make a Gauge from MS plate.	8P
3	Carpentry: Typical jobs that may be made in this practice module: To make wooden joints and/or a pattern or like.	8P
4	Welding shop (Arc welding 4 hrs + gas welding 4 hrs): Typical jobs that may be made in this practice module: ARC WELDING (4 hours): - To join two thick (approx 6mm) MS plates by manual metal arc welding. GAS WELDING (4 hours): - To join two thin mild steel plates or sheets by gas welding.	8P
5	Casting: Typical jobs that may be made in this practice module: One/ two green sand moulds to prepare, and a casting be demonstrated.	8P
6	Smithy: Typical jobs that may be made in this practice module: A simple job of making a square rod from a round bar or like.	4P
7	Electrical & Electronics: - Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable. - Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point. - Simple wiring exercise to be executed to understand the basic electrical circuit. - Simple soldering exercises to be executed to understand the basic process of soldering. - Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.	8P
Total		13L+52P



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Course Outcomes:

After completion of the course, students will be able to:

1	Identify and utilize machine tools for producing components through machining processes
2	Demonstrate fundamental concept of pattern making, and moulding processes for engineering applications.
3	Practice fitting, carpentry, and smithy operations for manufacturing of components.
4	Explain concepts and applications of various types of fabrication processes.
5	Apply basic electrical and electronics engineering knowledge for household applications.

Learning Resources:

1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpajian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
4	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998
5	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Name:	Language Laboratory		
Course Code:	HM-HU191	Category:	HM
Semester:	First	Credit:	1
L-T-P:	0-0-2	Pre-Requisites:	Students must have basic knowledge of English Language
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills. (listening, speaking, reading and writing)



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Honing 'Listening Skill' and its sub skills through Language Lab Audio device	4P
2	Honing 'Speaking Skill' and its sub skills: Extempore, Public speaking, etc. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/ Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.	6P
3	Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Debate, Role Play etc.)	4P
4	Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.	6P
5	Honing 'Reading Skills' and its sub skills.	2P
6.	Honing 'Writing Skill' and its sub skills by using Language Lab Audio – Visual input; Practice Sessions	2P
Total		24P

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop their intellectual, personal and professional abilities.

Learning Resources:

1.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
6.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019.

Second Semester

Course Name:	Physics		
Course Code:	BS-PH201	Category:	Basic Science Course
Semester:	First/ Second	Credit:	4.0
L-T-P:	3-1-0	Pre-Requisites:	Mathematics course with vector calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	Understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	Describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Module-1: Foundations of Quantum Mechanics	(8L)
	Introduction to Quantum Physics: Brief idea about the historical development of quantum mechanics.	1
	Black Body Radiation: Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws.	2
	Compton Effect: Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	2
	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation.	2
2	Uncertainty Principle: Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero point energy, Numerical problems.	1
	Module-2: Schrödinger Wave Equation and Its Applications	(8L)
2	Formulation of Quantum Mechanics: Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of	3

	associated problems. Schrödinger Wave Equation: Time independent Schrödinger's equation from time dependent one by the separation of variable method. Applications of Quantum Mechanics: Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator	1 4
3	Module-3: Dielectric Materials and their Applications Concept of Dielectric and Polarization: Electric field inside a Dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, Atomic polarizability and polarization vector. Inter Relationship among Dielectric Parameters: Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems on relation between polarizability, susceptibility and dielectric constant. Types of Polarization: Electronic polarization and derivation of electronic polarizability, Concept of ionic and orientational polarization (no derivation). Applications of Dielectric: Dielectric breakdown and dielectric strength, Concept of Dielectric loss, Few applications of dielectrics in different fields.	(5L) 1 2 1 1
4	Module-4: Time Varying Fields Electromagnetic Induction: Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in Motors and Generators, Calculation of Induced EMF. Displacement Current: Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	(3L) 2 1
5	Module-5: Electromagnetic Waves Maxwell's Electromagnetic Field Equations: Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators etc.). Plane Electromagnetic Wave in Free Space: Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. Plane Electromagnetic Wave in Medium: Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. Energy in an Electromagnetic Field: Flow of energy associated to electromagnetic field and Poynting vector.	(6L) 2 1 2 1

6	Module-6: Laser and Fiber Optics	(9L)
	Introduction to Laser: Properties of light sources, Need of suitable light source in communication, Invention of laser, Characteristics and applications of laser.	1
	Interaction of Light with Matter: Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them.	1
	Components and Working of Laser Systems: Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO ₂ laser).	2
	Optical Communication: Introduction, Need for optical communication, Salient features of optical fibers, Amplitude and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth analog/digital communication system	2
	Light Guidance in Fibers: Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single and multimode fibers, Step-index and graded-index fibers.	1
	Transmission characteristics of optical fibers: Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion, bit rate - length product, Minimization of intermodal dispersion.	2
Total		39L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various medium of propagations.
4	Understand the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy etc.
6	Explain the workings of various LASERS and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the dispersion leading to calculation of Bit Rate of a communication channel..

Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Arthur Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
9	'Understanding Lasers' by Jeff Hecht
10	'An Introduction to Fiber Optics' by Ajoy Ghatak and K. Thyagrajan

Course Name:	Mathematics-II		
Course Code:	BS-M201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To learn how to solve different types of differential equation
2	To know the different types of improper integral
3	To know the Laplace transform
4	Basic concept of graph, digraph, walk, Hamiltonian graph, Euler circuit,
5	Basic concept of tree, binary tree

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Ordinary Differential Equations of First order: ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, In-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree Equations solvable for p, solvable for x, solvable for y; Clairaut's equations,	8L
2	Higher Order Ordinary Differential Equations: (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI)	8L

	(ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	
3	Improper Integrals: (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L
4	Laplace Transforms and Inverse Laplace Transforms: (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of a function multiplied by t^n and divided by t ; LT of unit step and periodic functions; LT of derivatives (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii) Solutions of initial and boundary value problems by LT	8L
5	Graph Theory: (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	Tree: (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		40L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems
3	Use tree and graph algorithms for different problems
4	evaluation of different types of improper integrals

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	An introduction to differential equation, Maity & Ghosh, NCBA
5	Michael Greenberg, Advanced Engineering Mathematics, Pearson



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6	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
7	An introduction to Integral calculus, Maity and Ghosh, NCBA
8	Advanced Differential Equation, M.D Raisinghania
9	An introduction to Engineering mathematics-II, G.P.Samanta, New Age publication

Course Name:	Basic Electrical and Electronics Engineering		
Course Code:	ES-EE201	Category:	ES
Semester:	Second	Credit:	4
L-T-P:	4-0-0	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:	
1	To provide comprehensive idea about AC and DC circuit analysis
2	To make the students understand about working principals and applications of electric machines
3	To make the students understand the components of low voltage electrical installations
4	To provide basic idea about general structure of electrical power system.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
Module 1	DC Circuits Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5
Module 2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel),	4
Module 3	Three phase system Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2



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Module 4	DC Machines Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor	5
Module 5	AC Machines Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency Three-phase induction motor Generation of rotating magnetic fields, Construction and working of a three-phase induction motor.	4
Module 6	Electrical Installations Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3
Module 7	General structure of electrical power system: Power generation to distribution through overhead lines and underground cables with single line diagram	1
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.

Learning Resources:

1	D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2	C.L. Wadhwa, Basic Electrical Engineering, New Age, 2007.
3	S K Bhattacharya, Basic Electrical and Electronics Engineering, Pearson, 2011
4	Ashfaq Husain and Haroon Ashfaq, Fundamentals of Electrical Engineering, Dhanpat Rai & Co., Delhi, 2007.
5	J.B. Gupta, Basic Electrical Engineering, Kataria& Sons, 2015.
6	L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
7	E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:	
1	To make the students understand about the semiconductor.
2	To make the students understand about Diode and its circuit.
3	To make the students understand about different Transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Semiconductors: Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5
2	Diode and Diode Circuits: Formation of P-N junction, depletion region, built-in-potential, forward and reverse biased P-N junction, energy band diagrams, V-I characteristics, Zener diode forward and reverse characteristics, Avalanche breakdown and Zener breakdown, junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, PIV, ripple factor, efficiency.	4 3
3	Introduction to Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET): Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier. JFET (N channel only) structure, Drain and Transfer characteristics.	4 2
4	Introduction to OPAMP and Digital Electronics: Introduction to Operational Amplifiers: Characteristics, Inverting and Non-Inverting mode of operation, summing amplifier, difference amplifier. Introduction to binary number; Basic Boolean algebra; Introduction to integrated circuits, Logic gates and truth tables for different logic operations and simple digital circuits using the basic gates.	3 3
Total		24



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Course Outcomes:

After completion of the course, students will be able to:

1	identify semiconductor materials, draw band-diagrams, distinguish between intrinsic and extrinsic semiconductors, n- and p- type semiconductors, calculate drift and diffusion current components
2	explain the junction properties and the phenomenon of rectification, draw the I-V characteristics and identify operating points; Calculate ripple factors, efficiency of power supplies.
3	draw and explain the I-V characteristics of BJTs and FET – both input and output;
4	understand basics of OPAMP and learn the use of it as amplifier.
5	Explain binary numbers and identify different logic gates and circuit implementation.

Learning Resources:

1	Rakshit and Chattopadhyay: Introduction to Electronics Principle
2	Malvino: Electronic Principle.
3	Millman & Halkias: Integrated Electronics.
4	Boyelstad & Nashelsky: Electronic Devices & Circuit Theory.

Course Name:	English		
Course Code:	HM-HU201	Category:	HM
Semester:	Second	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	Students must have basic knowledge of English Language
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills (speaking, reading and writing).

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	TECHNICAL COMMUNICATION: Theory of Communication – Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills	1L

2	VOCABULARY BUILDING: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms	1L
3.	BASIC WRITING SKILLS. Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences in logical order.	1 L
4	GRAMMAR: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9 L
5	WRITING PRACTICES: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10 L
6.	READING COMPREHENSION: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		24L

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:

1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Universal English. Prof. Prasad Kataria Publications, 2019.
6.	"Communication Skills for Professionals"-Nira Konar, Prentice Hall of India 2nd edition, New Delhi, 2011
7.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019. Course Outcomes The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.



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Course Name:	Physics Laboratory		
Course Code:	BS-PH291	Category:	Basic Science Courses
Semester:	Second	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Apply the concepts of physics to carry out experiments on Quantum physics, EMT, Optics and General properties of matter and interpret the same for deduction of results.

Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Determination of Dispersive Power of the Material of a Prism	3P/ week
2	Determination of wavelength of a monochromatic light by Newton's ring	
3	Determination of Wavelength of the Given LASER Light by Diffraction Method	
4	Determination of Thermo-electric Power of a given Thermocouple	
5	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method	
6	Determination of Hall Coefficient of a Semiconductor	
7	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell	
8	Determination of Unknown Resistance using Carey Foster's Bridge	
9	Determination of Planck Constant using Photocell	
10	Verification of Bohr's Atomic Orbital Theory Through Frank-Hertz Experiment	
11	Determination of Rydberg Constant by Studying Hydrogen Spectrum	
12	Determination of Band Gap of a Semiconductor by Four Probe Method	
13	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure	
14	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method	
15	Determination of Coefficient of Viscosity by Poiseuille's Capillary Flow Method	
Total		39P



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Course Outcomes:

After completion of the course, students will be able to:

1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.

Learning Resources:

1	An Advanced Course in Practical Physics, by D. Chattopadhyay , P. C. Rakshit
2	A Manual of Practical Engineering Physics and Material Science, by A S Vasudeva
3	A Textbook of Engineering Physics Practical, by Dr. R Das, Dr. R Kumar, C S Robinson & P K Sahu

Course Name:	Basic Electrical and Electronics Engineering Lab		
Course Code:	ES-EE291	Category:	ES
Semester:	Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:

1	Provide working knowledge for the analysis of basic DC and AC circuits
2	Measurement of power in three phase system
3	Provide working knowledge on Electric machines.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	3



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2	Calibration of ammeter and Wattmeter.	3
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	3
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method	3
5	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3
6	Determination of Torque –Speed characteristics of separately excited DC motor.	3
Total		18 P

Course Outcomes:

After completion of the course, students will be able to:

1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.
3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the different characteristics of separately excited DC motor.

Learning Resources:

1	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:

1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.

Course Contents:

Exp. No.	Description of Topic	Contact Hrs.
1.	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	3
2	a) Study of I-V characteristics of Junction diodes.	3



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	b) Study of I-V characteristics of Zener diodes.	
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	3
4	a) Study of I-V characteristics of BJTs. for CB configurations b) Study of I-V characteristics of BJTs. for CE configurations	3
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	3
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	3
Total		18P

Course Outcomes:

After completion of the course, students will be able to:

1	identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.
3	implement half wave and full wave rectifier circuits and can analyse the performance of them.
4	realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	use OPAMP as amplifier and verify the truth tables of different logic gates.

Learning Resources:

1	Laboratory Manual

Course Name:	Engineering Graphics & Design		
Course Code:	ES-ME291	Category:	Engineering Sciences
Semester:	Second	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To make students aware of importance of engineering drawing and to familiar with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing

	for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P
5	Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P
7	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1L+4P
8	Sections and Sectional Views Of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1L+4P
9	Overview of Computer Graphics, Customisation& CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound	1L+4P

	Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	
10	Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	2L+8P
11	Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	2L+8P
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Familiarize with basics of drawing, dimensioning, scales, curves
2	Comprehend the theory of orthographic projection and its applications
3	Prepare and interpret isometric projection
4	Create and modify 2D drawing using AutoCAD software

Learning Resources:

1	Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House



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2	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6	Corresponding set of CAD Software Theory and User Manuals



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Curriculum for Undergraduate Degree (B.Tech.) in Information Technology (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Range of Credits:

As per AICTE, a student covering 160 credits during 4 years of studies as per curriculum of the Institute will be eligible to get Under Graduate B.Tech. degree. A student will be eligible to get B.Tech. degree with Honours, if he/ she completes an additional 20 credits. These could be acquired through MOOCs prescribed by the Institute. Every student admitted to the 4 years B.Tech programme is required to earn a minimum of 100 Activity Points under Mandatory Additional Requirement (MAR), in addition to the required academic grades, for getting B.Tech./ B.Tech. (Honours) degree. Also some non-credit mandatory courses are there included in the curriculum. Like theory courses, students are required to appear in the semester examination for all mandatory courses and must get a minimum of pass marks in those courses to be eligible to get the final degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Humanities and Social Sciences including Management Courses	12	12
2	Basic Science Courses	27	25
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.	25	24
4	Professional Core Courses	49.5	48
5	Professional Elective Courses relevant to chosen specialization/ branch	19.5	18
6	Open Elective Courses from other technical and /or emerging subjects	12	18
7	Project Work, Seminar and Internship in Industry or elsewhere	15	15
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	Non-Credit	Non-Credit
Total		160	160



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D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	BS	Basic Science Courses
5	ES	Engineering Science Courses
6	HM	Humanities and Social Sciences including Management Courses
7	PC	Professional Core Courses
8	PE	Professional Elective Courses
9	OE	Open Elective Courses
10	MC	Mandatory Courses
11	PW	Project/ Internships/ Sessional

E. Courses in Different Categories:

Humanities and Social Sciences including Management Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	HM-HU101	English	2	0	0	2
2	III	HM-HU301	Economics for Engineers	3	0	0	3
3	V	HM-HU501	Introduction to Industrial Management	2	0	0	2
4	VII	HM-HU702	Project Management and Entrepreneurship	3	0	0	3
Total Theory				10	0	0	10
Practical/ Sessional							
1	II	HM-HU291	Language Laboratory	0	0	2	1
2	V	HM-HU591	Soft Skill Development Lab	0	0	2	1
Total Practical/ Sessional				0	0	4	2
Total				10	0	4	12

Basic Science Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	BS-PH101	Physics	3	1	0	4
2	I	BS-M101	Mathematics-I	3	1	0	4
3	II	BS-CH201	Chemistry	3	1	0	4
4	II	BS-M201	Mathematics-II	3	1	0	4



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5	III	BS-M301	Mathematics-III	3	0	0	3
6	IV	BS-M404	Numerical Methods	2	0	0	2
7	IV	BS-BIO401	Biology	2	0	0	2
<i>Total Theory</i>				19	4	0	23
Practical/ Sessional							
1	I	BS-PH191	Physics Laboratory	0	0	3	1.5
2	II	BS-CH291	Chemistry Laboratory	0	0	3	1.5
3	IV	BS-M494	Numerical Methods Lab	0	0	2	1
<i>Total Practical/ Sessional</i>				0	0	8	4
Total				19	4	8	27

Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.							
Sl No.	Semeste r	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	ES-EE101	Basic Electrical & Electronics Engineering	4	0	0	4
2	II	ES-CS201	Programming for Problem Solving	3	0	0	3
3	III	ES-EC303	Analog and Digital Electronics	3	0	0	3
4	IV	ES-IT401	Discrete Mathematics	3	0	0	3
Total Theory				13	0	0	13
Practical/ Sessional							
1	I	ES-EE191	Basic Electrical & Electronics Engineering Lab	0	0	4	2
2	I	ES-ME191	Engineering Graphics & Design Lab	1	0	4	3
3	II	ES-CS291	Programming for Problem Solving Lab	0	0	4	2
4	II	ES-ME292	Workshop/ Manufacturing Practices Lab	1	0	4	3
5	III	ES-EC393	Analog and Digital Electronics Lab	0	0	4	2
Total Practical/ Sessional				2	0	20	12
Total				15	0	20	25



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Professional Core Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	PC-IT301	Data Structure & Algorithms	3	1	0	4
2	III	PC-IT302	Computer Organization and Architecture	3	0	0	3
3	IV	PC-IT401	Database Management System	3	0	0	3
4	IV	PC-IT402	Design & Analysis of Algorithms	3	1	0	4
5	IV	PC-IT403	Formal Language & Automata Theory	3	0	0	3
6	V	PC-IT501	Compiler Design	2	0	0	2
7	V	PC-IT502	Operating Systems	3	0	0	3
8	V	PC- IT503	Object Oriented Programming	3	0	0	3
9	VI	PC-IT601	Software Engineering	3	0	0	3
10	VI	PC-IT602	Computer Networks	3	0	0	3
Total Theory				29	2	0	31
Practical/ Sessional							
1	III	PC-IT393	IT Workshop (Sci. Lab/ MATLAB/ Python/ R)	0	0	3	1.5
2	III	PC-IT391	Data Structure & Algorithms Lab	0	0	4	2
3	III	PC-IT392	Computer Organization and Architecture Lab	0	0	4	2
4	IV	PC-IT491	Database Management System Lab	0	0	4	2
5	IV	PC-IT492	Design & Analysis of Algorithms Lab	0	0	4	2
6	V	PC-IT591	Compiler Design Lab	0	0	3	1.5
7	V	PC-IT592	Operating Systems Lab	0	0	4	2
8	V	PC-IT593	Object Oriented Programming Lab	0	0	4	2
9	VI	PC-IT691	Software Engineering Lab	0	0	3	1.5
10	VI	PC-IT692	Computer Networks Lab	0	0	4	2
Total Practical/ Sessional				0	0	37	18.5
Total				29	2	37	49.5



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Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	PE-IT501	Professional Elective-I	3	0	0	3
2	VI	PE-IT601	Professional Elective-II	3	0	0	3
3	VI	PE-IT602	Professional Elective-III	3	0	0	3
4	VII	PE-IT701	Professional Elective-IV	3	0	0	3
5	VII	PE-IT702	Professional Elective-V	3	0	0	3
6	VIII	PE- IT801	Professional Elective-VI	3	0	0	3
Total Theory				18	0	0	18
Practical/ Sessional							
1	VI	PE-IT691	Professional Elective-II Lab	0	0	3	1.5
Total Practical/ Sessional				0	0	3	1.5
Total				18	0	3	19.5

Open Elective Courses from other technical and / or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	VI	OE-IT601	Open Elective-I	3	0	0	3
2	VII	OE-IT701	Open Elective-II	3	0	0	3
3	VIII	OE-IT801	Open Elective-III	3	0	0	3
4	VIII	OE-IT802	Open Elective-IV	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional							
1							
Total Practical/Sessional							
Total				12	0	0	12

Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1							
Total Theory							
Practical/ Sessional							



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1	VI	PW-IT681	Project-I	0	0	4	2
2	VII	PW-IT781	Project-II	0	0	12	6
3	VII	PW-IT782	Practical Training Evaluation	0	0	0	1
4	VIII	PW-IT881	Project-III	0	0	12	6
<i>Total Practical/ Sessional</i>				0	0	28	15
Total				0	0	28	15

Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semeste r	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	IV	MC471	Environmental Sciences	2	0	0	0
2	V	MC571	Aptitude Skill Development-I	2	0	0	0
3	V	MC572	Constitution of India	2	0	0	0
4	VI	MC671	Aptitude Skill Development -II	2	0	0	0
Total Theory				8	0	0	0
Practical/ Sessional							
1							
Total Practical/ Sessional							
Total				8	0	0	0

Curriculum for Undergraduate Degree (B.Tech.) in Information Technology (w.e.f. AY: 2020-21)

Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)							
Mandatory Induction Program- 3 Weeks Duration							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-PH101	Physics	3	1	0	4
2	BS	BS-M101	Mathematics-I	3	1	0	4
3	ES	ES-EE101	Basic Electrical & Electronics Engineering	4	0	0	4
4	HM	HM-HU101	English	2	0	0	2
	Total Theory			12	2	0	14
Practical/ Sessional/ Mandatory Course							
1	BS	BS-PH191	Physics Laboratory	0	0	3	1.5
2	ES	ES-EE191	Basic Electrical & Electronics Engineering Lab	0	0	4	2
3	ES	ES-ME191	Engineering Graphics & Design Lab	1	0	4	3
	Total Practical/ Sessional/ Mandatory Course			1	0	11	6.5
Total of First Semester				13	2	11	20.5

Second Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-CH201	Chemistry	3	1	0	4
2	BS	BS-M201	Mathematics-II	3	1	0	4
3	ES	ES-CS201	Programming for Problem Solving	3	0	0	3
Total Theory				9	2	0	11
Practical/ Sessional/ Mandatory Course							
1	BS	BS-CH291	Chemistry Laboratory	0	0	3	1.5
2	ES	ES-CS291	Programming for Problem Solving Lab	0	0	4	2
3	ES	ES-ME292	Workshop/ Manufacturing Practices Lab	1	0	4	3



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4	HM	HM-HU291	Language Laboratory	0	0	2	1
<i>Total Practical/ Sessional/ Mandatory Course</i>				1	0	13	7.5
Total of Second Semester				10	2	13	18.5

Third Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	ES	ES-EC303	Analog and Digital Electronics	3	0	0	3
2	PC	PC-IT301	Data Structure & Algorithms	3	1	0	4
3	PC	PC-IT302	Computer Organization and Architecture	3	0	0	3
4	BS	BS-M301	Mathematics-III	3	0	0	3
5	HM	HM-HU301	Economics for Engineers	3	0	0	3
Total Theory				15	1	0	16
Practical/ Sessional/ Mandatory Course							
1	PC	PC-IT393	IT Workshop (Sci. Lab/ MATLAB/ Python/ R)	0	0	3	1.5
2	ES	ES-EC393	Analog and Digital Electronics Lab	0	0	4	2
3	PC	PC-IT391	Data Structure & Algorithms Lab	0	0	4	2
4	PC	PC-IT392	Computer Organization and Architecture Lab	0	0	4	2
Total Practical/ Sessional/ Mandatory Course				0	1	15	7.5
Total of Third Semester				15	1	15	23.5

Fourth Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	ES	ES-IT401	Discrete Mathematics	3	0	0	3
2	PC	PC-IT401	Database Management System	3	0	0	3
3	PC	PC-IT402	Design & Analysis of Algorithms	3	1	0	4
4	PC	PC-IT403	Formal Language & Automata Theory	3	0	0	3
5	BS	BS-M404	Numerical Methods	2	0	0	2
6	BS	BS-BIO401	Biology	2	0	0	2
7	MC	MC471	Environmental Sciences	2	0	0	0
Total Theory				18	1	0	17

Practical/ Sessional/ Mandatory Course							
1	PC	PC-IT491	Database Management System Lab	0	0	4	2
2	PC	PC-IT492	Design & Analysis of Algorithms Lab	0	0	4	2
3	BS	BS-M494	Numerical Methods Lab	0	0	2	1
<i>Total Practical/ Sessional/ Mandatory Course</i>				0	0	10	5
Total of Fourth Semester				18	0	10	22

Fifth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-IT501	Compiler Design	2	0	0	2
2	PC	PC-IT502	Operating Systems	3	0	0	3
3	PC	PC- IT503	Object Oriented Programming	3	0	0	3
4	HM	HM-HU501	Introduction to Industrial Management	2	0	0	2
5	PE	PE-IT501	Professional Elective-I	3	0	0	3
6	MC	MC571	Aptitude Skill Development-I	2	0	0	0
7	MC	MC572	Constitution of India	2	0	0	0
Total Theory				17	0	0	13
Practical/ Sessional/ Mandatory Course							
1	PC	PC-IT591	Compiler Design Lab	0	0	3	1.5
2	PC	PC-IT592	Operating Systems Lab	0	0	4	2
3	PC	PC-IT593	Object Oriented Programming Lab	0	0	4	2
4	HM	HM-HU591	Soft Skill Development Lab	0	0	2	1
Total Practical/ Sessional				0	0	13	6.5
Total of Fifth Semester				17	0	13	19.5

List of Elective Courses	
PE-IT501	Professional Elective-I
PE-IT501A	Theory of Computation
PE-IT501B	Machine Learning
PE-IT501C	Data Mining
PE-IT501D	Distributed Systems

Sixth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
L	T	P					
Theory							
1	PC	PC-IT601	Software Engineering	3	0	0	3
2	PC	PC-IT602	Computer Networks	3	0	0	3
3	PE	PE-IT601	Professional Elective-II	3	0	0	3
4	PE	PE-IT602	Professional Elective-III	3	0	0	3
5	OE	OE-IT601	Open Elective-I	3	0	0	3
6	MC	MC671	Aptitude Skill Development -II	2	0	0	0
Total Theory				17	0	0	15
Practical/ Sessional/ Mandatory Course							
1	PC	PC-IT691	Software Engineering Lab	0	0	3	1.5
2	PC	PC-IT692	Computer Networks Lab	0	0	4	2
3	PE	PE-IT691	Professional Elective-II Lab	0	0	3	1.5
4	PW	PW-IT681	Project-I	0	0	4	2
Total Practical/ Sessional				0	0	14	7
Total of Sixth Semester				15	0	14	22

List of Elective Courses	
PE-IT601	Professional Elective-II
PE-IT601A	Advanced Algorithms
PE-IT601B	Data Analytics and Big Data
PE-IT601C	Computer Graphics
PE-IT601D	Advanced Computer Architecture
PE-IT691	Professional Elective-II Lab
PE-IT691A	Advanced Algorithms Lab
PE-IT691B	Data Analytics and Big Data Lab
PE-IT691C	Computer Graphics Lab
PE-IT691D	Advanced Computer Architecture Lab
PE-IT602	Professional Elective-III
PE-IT602A	Artificial Intelligence
PE-IT602B	Introduction to Information Security
PE-IT602C	Internet of Things
PE-IT602D	Signals & System



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OE-IT601	Open Elective-I
OE-IT601A	E-Commerce and ERP
OE-IT601B	Microprocessor
OE-IT601C	Wireless Communication

Seventh Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-IT701	Professional Elective-IV	3	0	0	3
2	PE	PE-IT702	Professional Elective-V	3	0	0	3
3	OE	OE-IT701	Open Elective-II	3	0	0	3
4	HM	HM-HU702	Project Management and Entrepreneurship	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PW	PW-IT781	Project-II	0	0	12	6
2	PW	PW-IT782	Practical Training Evaluation	0	0	0	1
Total Practical/ Sessional/ Mandatory Course				0	0	12	7
Total of Seventh Semester				12	0	12	19

List of Elective Courses	
PE-IT701	Professional Elective-IV
PE-IT701A	Internet Technology
PE-IT701B	Quantum Computing
PE-IT701C	Cloud Computing
PE-IT702	Professional Elective-V
PE-IT702A	Multimedia Technology
PE-IT702B	Soft Computing
PE-IT702C	Ad-Hoc and Sensor Networks
PE-IT702D	Information Theory and Coding
PE-IT702E	Human Computer Interaction
PE-IT702F	Block Chain and its Applications
OE-IT701	Open Elective-II
OE-IT701A	Human Resource Development and Organizational Behavior
OE-IT701B	Introduction to Philosophical Thoughts
OE-IT701C	Operational Research

Eighth Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE- IT801	Professional Elective-VI	3	0	0	3
2	OE	OE-IT801	Open Elective-III	3	0	0	3
3	OE	OE-IT802	Open Elective-IV	3	0	0	3
Total Theory				9	0	0	9
Practical/ Sessional							
1	PW	PW- IT881	Project-III	0	0	12	6
Total Practical/ Sessional/ Mandatory Course				0	0	12	6
Total of Eighth Semester				9	0	12	15

List of Elective Courses	
PE-IT801	Professional Elective-VI
PE-IT801A	Mobile Computing
PE-IT801B	Cryptography & Network Security
PE-IT801C	Natural Language Processing
PE-IT801D	Embedded System with IOT
PE-IT801E	Image Processing
PE-IT801F	Augmented Reality and Virtual Reality
OE-IT801	Open Elective-III
OE-IT801A	Cyber Law and Ethics
OE-IT801B	Bioinformatics
OE-IT801C	Robotics
OE-IT801D	Computational Biology
OE-IT802	Open Elective-IV
OE-IT802A	Introduction to Business Analytics
OE-IT802B	Economic Policies in India
OE-IT802C	Remote Sensing and GIS



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Curriculum for Undergraduate Degree (B.Tech.) in Information Technology (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Induction Program (Mandatory)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Duration

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Please refer **Appendix-A** for AICTE guidelines on Mandatory Induction Program.

First Semester

Course Name:	Physics		
Course Code:	BS-PH101	Category:	Basic Science Course
Semester:	First	Credit:	4.0
L-T-P:	3-1-0	Pre-Requisites:	Mathematics course with vector calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	Understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	Describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Module-1: Foundations of Quantum Mechanics	(8L)
	Introduction to Quantum Physics: Brief idea about the historical development of quantum mechanics.	1
	Black Body Radiation: Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws.	2
	Compton Effect: Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	2
	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation.	2
	Uncertainty Principle: Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero point energy, Numerical problems.	1
2	Module-2: Schrödinger Wave Equation and Its Applications	(8L)
	Formulation of Quantum Mechanics: Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of associated problems.	3
	Schrödinger Wave Equation: Time independent Schrödinger's equation from time dependent one by the separation of variable method.	1
	Applications of Quantum Mechanics: Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator	4
3	Module-3: Dielectric Materials and their Applications	(5L)
	Concept of Dielectric and Polarization: Electric field inside a Dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, Atomic polarizability and polarization vector.	1
	Inter Relationship among Dielectric Parameters: Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems on relation between polarizability, susceptibility and dielectric constant.	2
	Types of Polarization: Electronic polarization and derivation of electronic	1

	polarizability, Concept of ionic and orientational polarization (no derivation). Applications of Dielectric: Dielectric breakdown and dielectric strength, Concept of Dielectric loss, Few applications of dielectrics in different fields.	1
4	Module-4: Time Varying Fields Electromagnetic Induction: Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in Motors and Generators, Calculation of Induced EMF. Displacement Current: Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	(3L) 2 1
5	Module-5: Electromagnetic Waves Maxwell's Electromagnetic Field Equations: Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators etc.). Plane Electromagnetic Wave in Free Space: Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. Plane Electromagnetic Wave in Medium: Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. Energy in an Electromagnetic Field: Flow of energy associated to electromagnetic field and Poynting vector.	(6L) 2 1 2 1
6	Module-6: Laser and Fiber Optics Introduction to Laser: Properties of light sources, Need of suitable light source in communication, Invention of laser, Characteristics and applications of laser. Interaction of Light with Matter: Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them. Components and Working of Laser Systems: Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO ₂ laser). Optical Communication: Introduction, Need for optical communication, Salient features of optical fibers, Amplitude and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth analog/digital communication system Light Guidance in Fibers: Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single and multimode fibers, Step-index and graded-index fibers. Transmission characteristics of optical fibers: Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion,	(9L) 1 1 2 2 1 2



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	bit rate - length product, Minimization of intermodal dispersion.	
Total		39L

Course Outcomes:

After completion of the course, students will be able to:

1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various medium of propagations.
4	Understand the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy etc.
6	Explain the workings of various LASERs and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the dispersion leading to calculation of Bit Rate of a communication channel..

Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Aurther Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
9	'Understanding Lasers' by Jeff Hecht
10	'An Introduction to Fiber Optics' by Ajoy Ghatak and K. Thyagrajan



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Course Name:	Mathematics-I		
Course Code:	BS-M101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know Convergence of sequence and series
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function
3	To know the uses of matrix in different areas in engineering
4	To know the use of mean value theorems in engineering fields
5	Use of vector functions in different fields of Engineering

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Determinants and Matrices: (i) Introduction to determinant, properties (proofs of identities are excluded). (ii) Types of matrices, rank of a matrix, inverse of a matrix, Linear systems of equations, Cramer's rule, eigen-values and eigen-vectors, Caley-Hamilton theorem.	6L
2	Differential Calculus (Function of single variable): (i) Indeterminate forms and L'Hospital's rule; Successive differentiation, Leibnitz's theorem. (ii) Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin theorems with remainders; Maxima and minima. (iii) Evolutes and Involutives.	6L
3	Differential Calculus (Function of multi-variables): (i) Concept of limit, continuity and partial differentiation, chain rule, total differential, Jacobian, Euler's theorem on homogeneous function. (ii) Hessian, Maxima and minima; Lagrange's multipliers.	8L
4	Integral Calculus: (i) Line integrals; double integrals, change of order; triple integrals. (ii) Evaluation of surface areas and volumes of revolutions.	6L



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5	Vector Calculus: (i) Vector differential operator, scalar and vector point function, gradient, directional derivative, divergence and curl. (ii) Divergence theorem, Green's and Stoke's theorem (Statements only) and applications.	8L
6	Sequence and Series: (i) Sequence, type of a sequence. (ii) Series of positive terms; Geometric and p-series and their convergence criterion; Convergence test of series: Comparison test, D'Alembert's ratio test, Cauchy's root test. (iii) Alternating series; Absolute convergence, Leibnitz's theorem.	6L
Total		40

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply knowledge of differential and integral calculus to determine curvature and evaluation of different types of improper integrals
2	Utilize mean value theorems for solution of engineering problems.
3	Learn matrices, concept of rank, methods of matrix inversion and their applications.
4	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
5	Determine eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces to solve physical and engineering problems
6	Solve multiple integrals and utilize it to different physical problems

Course Name:	Basic Electrical and Electronics Engineering		
Course Code:	ES-EE101	Category:	ES
Semester:	First	Credit:	4
L-T-P:	4-0-0	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:	
1	To provide comprehensive idea about AC and DC circuit analysis
2	To make the students understand about working principals and applications of electric machines



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3	To make the students understand the components of low voltage electrical installations
4	To provide basic idea about general structure of electrical power system.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
Module 1	DC Circuits Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5
Module 2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel),	4
Module 3	Three phase system Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2
Module 4	DC Machines Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor	5
Module 5	AC Machines Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency Three-phase induction motor Generation of rotating magnetic fields, Construction and working of a three-phase induction motor.	4
Module 6	Electrical Installations Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3
Module 7	General structure of electrical power system: Power generation to distribution through overhead lines and underground cables with single line diagram	1
Total		24



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Course Outcomes:

After completion of the course, students will be able to:

1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.

Learning Resources:

1	D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2	C.L. Wadhwa, Basic Electrical Engineering, New Age, 2007.
3	S K Bhattacharya, Basic Electrical and Electronics Engineering, Pearson, 2011
4	Ashfaq Husain and Haroon Ashfaq, Fundamentals of Electrical Engineering, Dhanpat Rai & Co., Delhi, 2007.
5	J.B. Gupta, Basic Electrical Engineering, Kataria & Sons, 2015.
6	L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
7	E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:

1	To make the students understand about the semiconductor.
2	To make the students understand about Diode and its circuit.
3	To make the students understand about different Transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Semiconductors: Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5
2	Diode and Diode Circuits: Formation of P-N junction, depletion region, built-in-potential, forward and reverse biased P-N junction, energy band diagrams, V-I characteristics, Zener diode forward and reverse characteristics, Avalanche breakdown and Zener breakdown, junction capacitance and varactor diode.	4 3



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Course Name:	English		
Course Code:	HM-HU101	Category:	HM
Semester:	First	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop Technical Communication Skills (speaking, reading and writing).

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1.	TECHNICAL COMMUNICATION: Theory of Communication – Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills	1L
2	VOCABULARY BUILDING: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms	1L
3.	BASIC WRITING SKILLS. Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences in logical order.	1 L
4	GRAMMAR: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9 L
5	WRITING PRACTICES: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10 L
6.	READING COMPREHENSION: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		24L



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Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:

1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Universal English. Prof. Prasad Kataria Publications, 2019.
6.	"Communication Skills for Professionals"-Nira Konar, Prentice Hall of India 2nd edition, New Delhi, 2011
7.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019. Course Outcomes The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Name:	Physics Laboratory		
Course Code:	BS-PH191	Category:	Basic Science Courses
Semester:	First	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	Apply the concepts of physics to carry out experiments on Quantum physics, EMT, Optics and General properties of matter and interpret the same for deduction of results.

Course Contents: (Choose 10 experiments from the following)

Module No.	Description of Topic	Contact Hrs.
1	Determination of Dispersive Power of the Material of a Prism	3P/ week
2	Determination of wavelength of a monochromatic light by Newton's ring	
3	Determination of Wavelength of the Given LASER Light by Diffraction Method	



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4	Determination of Thermo-electric Power of a given Thermocouple	
5	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method	
6	Determination of Hall Coefficient of a Semiconductor	
7	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell	
8	Determination of Unknown Resistance using Carey Foster's Bridge	
9	Determination of Planck Constant using Photocell	
10	Verification of Bohr's Atomic Orbital Theory Through Frank-Hertz Experiment	
11	Determination of Rydberg Constant by Studying Hydrogen Spectrum	
12	Determination of Band Gap of a Semiconductor by Four Probe Method	
13	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure	
14	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method	
15	Determination of Coefficient of Viscosity by Poiseuille's Capillary Flow Method	
Total		39P

Course Outcomes:

After completion of the course, students will be able to:

1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.

Learning Resources:

1	An Advanced Course in Practical Physics, by D. Chattopadhyay , P. C. Rakshit
2	A Manual of Practical Engineering Physics and Material Science, by A S Vasudeva
3	A Textbook of Engineering Physics Practical, by Dr. R Das, Dr. R Kumar, C S Robinson & P K Sahu



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Course Name:	Basic Electrical and Electronics Engineering Lab		
Course Code:	ES-EE191	Category:	ES
Semester:	First	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:	
1	Provide working knowledge for the analysis of basic DC and AC circuits
2	Measurement of power in three phase system
3	Provide working knowledge on Electric machines.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	3
2	Calibration of ammeter and Wattmeter.	3
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	3
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method	3
5	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3
6	Determination of Torque –Speed characteristics of separately excited DC motor.	3
Total		18 P

Course Outcomes:	
After completion of the course, students will be able to:	
1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.
3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the different characteristics of separately excited DC motor.



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Learning Resources:

1	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:

1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.

Course Contents:

Exp. No.	Description of Topic	Contact Hrs.
1.	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	3
2	a) Study of I-V characteristics of Junction diodes. b) Study of I-V characteristics of Zener diodes.	3
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	3
4	a) Study of I-V characteristics of BJTs. for CB configurations b) Study of I-V characteristics of BJTs. for CE configurations	3
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	3
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	3
Total		18P

Course Outcomes:

After completion of the course, students will be able to:

1	Identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	Realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.



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3	Implement half wave and full wave rectifier circuits and can analyse the performance of them.
4	Realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	Realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	Use OPAMP as amplifier and verify the truth tables of different logic gates.

Learning Resources:

1	Laboratory Manual

Course Name:	Engineering Graphics & Design		
Course Code:	ES-ME191	Category:	Engineering Sciences
Semester:	First	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To make students aware of importance of engineering drawing and to familiar with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P

5	Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P
7	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1L+4P
8	Sections and Sectional Views Of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1L+4P
9	Overview of Computer Graphics, Customisation & CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	1L+4P
10	Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and	2L+8P

	section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	
11	Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	2L+8P
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Familiarize with basics of drawing, dimensioning, scales, curves
2	Comprehend the theory of orthographic projection and its applications
3	Prepare and interpret isometric projection
4	Create and modify 2D drawing using AutoCAD software

Learning Resources:

1	Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6	Corresponding set of CAD Software Theory and User Manuals



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Second Semester

Course Name:	Chemistry		
Course Code:	BS-CH201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	The objective of the Chemistry course is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Atomic and molecular structure <i>Atomic Structure:</i> Dalton's atomic theory; Fundamental of sub atomic particles; Rutherford's atomic model; Bohr's atomic model; Dual nature of electron; Heisenberg's uncertainty principle; Schrodinger wave equation; Orbitals and Quantum numbers; Particle in a box solutions (One dimension) and their applications for simple sample. <i>Molecular Structure:</i> Molecular orbital theory: Postulates of MOT; Bonding and anti bonding orbital's; MO diagram of diatomic molecules (H_2 , He_2 , Li_2 , Be_2); Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties (Octahedral and tetrahedral complexes); Band structure of solids and the role of doping on band structures (Band theory, Valence band and conduction band, Conductor, Semiconductor, Insulator, p-Type and n-Type semiconductor).	10L
2	Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals' interactions; Ideal gas equation, compressibility factor, Real gas equation, Boyles Temperature, Critical state (Critical pressure, critical volume and critical temperature).	4L

3	Periodic properties Mendeleev's periodic table; Periodic properties (Atomic radii, Ionic radii, Ionization potential, electron affinity, Electronegativity, metallic and non metallic character, oxidizing and reducing character); Polarizability (Fajans' rule); Hard soft acids and bases; molecular geometries (VSEPR theory, Hybridization, sigma and pi bond, determination of hybridization state and structure of molecules); Hydrogen bond (Inter and intra molecular H bond); Effective nuclear charge; oxidation states.	4L
4	Use of free energy in chemical equilibria <i>Thermodynamics:</i> First law of thermodynamics, Internal energy & Enthalpy, Heat capacity, Adiabatic & Isothermal process, Reversible & Irreversible process, Second law of thermodynamics, Entropy, Free energy, Gibbs-Helmholtz equation. <i>Electrochemistry:</i> Electrochemical cell (Electrolytic cell & Galvanic cell), Representation of cell, Free energy and EMF, Reversible and Irreversible cell, Nernst equation and application, Application of EMF measurement on ΔG , ΔH , ΔS , equilibrium constant of a reversible chemical reaction and valency of an ion. Hydrogen Half cell, calomel half cell, Quinhydrone half cell. <i>Water Chemistry:</i> Hydrosphere; Hydrological cycle; Sources of water; Acidity and alkalinity of water; Pollutants of water; Biochemical and Chemical oxygen demand; Removal of dissolved solids from water (Electrodialysis & Reverse osmosis); Hardness of water (Types of hardness, Removal of hardness of water). <i>Corrosion:</i> Oxidation corrosion, Corrosion by gases, Pilling Bedworth rule, Electrochemical corrosion, Hydrogen evolution type & oxygen absorption type of corrosion, Corrosion of bimetals, Waterline corrosion, Crevice corrosion, Pitting corrosion, Stress corrosion, Factors influencing the corrosion, Prevention of corrosion.	10L
5	Spectroscopic techniques and applications Electromagnetic spectrum; Principles of spectroscopy and selection rules; UV/Vis Spectroscopy (Energy diagram of electron excitation, Lambert-Beer's law, Bathochromic and Hypsochromic shift, Hyperchromic and hypochromic effect, Instrumental technique, Solvent effect, application); IR spectroscopy [Basic principle, Stretching and bending vibration of AX_2 type molecule(non linear), Calculation of stretching frequency, Identification of organic compounds by IR spectroscopy, Instrumental technique and application]; NMR spectroscopy (Principle of NMR spectra, chemical shift, shielding and deshielding nucleus, application of NMR).	5L

6	Stereochemistry Isomerism, Structural isomerism, Metamerism, Tautomerism, Stereoisomerism, Optical activity, Configurations and symmetry and Chirality, Enantiomers and Diastereomers, Conformational analysis, Fischer and Sawhorse and Newman projection (inter conversion), R-, S- and E-, Z- Nomenclature.	5L
7	Organic reactions and synthesis of a drug molecule Introduction to reactions involving <i>Addition Reaction:</i> Nucleophilic addition reaction [Acid catalysed reaction; Base catalysed reaction, Reactions of aldehyde or ketone with hydrocyanic acid, sodium bisulphite, water, Grignard reagent, alcohols], Electrophilic addition reaction [addition of Br ₂ to alkene; addition of hydrogen halide in symmetrical and unsymmetrical alkene (Markownikov rule); addition of Hypohalous acid, sulphuric acid and water to unsymmetrical alkene; addition of hydrogen halide in unsymmetrical alkene in presence of peroxide (Anti Markownikov rule) Ozonolysis reaction. <i>Substitution Reaction:</i> Electrophilic substitution reaction [Chlorination of Benzene; Nitration of Benzene; Friedel-Crafts Reaction (Alkylation, Acylation)], Nucleophilic substitution reaction [S _N 1 and S _N 2 reaction]. <i>Elimination Reaction:</i> E1 elimination and E2 elimination: Hofmann and Saytzev elimination. <i>Nucleophilic addition followed by elimination Reaction:</i> Reaction of carbonyl compound with ammonia, Primary amine. <i>Cyclization reaction:</i> Diels-Alder reaction. <i>Oxidation Reaction:</i> Oxidation of alcohol (Primary, secondary and tertiary alcohol); autoxidation of ether; Oxidation of aldehyde and ketone; Baeyer-Villiger oxidation; Oxidation of aromatic compounds (Oxidation of toluene and its derivatives, benzaldehyde, acetophenone, phenol). <i>Reduction Reaction:</i> Reduction of alkenes; Alkynes; carbonyl compounds (aldehydes and ketones); Carboxylic acid and esters; Bouveault-Blanc reduction; Clemensen reduction; Wolf-Kishner reduction; Meerwein-Pondorf-Verley reduction; Pinacol-Pinacolone rearrangement; Reduction of aromatic compounds (Benzaldehyde, Benzoic acid, Nitrobenzene, m-dinitrobenzene, Diazonium salt). <i>Name Reactions:</i> Aldol condensation and Mixed Aldol condensation; Claisen-schmidt reaction; Cannizaro reaction; Crossed Cannizaro reaction; Kolbe-Schmitt reaction; Gattermann-Koch aldehyde synthesis <i>Synthesis of a commonly used drug molecule:</i> Paracetamol, Aspirin	7L
Total		45L



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Course Outcomes:

After completion of the course, students will be able to:

1	Demonstrate microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2	Illustrate bulk properties and processes using thermodynamic considerations.
3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
4	Articulate periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5	List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2	University Chemistry, by B. H. Mahan
3	Fundamentals of environment and Ecology, by D. De & D. De, S. Chand Publishing.
4	Chemistry-I, by Gourkrishna Das Mohapatra, VIKAS Publishing House Pvt. Ltd.
5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6	Engineering Chemistry (NPTEL Web-book) by B.L.Tembe, Kamaluddin and M.S. Krishnan
7	Physical Chemistry, by P. W. Atkins
8	Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Pub.
9	Physical Chemistry, P. C. Rakshit, Sarat Book House
10	Organic Chemistry, Volume I, I. L. Finar, Pearson

Course Name:	Mathematics-II		
Course Code:	BS-M201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To learn how to solve different types of differential equation
2	To know the different types of improper integral
3	To know the Laplace transform
4	Basic concept of graph, digraph, walk, Hamiltonian graph, Euler circuit,
5	Basic concept of tree, binary tree

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Ordinary Differential Equations of First order: ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, In-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree - Equations solvable for p, solvable for x, solvable for y; Clairaut's equations,	8L
2	Higher Order Ordinary Differential Equations: (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI) (ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	8L
3	Improper Integrals: (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L
4	Laplace Transforms and Inverse Laplace Transforms: (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second shifting property; LT of a function multiplied by t^n and divided by t; LT of unit step and periodic functions; LT of derivatives (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii) Solutions of initial and boundary value problems by LT	8L
5	Graph Theory: (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	Tree: (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		40L



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Course Outcomes:

After completion of the course, students will be able to:

1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems
3	Use tree and graph algorithms for different problems
4	Evaluation of different types of improper integrals

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	An introduction to differential equation, Maity & Ghosh, NCBA
5	Michael Greenberg, Advanced Engineering Mathematics, Pearson
6	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
7	An introduction to Integral Calculus, Maity and Ghosh, NCBA
8	Advanced Differential Equation, M.D Raisinghanian
9	An Introduction to Engineering Mathematics-II, G.P.Samanta, New Age Publication

Course Name:	Programming for Problem Solving		
Course Code:	ES-CS201	Category:	Engineering Science
Semester:	Second	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language).
2	To develop the ability to apply knowledge of programming for solution of science & engineering problems.



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs: Basic I/O operations, keywords, data types, variables & memory locations, source code, Syntax and Logical Errors in compilation, object and executable code. Operators and Expressions, operator precedence in C programming Language.	5
2	Conditional Branching and Looping : Concepts of Conditional Branching: if-else, nested if-else , switch-case Concepts of Loops: While, do-while, for loops, Use of break and continue statement.	8
3	Arrays : Concepts of 1-D, 2-D array, array manipulation, Concepts of character array, Strings and their uses. Basic Algorithms using array: Searching (linear and binary search) and Sorting Algorithms (Bubble, Insertion and Selection sort),	9
4	Functions: Functions (including using built in libraries), Parameter passing in functions, function call by value, Recursive functions. Pointers: Idea of pointers, Defining pointers, relation between array and pointer, idea of function call by address, Dynamic memory allocation.	8
5	Structure: Structures, Array of Structures, Self-referential structures. Storage Class and Preprocessor Directives. Disk I/O operations - File handling: open, read, write, close a file.	6
Total		36L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of structured programming language .
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford



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Approved by AICTE & affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal
243 G.T. Road (N), Liluah, Howrah- 711204, West Bengal, India
Ph: +91 33 26549315/17 Fax +91 33 26549318 Web: www.mckvie.edu.in/

5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Chemistry Laboratory		
Course Code:	BS-CH291	Category:	Basic Science Courses
Semester:	Second	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	The objective of this course is to acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field. The students will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence. The course will enable the student to: • Determine the strength of an unknown solution through conductometric and pH metric titration. • Estimate the chloride ion concentration, alkalinity and hardness in water. • Find out the rate constant of a reaction. • Synthesize polymer molecules.

Course Contents: (Choose 10 experiments from the following)		
Module No.	Description of Topic	Contact Hrs.
1	Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.	3P/ Week
2	pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.	
3	To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).	
4	Determination of dissolved oxygen present in a given water sample.	
5	Determination of viscosity of the given liquid by Ostwald –Viscometer.	
6	Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).	

7	Chemical kinetics (determination of relative rates of reaction of iodide with H ₂ O ₂ at room temperature).	
8	Determination of acid value (Acidity) of oil.	
9	The adsorption of acetic acid on active charcoal.	
10	Complexometric titration (estimation of hardness of water using EDTA).	
11	Redox titration (estimation of iron using permanganometry).	
12	To determine Alkalinity of a Given Water Sample.	
13	Synthesis of a polymer (Polyacrylamide) and determine its molecular weight by solution viscosity method.	
14	Determination of cell constant and conductance of solutions.	
Total		36P

Course Outcomes:

After completion of the course, students will be able to:

1	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: - Estimate rate constants of reactions from concentration of reactants/products as a function of time - Measure molecular/system properties such as viscosity, conductance of solutions, redox potentials, chloride content of water, etc. - Synthesize a macromolecule and determine its molecular weight by solution viscosity method.

Learning Resources:

1	Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house.
2	A Text book on Experiments and calculations in Engineering Chemistry, by S.S. Dara, S Chand publications.
3	Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited.

Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS291	Category:	Engineering Science
Semester:	Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05



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Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8
4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve basic data manipulation related problems.
4	Apply programming concepts to handle memory allocation and files.

Course Name:	Workshop/ Manufacturing Practices Lab		
Course Code:	ES-ME292	Category:	Engineering Sciences
Semester:	Second	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart basic knowledge of various hand tools and their applications in different sections of manufacturing
2	To develop basic manufacturing skills, precision, safety at work place, team working and development of right attitude.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
Lectures and videos:		
	1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods 2. CNC machining, Additive manufacturing 3. Fitting operations & power tools 4. Electrical & Electronics 5. Carpentry 7. Metal casting 8. Welding (arc welding & gas welding), brazing	13L
Workshop Practice:		
1	Machine shop: <i>Typical jobs that may be made in this practice module:</i> - To make a pin from a mild steel rod in a lathe. - To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.	8P
2	Fitting shop: <i>Typical jobs that may be made in this practice module:</i> To make a Gauge from MS plate.	8P
3	Carpentry: <i>Typical jobs that may be made in this practice module:</i> To make wooden joints and/or a pattern or like.	8P

4	Welding shop (Arc welding 4 hrs + gas welding 4 hrs): Typical jobs that may be made in this practice module: ARC WELDING (4 hours): - To join two thick (approx 6mm) MS plates by manual metal arc welding. GAS WELDING (4 hours): - To join two thin mild steel plates or sheets by gas welding.	8P
5	Casting: Typical jobs that may be made in this practice module: One/ two green sand moulds to prepare, and a casting be demonstrated.	8P
6	Smithy: Typical jobs that may be made in this practice module: A simple job of making a square rod from a round bar or like.	4P
7	Electrical & Electronics: - Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable. - Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point. - Simple wiring exercise to be executed to understand the basic electrical circuit. - Simple soldering exercises to be executed to understand the basic process of soldering. - Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.	8P
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Identify and utilize machine tools for producing components through machining processes
2	Demonstrate fundamental concept of pattern making, and moulding processes for engineering applications.
3	Practice fitting, carpentry, and smithy operations for manufacturing of components.
4	Explain concepts and applications of various types of fabrication processes.



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5	Apply basic electrical and electronics engineering knowledge for household applications.

Learning Resources:	
1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998
5	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Name:	Language Laboratory		
Course Code:	HM-HU291	Category:	HM
Semester:	Second	Credit:	1
L-T-P:	0-0-2	Pre-Requisites:	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To develop Technical Communication Skills. (listening, speaking, reading and writing)

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Honing 'Listening Skill' and its sub skills through Language Lab Audio device	4P
2	Honing 'Speaking Skill' and its sub skills: Extempore, Public speaking, etc. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/ Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.	6P



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3	Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Debate, Role Play etc.)	4P
4	Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.	6P
5	Honing 'Reading Skills' and its sub skills.	2P
6.	Honing 'Writing Skill' and its sub skills by using Language Lab Audio – Visual input; Practice Sessions	2P
Total		24P

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop their intellectual, personal and professional abilities.

Learning Resources:

1.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
6.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019.



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Curriculum for Undergraduate Degree (B.Tech.) in Mechanical Engineering (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Range of Credits:

As per AICTE, a student covering 160 credits during 4 years of studies as per curriculum of the Institute will be eligible to get Under Graduate B.Tech. degree. A student will be eligible to get B.Tech. degree with Honours, if he/ she completes an additional 20 credits. These could be acquired through MOOCs prescribed by the Institute. Every student admitted to the 4 years B.Tech programme is required to earn a minimum of 100 Activity Points under Mandatory Additional Requirement (MAR), in addition to the required academic grades, for getting B.Tech./ B.Tech. (Honours) degree. Also some non-credit mandatory courses are there included in the curriculum. Like theory courses, students are required to appear in the semester examination for all mandatory courses and must get a minimum of pass marks in those courses to be eligible to get the final degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Humanities and Social Sciences including Management Courses	13	12
2	Basic Science Courses	26	25
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.	24	24
4	Professional Core Courses	57.5	48
5	Professional Elective Courses relevant to chosen specialization/ branch	18	18
6	Open Elective Courses from other technical and / or emerging subjects	9	18
7	Project Work, Seminar and Internship in Industry or elsewhere	12.5	15
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	Non-Credit	Non-Credit
Total		160	160



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D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	BS	Basic Science Courses
5	ES	Engineering Science Courses
6	HM	Humanities and Social Sciences including Management Courses
7	PC	Professional Core Courses
8	PE	Professional Elective Courses
9	OE	Open Elective Courses
10	MC	Mandatory Courses
11	PW	Project/ Internships/ Sessional

E. Courses in Different Categories:

Humanities and Social Sciences including Management Courses							
SI No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	II	HM-HU201	English	2	0	0	2
2	V	HM-HU503	Principles of Management	2	0	0	2
3	VI	HM-HU 601	Humanities-II (Operations Research)	4	0	0	4
4	VII	HM-HU701	Economics for Engineers	3	0	0	3
Total Theory				11	0	0	11
Practical/ Sessional							
1	I	HM-HU191	Language Laboratory	0	0	2	1
2	VI	HM-HU691	Soft Skill Development Lab	0	0	3	1
Total Practical/ Sessional				0	0	5	2
Total				11	0	5	13

Basic Science Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	BS-CH101	Chemistry	3	1	0	4
2	I	BS-M101	Mathematics-I	3	1	0	4
3	II	BS-PH201	Physics	3	1	0	4



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4	II	BS-M201	Mathematics - II	3	1	0	4
5	III	BS-M303	Mathematics- III	2	1	0	3
6	III	BS-BIO301	Biology	2	0	0	2
7	IV	BS-M404	Numerical Methods	2	0	0	2
Total Theory				18	5	0	23
Practical/ Sessional							
1	I	BS-CH191	Chemistry Laboratory	0	0	3	1.5
2	II	BS-PH291	Physics Laboratory	0	0	3	1.5
Total Practical/ Sessional				0	0	6	3
Total				18	5	6	26

Engineering Science Courses including Workshop, Drawing, Basics of Electrical/ Mechanical/ Computer etc.							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	ES-CS101	Programming for Problem Solving	3	0	0	3
2	II	ES-EE201	Basic Electrical & Electronics Engineering	4	0	0	4
3	III	ES-ME301	Engineering Mechanics	3	1	0	4
4	III	ES-ME302	Materials Engineering	3	0	0	3
Total Theory				13	1	0	14
Practical/ Sessional							
1	I	ES-CS191	Programming for Problem Solving Lab	0	0	4	2
2	I	ES-ME192	Workshop/ Manufacturing Practices	1	0	4	3
3	II	ES-EE291	Basic Electrical & Electronics Engineering Lab	0	0	4	2
4	II	ES-ME291	Engineering Graphics & Design	1	0	4	3
Total Practical/ Sessional				2	0	16	10
Total				15	1	16	24

Professional Core Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	PC-ME301	Thermodynamics	3	1	0	4
2	III	PC-ME302	Manufacturing Processes	4	0	0	4



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3	IV	PC-ME401	Applied Thermodynamics	3	1	0	4
4	IV	PC-ME402	Fluid Mechanics & Fluid Machines	3	1	0	4
5	IV	PC-ME403	Strength of Materials	3	1	0	4
6	IV	PC-ME404	Metrology and Instrumentation	3	1	0	4
7	V	PC-ME501	Heat Transfer	3	1	0	4
8	V	PC-ME502	Solid Mechanics	3	1	0	4
9	V	PC-ME503	Kinematics & Theory of Machines	3	1	0	4
10	VI	PC-ME601	Manufacturing Technology	4	0	0	4
11	VI	PC-ME602	Design of Machine Elements	3	1	0	4
12	VII	PC-ME701	Advanced Manufacturing Technology	3	0	0	3
Total Theory				38	9	0	47
Practical/ Sessional							
1	III	PC-ME391	Practice of Manufacturing Processes	0	0	3	1.5
2	IV	PC-ME491	Practice of Manufacturing Processes and Systems Laboratory	0	0	3	1.5
3	IV	PC-ME492	Machine Drawing- I	0	0	3	1.5
4	V	PC-ME591	Mechanical Engineering Laboratory I (Thermal)	0	0	3	1.5
5	V	PC-ME592	Machine Drawing-II	0	0	3	1.5
6	VI	PC-ME691	Mechanical Engineering Laboratory II (Design)	0	0	3	1.5
7	VII	PC-ME791	Mechanical Engineering Laboratory III (Manufacturing)	0	0	3	1.5
Total Practical/ Sessional				0	0	22	10.5
Total				38	9	22	57.5

Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	VI	PE-ME601	Professional Elective-I	3	0	0	3
2	VI	PE-ME602	Professional Elective-II	3	0	0	3
3	VII	PE-ME701	Professional Elective III	3	0	0	3
4	VII	PE-ME702	Professional Elective-IV	3	0	0	3
5	VIII	PE-ME801	Professional Elective-V	3	0	0	3
6	VIII	PE-ME802	Professional Elective-VI	3	0	0	3
Total Theory				18	0	0	18



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Practical/ Sessional							
1							
Total Practical/ Sessional							
Total				18	0	0	18

Open Elective Courses from other technical and / or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	VII	OE-ME 701	Open Elective- I	3	0	0	3
2	VIII	OE-ME 801	Open Elective-II	3	0	0	3
3	VIII	OE-ME 802	Open Elective- III	3	0	0	3
Total Theory				9	0	0	9
Practical/ Sessional							
1							
Total Practical/ Sessional							
Total				9	0	0	9

Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	V	PW-ME581	Project-I (30 hrs. Total)	0	0	2	1
2	VI	PW-ME681	Project-II (90 hrs. Total)	0	0	4	2
3	VII	PW-ME781	Project-III	0	0	6	3
	VIII	PW-ME881	Project-IV	0	0	10	5
Total Theory				0	0	22	11
Practical/ Sessional							
1	VIII	PW-ME882	Comprehensive viva	0	0	0	1.5
Total Practical/ Sessional							
Total				0	0	22	12.5



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Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	IV	MC471	Environmental Science	2	0	0	0
	V	MC571	Aptitude Skill Development-I	2	0	0	0
2	V	MC573	Essence of Indian Knowledge Tradition	2	0	0	0
	VI	MC671	Aptitude Skill Development-II	2	0	0	0
3	VI	MC672	Constitution of India	2	0	0	0
Total Theory				10	0	0	0
Practical/ Sessional							
1							
Total Practical/ Sessional							
Total				0	0	0	0

Curriculum for Undergraduate Degree (B.Tech.) in Mechanical Engineering (w.e.f. AY: 2020-21)

Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)							
Mandatory Induction Program- 3 Weeks Duration							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-CH101	Chemistry	3	1	0	4
2	BS	BS-M101	Mathematics-I	3	1	0	4
3	ES	ES-CS101	Programming for Problem Solving	3	0	0	3
Total Theory				9	2	0	11
Practical/ Sessional							
1	BS	BS-CH191	Chemistry Laboratory	0	0	3	1.5
2	ES	ES-CS191	Programming for Problem Solving Lab	0	0	4	2
3	ES	ES-ME192	Workshop/ Manufacturing Practices	1	0	4	3
4	HM	HM-HU191	Language Laboratory	0	0	2	1
Total Practical/ Sessional				1	0	13	7.5
Total of First Semester				10	2	13	18.5

Second Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-PH201	Physics	3	1	0	4
2	BS	BS-M202	Mathematics-II	3	1	0	4
3	ES	ES-EE201	Basic Electrical & Electronics Engineering	4	0	0	4
4	HM	HM-HU201	English	2	0	0	2
Total Theory				12	2	0	14
Practical/ Sessional/ Mandatory Courses							
1	BS	BS-PH291	Physics Laboratory	0	0	3	1.5
2	ES	ES-EE291	Basic Electrical & Electronics Engineering Lab	0	0	4	2
3	ES	ES-ME291	Engineering Graphics & Design	1	0	4	3
Total Practical/ Sessional/ Mandatory Courses				1	0	10	6.5
Total of Second Semester				13	2	10	20.5

Third Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS-M303	Mathematics-III	2	1	0	3
2	BS	BS-BIO301	Biology	2	0	0	2
3	ES	ES-ME301	Materials Engineering	3	0	0	3
4	ES	ES-ME302	Engineering Mechanics	3	1	0	4
5	PC	PC-ME301	Thermodynamics	3	1	0	4
6	PC	PC-ME302	Manufacturing Processes	4	0	0	4
Total Theory				17	3	0	20
Practical/ Sessional/ Mandatory Courses							
1	PC	PC-ME391	Practice of Manufacturing Processes	0	0	3	1.5
Total Practical/ Sessional/ Mandatory Courses				0	0	3	1.5
Total of Third Semester				17	3	3	21.5

Fourth Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	BS	BS- M404	Numerical Methods	2	0	0	2
2	PC	PC-ME401	Applied Thermodynamics	3	1	0	4
3	PC	PC-ME402	Fluid Mechanics & Fluid Machines	3	1	0	4
4	PC	PC-ME403	Strength of Materials	3	1	0	4
5	PC	PC-ME404	Metrology and Instrumentation	4	0	0	4
6	MC	MC471	Environmental Science	0	0	2	0
	Total Theory			15	3	2	18
Practical/ Sessional/ Mandatory Courses							
1	PC	PC-ME491	Practice of Manufacturing Processes and Systems Laboratory	0	0	3	1.5
2	PC	PC-ME492	Machine Drawing-I	0	0	3	1.5
Total Practical/ Sessional/ Mandatory Courses				0	0	6	3
Total of Fourth Semester				15	3	8	21



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Fifth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Cre dits
				L	T	P	
Theory							
1	HM	HM-HU503	Principles of Management	2	0	0	2
2	PC	PC-ME501	Heat Transfer	3	1	0	4
3	PC	PC-ME502	Solid Mechanics	3	1	0	4
4	PC	PC-ME503	Kinematics & Theory of Machines	3	1	0	4
5	MC	MC501	Essence of Indian Knowledge Tradition	2	0	0	0
6	MC	MC571	Aptitude Skill Development-I	2	0	0	0
Total Theory				15	3	0	14
Practical/ Sessional/ Mandatory Courses							
1	PC	PC-ME591	Mechanical Engineering Laboratory-I (Thermal)	0	0	3	1.5
2	PC	PC-ME592	Machine Drawing-II	0	0	3	1.5
3	PW	PW-ME581	Project-I (30 hrs. Total)	0	0	2	1
Total Practical/ Sessional/ Mandatory Courses				0	0	9	4
Total of Fifth Semester				15	3	9	18

Sixth Semester (Third Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-ME601	Manufacturing Technology	4	0	0	4
2	PC	PC-ME602	Design of Machine Elements	3	1	0	4
3	PE	PE-ME601	Professional Elective-I	3	0	0	3
4	PE	PE-ME602	Professional Elective-II	3	0	0	3
5	HM	HM-HU601	Humanities-II (Operations Research)	4	0	0	4
6	MC	MC671	Aptitude Skill Development-II	2	0	0	0
7	MC	MC672	Constitution of India	2	-	-	0
Total Theory				21	1	0	18
Practical/ Sessional/ Mandatory Courses							
1	PC	PC-ME691	Mechanical Engineering Laboratory-II (Design)	0	0	3	1.5
2	PW	PW-ME681	Project-II (90 hrs. Total)	0	0	4	2
3	HM	HM-HU691	Soft Skill Development Lab	0	0	2	1
Total Practical/ Sessional/ Mandatory Courses				0	0	9	4.5
Total of Sixth Semester				21	1	9	22.5



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Seventh Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-ME701	Advanced Manufacturing Technology	3	0	0	3
2	PE	PE-ME701	Professional Elective-III	3	0	0	3
3	PE	PE-ME702	Professional Elective-IV	3	0	0	3
4	OE	OE-ME 701	Open Elective-I	3	0	0	3
5	HM	HM-HU701	Economics for Engineers	3	0	0	3
Total Theory				15	0	0	15
Practical/ Sessional/ Mandatory Courses							
1	PC	PC-ME791	Mechanical Engineering Laboratory-III (Manufacturing)	0	0	3	1.5
2	PW	PW-ME781	Project-III	0	0	6	3
Total Practical/ Sessional/ Mandatory Courses				0	0	9	4.5
Total of Seventh Semester				15	0	9	19.5

Eighth Semester (Fourth Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-ME801	Elective V	3	0	0	3
2	PE	PE-ME802	Elective VI	3	0	0	3
3	OE	OE-ME 801	Open Elective-II	3	0	0	3
4	OE	OE-ME 802	Open Elective- III	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional							
1	PW	PW-ME881	Project-IV	0	0	10	5
2	PW	PW-ME882	Comprehensive viva-voce	0	0	0	1.5
Total Practical/ Sessional				0	0	10	6.5
Total of Eighth Semester				12	0	10	18.5
Total Credit							160

List of Professional Electives

There are six Professional Elective Course Papers in Semester VI, VII and VIII as follows:

(Elective-I) PE-ME601, (Elective-II) PE-ME602, (Elective-III) PE-ME701, (Elective-IV) PE-ME702, (Elective-V) PE-ME801 and (Elective VI) PE-ME802.

Students are to choose one paper for each of the Professional Elective Courses specified in the curriculum structure of a Semester from the following list of Professional Elective Papers. Selection of a paper should be non-repetitive. If a student chooses the paper, **Internal Combustion Engines and Gas Turbines (Code: A)** as a **Professional Elective I in Semester VI**, its paper code will be **PE-ME601A**. Similarly, in case **Mechanical Vibration (Code: A)** is chosen by one in **Semester VIII** as **Professional Elective-V**, its paper Code will be **PE-ME801A**.

PE-ME601	Professional Elective Courses (Elective-I)
PE-ME601A	Internal Combustion Engines and Gas Turbines
PE-ME601B	Composite Materials
PE-ME601C	Mechatronics
PE-ME601D	Process Planning and Cost Estimation

PE-ME602	Professional Elective Courses (Elective-II)
PE-ME602A	Finite Element Methods
PE-ME602B	CAD/CAM
PE-ME602C	Refrigeration and Air Conditioning
PE-ME602D	Cryogenics

PE-ME701	Professional Elective Courses (Elective-III)
PE-ME701A	Production and Operations Management
PE-ME701B	Gas Dynamics and Jet Propulsion
PE-ME701C	Machine Learning and Artificial Intelligence
PE-ME701D	Quantity Production Methods

PE-ME702	Professional Elective Courses (Elective-IV)
PE-ME702A	Material Handling
PE-ME702B	Robotics
PE-ME702C	Automobile Engineering
PE-ME702D	Computational Fluid Dynamics

PE-ME801	Professional Elective Courses (Elective-V)
PE-ME801A	Mechanical Vibration
PE-ME801B	Principles of Management
PE-ME801C	Additive Manufacturing



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PE-ME802	Professional Elective Courses (Elective-VI)
PE-ME802A	Energy Conservation & Management
PE-ME802B	Micro and Nano Fluidics
PE-ME802C	Product Design and Development

List of Open Electives

There are three Open Elective Course Papers in Semester VII and VIII as follows:

(Open Elective-I) OE-ME701, (Open Elective-II) OE-ME801, and (Open Elective-III) OE-ME802.

Students are to choose one paper for each of the Open Elective Courses specified in the curriculum structure of a Semester from the following list of Open Elective Papers. Selection of a paper should be non-repetitive. If a student chooses the paper, **Optimization Techniques in Engineering (Code: A)** as an **Open Elective-I in Semester VII**, its paper code will be **OE-ME701A**. Similarly, in case **Industrial Engineering (Code: A)** is chosen by one in **Semester VIII as Open Elective-II**, its paper Code will be **OE-ME801A**.

OE-ME701	Open Elective Courses (Open Elective-I)
OE-ME701A	Optimization Techniques in Engineering
OE-ME701B	Automation & Control
OE-ME701C	Biomechanics & Biomaterials
OE-ME701D	Quality and Reliability Engineering

OE-ME801	Open Elective Courses (Open Elective-II)
OE-ME801A	Industrial Engineering
OE-ME801B	Power Plant Engineering
OE-ME801C	Internet & Web Technology
OE-ME801D	Green Building Design

OE-ME802	Open Elective Courses (Open Elective-III)
OE-ME802A	Advanced Welding Technology
OE-ME802B	Internet of Things
OE-ME802C	MEMS & Microsystems Technology
OE-ME802D	Micro and Nano Manufacturing



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Curriculum for Undergraduate Degree (B.Tech.) in Mechanical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Induction Program (Mandatory)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Duration

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Please refer **Appendix-A** for AICTE guidelines on Mandatory Induction Program.

First Semester

Course Name:	Chemistry		
Course Code:	BS-CH101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	The objective of the Chemistry course is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Atomic and molecular structure <i>Atomic Structure:</i> Dalton's atomic theory; Fundamental of sub atomic particles; Rutherford's atomic model; Bohr's atomic model; Dual nature of electron; Heisenberg's uncertainty principle; Schrodinger wave equation; Orbitals and Quantum numbers; Particle in a box solutions (One dimension) and their applications for simple sample. <i>Molecular Structure:</i> Molecular orbital theory: Postulates of MOT; Bonding and anti bonding orbital's; MO diagram of diatomic molecules (H_2, He_2, Li_2, Be_2); Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties (Octahedral and tetrahedral complexes); Band structure of solids and the role of doping on band structures (Band theory, Valence band and conduction band, Conductor, Semiconductor, Insulator, p-Type and n-Type semiconductor).	10L
2	Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals' interactions; Ideal gas equation, compressibility factor, Real gas equation, Boyles Temperature, Critical state (Critical pressure, critical volume and critical temperature).	4L
3	Periodic properties Mendeleev's periodic table; Periodic properties (Atomic radii, Ionic radii, Ionization potential, electron affinity, Electronegativity, metallic and non metallic character, oxidizing and reducing character); Polarizability (Fajans' rule); Hard soft acids and bases; molecular geometries (VSEPR theory, Hybridization, sigma and pi bond, determination of hybridization state and structure of molecules); Hydrogen bond (Inter and intra molecular H bond); Effective nuclear charge; oxidation states.	4L
4	Use of free energy in chemical equilibria <i>Thermodynamics:</i> First law of thermodynamics, Internal energy & Enthalpy, Heat capacity, Adiabatic & Isothermal process, Reversible & Irreversible process, Second law of thermodynamics, Entropy, Free energy, Gibbs-Helmholtz equation. <i>Electrochemistry:</i> Electrochemical cell (Electrolytic cell & Galvanic cell), Representation of cell, Free energy and EMF, Reversible and Irreversible cell, Nernst equation and application, Application of EMF measurement on ΔG, ΔH, ΔS, equilibrium constant of a reversible chemical reaction and valency of an ion. Hydrogen Half cell, calomel half cell, Quinhydrone half cell. <i>Water Chemistry:</i> Hydrosphere; Hydrological cycle; Sources of water;	10L

	Acidity and alkalinity of water; Pollutants of water; Biochemical and Chemical oxygen demand; Removal of dissolved solids from water (Electrodialysis & Reverse osmosis); Hardness of water (Types of hardness, Removal of hardness of water). <i>Corrosion:</i> Oxidation corrosion, Corrosion by gases, Pilling Bedworth rule, Electrochemical corrosion, Hydrogen evolution type & oxygen absorption type of corrosion, Corrosion of bimetals, Waterline corrosion, Crevice corrosion, Pitting corrosion, Stress corrosion, Factors influencing the corrosion, Prevention of corrosion.	
5	Spectroscopic techniques and applications Electromagnetic spectrum; Principles of spectroscopy and selection rules; UV/Vis Spectroscopy (Energy diagram of electron excitation, Lambert-Beer's law, Bathochromic and Hypsochromic shift, Hyperchromic and hypochromic effect, Instrumental technique, Solvent effect, application); IR spectroscopy [Basic principle, Stretching and bending vibration of AX₂ type molecule(non linear), Calculation of stretching frequency, Identification of organic compounds by IR spectroscopy, Instrumental technique and application]; NMR spectroscopy (Principle of NMR spectra, chemical shift, shielding and deshielding nucleus, application of NMR).	5L
6	Stereochemistry Isomerism, Structural isomerism, Metamerism, Tautomerism, Stereoisomerism, Optical activity, Configurations and symmetry and Chirality, Enantiomers and Diastereomers, Conformational analysis, Fischer and Sawhorse and Newman projection (inter conversion), R-, S- and E-, Z- Nomenclature.	5L
7	Organic reactions and synthesis of a drug molecule Introduction to reactions involving <i>Addition Reaction:</i> Nucleophilic addition reaction [Acid catalysed reaction; Base catalysed reaction, Reactions of aldehyde or ketone with hydrocyanic acid, sodium bisulphite, water, Grignard reagent, alcohols], Electrophilic addition reaction [addition of Br₂ to alkene; addition of hydrogen halide in symmetrical and unsymmetrical alkene (Markownikov rule); addition of Hypohalous acid, sulphuric acid and water to unsymmetrical alkene; addition of hydrogen halide in unsymmetrical alkene in presence of peroxide (Anti Markownikov rule) Ozonolysis reaction. <i>Substitution Reaction:</i> Electrophilic substitution reaction [Chlorination of Benzene; Nitration of Benzene; Friedel-Crafts Reaction (Alkylation, Acylation)], Nucleophilic substitution reaction [S_N1 and S_N2 reaction]. <i>Elimination Reaction:</i> E1 elimination and E2 elimination: Hofmann and	7L



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	Saytzev elimination. <i>Nucleophilic addition followed by elimination Reaction:</i> Reaction of carbonyl compound with ammonia, Primary amine. <i>Cyclization reaction:</i> Diels-Alder reaction. <i>Oxidation Reaction:</i> Oxidation of alcohol (Primary, secondary and tertiary alcohol); autoxidation of ether; Oxidation of aldehyde and ketone; Baeyer-Villiger oxidation; Oxidation of aromatic compounds (Oxidation of toluene and its derivatives, benzaldehyde, acetophenone, phenol). <i>Reduction Reaction:</i> Reduction of alkenes; Alkynes; carbonyl compounds (aldehydes and ketones); Carboxylic acid and esters; Bouveault-Blanc reduction; Clemensen reduction; Wolf-Kishner reduction; Meerwein-Ponndorf-Verley reduction; Pinacol-Pinacolone rearrangement; Reduction of aromatic compounds (Benzaldehyde, Benzoic acid, Nitrobenzene, m-dinitrobenzene, Diazonium salt). <i>Name Reactions:</i> Aldol condensation and Mixed Aldol condensation; Claisen-schmidt reaction; Cannizzaro reaction; Crossed Cannizzaro reaction; Kolbe-Schmitt reaction; Gattermann-Koch aldehyde synthesis <i>Synthesis of a commonly used drug molecule:</i> Paracetamol, Aspirin	
Total		45L

Course Outcomes:

After completion of the course, students will be able to:

1	Demonstrate microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2	Illustrate bulk properties and processes using thermodynamic considerations.
3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
4	Articulate periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5	List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2	University Chemistry, by B. H. Mahan
3	Fundamentals of environment and Ecology, by D. De & D. De, S. Chand Publishing.
4	Chemistry-I, by Gourkrishna Das Mohapatra, VIKAS Publishing House Pvt. Ltd.
5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6	Engineering Chemistry (NPTEL Web-book) by B.L.Tembe, Kamaluddin and M.S. Krishnan
7	Physical Chemistry, by P. W. Atkins



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8	Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Pub.
9	Physical Chemistry, P. C. Rakshit, Sarat Book House
10	Organic Chemistry, Volume I, I. L. Finar, Pearson

Course Name:	Mathematics-I		
Course Code:	BS-M101	Category:	Basic Science Courses
Semester:	First	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know Convergence of sequence and series
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function
3	To know the uses of matrix in different areas in engineering
4	To know the use of mean value theorems in engineering fields
5	Use of vector functions in different fields of Engineering

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Determinants and Matrices: (i) Introduction to determinant, properties (proofs of identities are excluded). (ii) Types of matrices, rank of a matrix, inverse of a matrix, Linear systems of equations, Cramer's rule, eigen-values and eigen-vectors, Caley-Hamilton theorem.	6L
2	Differential Calculus (Function of single variable): (i) Indeterminate forms and L'Hospital's rule; Successive differentiation, Leibnitz's theorem. (ii) Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin theorems with remainders; Maxima and minima. (iii) Evolutes and Involutives.	6L
3	Differential Calculus (Function of multi-variables): (i) Concept of limit, continuity and partial differentiation, chain rule, total differential, Jacobian, Euler's theorem on homogeneous function. (ii) Hessian, Maxima and minima; Lagrange's multipliers.	8L



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4	Integral Calculus: (i) Line integrals; double integrals, change of order; triple integrals. (ii) Evaluation of surface areas and volumes of revolutions.	6L
5	Vector Calculus: (i) Vector differential operator, scalar and vector point function, gradient, directional derivative, divergence and curl. (ii) Divergence theorem, Green's and Stoke's theorem (Statements only) and applications.	8L
6	Sequence and Series: (i) Sequence, type of a sequence. (ii) Series of positive terms; Geometric and p-series and their convergence criterion; Convergence test of series: Comparison test, D'Alembert's rati test, Cauchy's root test. (iii) Alternating series; Absolute convergence, Leibnitz's theorem.	6L
Total		40

Course Outcomes:

After completion of the course, students will be able to:

1	Apply knowledge of differential and integral calculus to determine curvature and evaluation of different types of improper integrals
2	Utilize mean value theorems for solution of engineering problems.
3	Learn matrices, concept of rank, methods of matrix inversion and their applications.
4	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
5	Determine eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces to solve physical and engineering problems
6	Solve multiple integrals and utilize it to different physical problems

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.
4	Higher Algebra, S. K. Mapa, Levant Books
5	Advanced Higher Algebra, Chakravorty and Ghosh, U N Dhar Pvt. Ltd.
6	Vector Analysis, Schaum's outline
7	An introduction to Integral calculus, Maity and Ghosh, NCBA
8	An introduction to Differential Calculus, Maity and Ghosh, NCBA
9	An introduction to Engineering mathematics-I, G.P.Samanta, New Age publication
10.	Vector Analysis, Chakravorty and Ghosh, U N Dhar Pvt. Ltd



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Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS191/ ES-CS291	Category:	Engineering Science
Semester:	First/ Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8
4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P



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Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of structured programming language .
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Chemistry Laboratory		
Course Code:	BS-CH191	Category:	Basic Science Courses
Semester:	First	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	The objective of this course is to acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field. The students will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence. The course will enable the student to: • Determine the strength of an unknown solution through conductometric and pH metric titration. • Estimate the chloride ion concentration, alkalinity and hardness in water. • Find out the rate constant of a reaction. • Synthesize polymer molecules.



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Course Contents: (Choose 10 experiments from the following)

Module No.	Description of Topic	Contact Hrs.
1	Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.	3P/ Week
2	pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.	
3	To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).	
4	Determination of dissolved oxygen present in a given water sample.	
5	Determination of viscosity of the given liquid by Ostwald –Viscometer.	
6	Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).	
7	Chemical kinetics (determination of relative rates of reaction of iodide with H ₂ O ₂ at room temperature).	
8	Determination of acid value (Acidity) of oil.	
9	The adsorption of acetic acid on active charcoal.	
10	Complexometric titration (estimation of hardness of water using EDTA).	
11	Redox titration (estimation of iron using permanganometry).	
12	To determine Alkalinity of a Given Water Sample.	
13	Synthesis of a polymer (Polyacrylamide) and determine its molecular weight by solution viscosity method.	
14	Determination of cell constant and conductance of solutions.	
Total		36P

Course Outcomes:

After completion of the course, students will be able to:

1	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: - Estimate rate constants of reactions from concentration of reactants/products as a function of time - Measure molecular/system properties such as viscosity, conductance of solutions, redox potentials, chloride content of water, etc. - Synthesize a macromolecule and determine its molecular weight by solution viscosity method.



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Learning Resources:

1	Laboratory Manual on Engineering Chemistry, by Dr Sudha Rani, Dhanpat Rai Publishing house.
2	A Text book on Experiments and calculations in Engineering Chemistry, by S.S. Dara, S Chand publications.
3	Laboratory Manual of Organic Chemistry, by Raj K Bansal, Wiley Eastern Limited, New age international limited.

Course Name:	Programming for Problem Solving Lab		
Course Code:	ES-CS191	Category:	Engineering Science
Semester:	First	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To facilitate students with the basic concept of a programming language (C programming language) and its execution using a compiler.
2	To develop the ability to apply the programming skills for solution of problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Lab1: Familiarization with C programming environment with simple problems, use of format specifier in printf() , sizeof() etc. . Lab 2: Simple computational problems using different operators, expressions.	8
2	Lab 3: Problems involving using Conditional Statements (if-else, nested if-else) Lab 4: Iterative problems using while, do-while, for loops (eg. Series sum, sum of digits etc). Lab 5: Problems to be solved using switch-case and nested loop.	12
3	Lab 6 & 7: Concepts of Array and problems using 1-D and 2-D array (array manipulation, searching, sorting, matrix manipulation).	8



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4	Lab 8: Concepts of Functions (call by value) and Recursive function (eg. Factorial, GCD etc.) Lab 9: Problems on String manipulation (using library function and user defined functions). Lab 10: Problems to be solved using concepts of Pointer, function call by address, relation between array and pointer.	12
5	Lab 11: Problems to be solved using concepts of array and structure. Lab 12: Problems involving File handling operations.	8
Total		48P

Course Outcomes:

After completion of the course, students will be able to:

1	Understand the concept of programming language.
2	Implement conditional branching, iteration and recursive functions.
3	Apply programming concepts to solve matrix manipulation, searching and sorting problems.
4	Use pointers and structures to solve related problems of different domain.

Learning Resources:

1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3	Yashavant Kanetkar, Let Us C, BPB Publication
4	Reema Thereja, Computer Fundamentals and Programming in C, Oxford
5	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	Workshop/ Manufacturing Practices		
Course Code:	ES-ME192	Category:	Engineering Sciences
Semester:	First	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To impart basic knowledge of various hand tools and their applications in different sections of manufacturing
2	To develop basic manufacturing skills, precision, safety at work place, team working and development of right attitude.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
Lectures and videos:		
	1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods 2. CNC machining, Additive manufacturing 3. Fitting operations & power tools 4. Electrical & Electronics 5. Carpentry 7. Metal casting 8. Welding (arc welding & gas welding), brazing	13L
Workshop Practice:		
1	Machine shop: <i>Typical jobs that may be made in this practice module:</i> - To make a pin from a mild steel rod in a lathe. - To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.	8P
2	Fitting shop: <i>Typical jobs that may be made in this practice module:</i> To make a Gauge from MS plate.	8P
3	Carpentry: <i>Typical jobs that may be made in this practice module:</i> To make wooden joints and/or a pattern or like.	8P
4	Welding shop (Arc welding 4 hrs + gas welding 4 hrs): <i>Typical jobs that may be made in this practice module:</i> ARC WELDING (4 hours): - To join two thick (approx 6mm) MS plates by manual metal arc welding. GAS WELDING (4 hours): - To join two thin mild steel plates or sheets by gas welding.	8P
5	Casting: <i>Typical jobs that may be made in this practice module:</i> One/ two green sand moulds to prepare, and a casting be demonstrated.	8P
6	Smithy: <i>Typical jobs that may be made in this practice module:</i> A simple job of making a square rod from a round bar or like.	4P

7	Electrical & Electronics: • Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable. • Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point. • Simple wiring exercise to be executed to understand the basic electrical circuit. • Simple soldering exercises to be executed to understand the basic process of soldering. • Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.	8P
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Identify and utilize machine tools for producing components through machining processes
2	Demonstrate fundamental concept of pattern making, and moulding processes for engineering applications.
3	Practice fitting, carpentry, and smithy operations for manufacturing of components.
4	Explain concepts and applications of various types of fabrication processes.
5	Apply basic electrical and electronics engineering knowledge for household applications.

Learning Resources:

1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology-I" Pearson Education, 2008.
4	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998
5	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill, 2017.



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Course Name:	Language Laboratory		
Course Code:	HM-HU191	Category:	Mandatory Course
Semester:	First	Credit:	1
L-T-P:	0-0-2	Pre-Requisites:	To develop Technical Communication Skills. (listening, speaking, reading and writing)
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To develop Technical Communication Skills. (listening, speaking, reading and writing)

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Honing 'Listening Skill' and its sub skills through Language Lab Audio device	4P
2	Honing 'Speaking Skill' and its sub skills: Extempore, Public speaking, etc. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/ Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.	6P
3	Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Debate, Role Play etc.)	4P
4	Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.	6P
5	Honing 'Reading Skills' and its sub skills.	2P
6.	Honing 'Writing Skill' and its sub skills by using Language Lab Audio – Visual input; Practice Sessions	2P
Total		24

Course Outcomes:	
After completion of the course, students will be able to:	
1	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop their intellectual, personal and professional abilities.



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Learning Resources:

1.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
6.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage , 2019.

Second Semester

Course Name:	Physics		
Course Code:	BS-PH201	Category:	Basic Science Course
Semester:	Second	Credit:	4.0
L-T-P:	3-1-0	Pre-Requisites:	Mathematics course with vector calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	Understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	Describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Module-1: Foundations of Quantum Mechanics	(8L)
	Introduction to Quantum Physics: Brief idea about the historical development of quantum mechanics.	1
	Black Body Radiation: Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws.	2
	Compton Effect: Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	2
	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation.	2
	Uncertainty Principle: Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero point energy, Numerical problems.	1

2	Module-2: Schrödinger Wave Equation and Its Applications Formulation of Quantum Mechanics: Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of associated problems. Schrödinger Wave Equation: Time independent Schrödinger's equation from time dependent one by the separation of variable method. Applications of Quantum Mechanics: Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator	(8L) 3 1 4
3	Module-3: Dielectric Materials and their Applications Concept of Dielectric and Polarization: Electric field inside a Dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, Atomic polarizability and polarization vector. Inter Relationship among Dielectric Parameters: Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems on relation between polarizability, susceptibility and dielectric constant. Types of Polarization: Electronic polarization and derivation of electronic polarizability, Concept of ionic and orientational polarization (no derivation). Applications of Dielectric: Dielectric breakdown and dielectric strength, Concept of Dielectric loss, Few applications of dielectrics in different fields.	(5L) 1 2 1 1
4	Module-4: Time Varying Fields Electromagnetic Induction: Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in Motors and Generators, Calculation of Induced EMF. Displacement Current: Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	(3L) 2 1
5	Module-5: Electromagnetic Waves Maxwell's Electromagnetic Field Equations: Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators etc.). Plane Electromagnetic Wave in Free Space: Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. Plane Electromagnetic Wave in Medium: Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. Energy in an Electromagnetic Field: Flow of energy associated to electromagnetic field and Poynting vector.	(6L) 2 1 2 1

6	Module-6: Laser and Fiber Optics	(9L)
	Introduction to Laser: Properties of light sources, Need of suitable light source in communication, Invention of laser, Characteristics and applications of laser.	1
	Interaction of Light with Matter: Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them.	1
	Components and Working of Laser Systems: Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO ₂ laser).	2
	Optical Communication: Introduction, Need for optical communication, Salient features of optical fibers, Amplitude and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth analog/digital communication system	2
	Light Guidance in Fibers: Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single and multimode fibers, Step-index and graded-index fibers.	1
	Transmission characteristics of optical fibers: Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion, bit rate - length product, Minimization of intermodal dispersion.	2
Total		39L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various medium of propagations.
4	Understand the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy etc.
6	Explain the workings of various LASERS and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the dispersion leading to calculation of Bit Rate of a communication channel.



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Learning Resources:

1	'Introduction to Quantum Mechanics' by David J. Griffiths
2	'Quantum Mechanics' by Leonard I. Schiff
3	'Quantum Physics' by A. N. Konar
4	'Perspectives of Modern Physics' by Arthur Beiser
5	'Introduction to Electrodynamics' by David J. Griffiths
6	'Electrical Engineering Materials' by A. J. Dekker
7	'Fundamentals of Optics' by Jenkins and White
8	'Lasers, theory and applications' by K. Thyagrajan and A. Ghatak
9	'Understanding Lasers' by Jeff Hecht
10	'An Introduction to Fiber Optics' by Ajoy Ghatak and K. Thyagrajan

Course Name:	Mathematics-II		
Course Code:	BS-M201	Category:	Basic Science Courses
Semester:	Second	Credit:	04
L-T-P:	3-1-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To learn how to solve different types of differential equation
2	To know the different types of improper integral
3	To know the Laplace transform
4	Basic concept of graph, digraph, walk, Hamiltonian graph, Euler circuit,
5	Basic concept of tree, binary tree

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Ordinary Differential Equations of First order: ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, In-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree Equations solvable for p , solvable for x , solvable for y ; Clairaut's equations	8L



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2	Higher Order Ordinary Differential Equations: (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI) (ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	8L
3	Improper Integrals: (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L
4	Laplace Transforms and Inverse Laplace Transforms: (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of a function multiplied by t^n and divided by t ; LT of unit step and periodic functions; LT of derivatives. (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii) Solutions of initial and boundary value problems by LT	8L
5	Graph Theory: (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	Tree: (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		40L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical or engineering problems
3	Use tree and graph algorithms for different problems
4	evaluation of different types of improper integrals

Learning Resources:

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.



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4	An introduction to differential equation, Maity & Ghosh, NCBA
5	Michael Greenberg, Advanced Engineering Mathematics, Pearson
6	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
7	An introduction to Integral calculus, Maity and Ghosh, NCBA
8	Advanced Differential Equation, M.D Raisinghanian
9	An introduction to Engineering mathematics-II, G.P. Samanta, New Age publication

Course Name:	Basic Electrical and Electronics Engineering		
Course Code:	ES-EE201	Category:	ES
Semester:	Second	Credit:	4
L-T-P:	4-0-0	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:	
1	To provide comprehensive idea about AC and DC circuit analysis
2	To make the students understand about working principals and applications of electric machines
3	To make the students understand the components of low voltage electrical installations
4	To provide basic idea about general structure of electrical power system.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
Module 1	DC Circuits Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5
Module 2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel),	4
Module 3	Three phase system Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2



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Module 4	DC Machines Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor	5
Module 5	AC Machines Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency Three-phase induction motor Generation of rotating magnetic fields, Construction and working of a three-phase induction motor.	4
Module 6	Electrical Installations Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3
Module 7	General structure of electrical power system: Power generation to distribution through overhead lines and underground cables with single line diagram	1
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Apply the concepts of KVL/ KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.

Learning Resources:

1	D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2	C.L. Wadhwa, Basic Electrical Engineering, New Age, 2007.
3	S K Bhattacharya, Basic Electrical and Electronics Engineering, Pearson, 2011
4	Ashfaq Husain and Haroon Ashfaq, Fundamentals of Electrical Engineering, Dhanpat Rai & Co., Delhi, 2007.
5	J.B. Gupta, Basic Electrical Engineering, Kataria& Sons, 2015.
6	L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
7	E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:	
1	To make the students understand about the semiconductor.
2	To make the students understand about Diode and its circuit.
3	To make the students understand about different Transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Semiconductors: Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5
2	Diode and Diode Circuits: Formation of P-N junction, depletion region, built-in-potential, forward and reverse biased P-N junction, energy band diagrams, V-I characteristics, Zener diode forward and reverse characteristics, Avalanche breakdown and Zener breakdown, junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, PIV, ripple factor, efficiency.	4 3
3	Introduction to Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET): Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier. JFET (N channel only) structure, Drain and Transfer characteristics.	4 2
4	Introduction to OPAMP and Digital Electronics: Introduction to Operational Amplifiers: Characteristics, Inverting and Non-Inverting mode of operation, summing amplifier, difference amplifier. Introduction to binary number; Basic Boolean algebra; Introduction to integrated circuits, Logic gates and truth tables for different logic operations and simple digital circuits using the basic gates.	3 3
Total		24



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Course Outcomes:

After completion of the course, students will be able to:

1	identify semiconductor materials, draw band-diagrams, distinguish between intrinsic and extrinsic semiconductors, n- and p- type semiconductors, calculate drift and diffusion current components
2	explain the junction properties and the phenomenon of rectification, draw the I-V characteristics and identify operating points; Calculate ripple factors, efficiency of power supplies.
3	draw and explain the I-V characteristics of BJTs and FET – both input and output;
4	understand basics of OPAMP and learn the use of it as amplifier.
5	Explain binary numbers and identify different logic gates and circuit implementation.

Learning Resources:

1	Rakshit and Chattopadhyay: Introduction to Electronics Principle
2	Malvino: Electronic Principle.
3	Millman & Halkias: Integrated Electronics.
4	Boyelstad & Nashelsky: Electronic Devices & Circuit Theory.

Course Name:	English		
Course Code:	HM-HU201	Category:	Mandatory Course
Semester:	Second	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	1. Students must have basic command of English to talk about day-to-day events and experiences of life. 2. Comprehend Lectures delivered in English. 3. Read and understand relevant materials written in English.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To develop Technical Communication Skills (speaking, reading and writing).



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	TECHNICAL COMMUNICATION: Theory of Communication – Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills	1L
2	VOCABULARY BUILDING: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms	1L
3.	BASIC WRITING SKILLS. Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences in logical order.	1 L
4	GRAMMAR: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9 L
5	WRITING PRACTICES: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10 L
6.	READING COMPREHENSION: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		24L

Course Outcomes:

After completion of the course, students will be able to:

1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:

1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007



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3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5.	Universal English. Prof. Prasad Kataria Publications, 2019.
6.	"Communication Skills for Professionals"-Nira Konar, Prentice Hall of India 2nd edition, New Delhi, 2011
7.	Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019. Course Outcomes The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Name:	Physics Laboratory		
Course Code:	BS-PH291	Category:	Basic Science Courses
Semester:	Second	Credit:	1.5
L-T-P:	0-0-3	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	Apply the concepts of physics to carry out experiments on Quantum physics, EMT, Optics and General properties of matter and interpret the same for deduction of results.

Course Contents: (Choose 10 experiments from the following)

Module No.	Description of Topic	Contact Hrs.
1	Determination of Dispersive Power of the Material of a Prism	3P/ week
2	Determination of wavelength of a monochromatic light by Newton's ring	
3	Determination of Wavelength of the Given LASER Light by Diffraction Method	
4	Determination of Thermo-electric Power of a given Thermocouple	
5	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method	
6	Determination of Hall Coefficient of a Semiconductor	
7	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell	
8	Determination of Unknown Resistance using Carey Foster's Bridge	
9	Determination of Planck Constant using Photocell	
10	Verification of Bohr's Atomic Orbital Theory Through Frank-Hertz Experiment	
11	Determination of Rydberg Constant by Studying Hydrogen Spectrum	
12	Determination of Band Gap of a Semiconductor by Four Probe Method	



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13	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure	
14	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method	
15	Determination of Coefficient of Viscosity by Poiseuille's Capillary Flow Method	
Total		39P

Course Outcomes:

After completion of the course, students will be able to:

1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.

Learning Resources:

1	An Advanced Course in Practical Physics, by D. Chattopadhyay, P. C. Rakshit
2	A Manual of Practical Engineering Physics and Material Science, by A S Vasudeva
3	A Textbook of Engineering Physics Practical, by Dr. R Das, Dr. R Kumar, C S Robinson & P K Sahu

Course Name:	Basic Electrical and Electronics Engineering Lab		
Course Code:	ES-EE291	Category:	ES
Semester:	Second	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:

1	Provide working knowledge for the analysis of basic DC and AC circuits
2	Measurement of power in three phase system
3	Provide working knowledge on Electric machines.



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Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	3
2	Calibration of ammeter and Wattmeter.	3
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	3
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method	3
5	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3
6	Determination of Torque –Speed characteristics of separately excited DC motor.	3
Total		18 P

Course Outcomes:

After completion of the course, students will be able to:

1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.
3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the different characteristics of separately excited DC motor.

Learning Resources:

1	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:

1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.

Course Contents:



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Exp. No.	Description of Topic	Contact Hrs.
1.	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	3
2	a) Study of I-V characteristics of Junction diodes. b) Study of I-V characteristics of Zener diodes.	3
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	3
4	a) Study of I-V characteristics of BJTs. for CB configurations b) Study of I-V characteristics of BJTs. for CE configurations	3
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	3
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	3
Total		18P

Course Outcomes:

After completion of the course, students will be able to:

1	identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.
3	implement half wave and full wave rectifier circuits and can analyse the performance of them.
4	realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	use OPAMP as amplifier and verify the truth tables of different logic gates.

Learning Resources:

1	Laboratory Manual



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Course Name:	Engineering Graphics & Design		
Course Code:	ES-ME291	Category:	Engineering Sciences
Semester:	Second	Credit:	3
L-T-P:	1-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make students aware of importance of engineering drawing and to familiar with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P
5	Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P
7	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1L+4P

8	Sections and Sectional Views Of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1L+4P
9	Overview of Computer Graphics, Customisation & CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	1L+4P
10	Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	2L+8P
11	Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing	2L+8P



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	practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	
Total		13L+52P

Course Outcomes:

After completion of the course, students will be able to:

1	Familiarize with basics of drawing, dimensioning, scales, curves
2	Comprehend the theory of orthographic projection and its applications
3	Prepare and interpret isometric projection
4	Create and modify 2D drawing using AutoCAD software

Learning Resources:

1	Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5	Narayana K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Pub.
6	Corresponding set of CAD Software Theory and User Manuals



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Curriculum for Postgraduate Degree (M.Tech.) in Electronics and Communication Engineering (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

B. Credits:

As per AICTE, a student covering 68 credits during 2 years of studies as per curriculum of the Institute will be eligible to get Post Graduate M.Tech. degree.

C. Category wise Credit Distribution:

Sl. No.	Category	Credit Allotted	Credit as per AICTE
1	Professional Core Courses	20	20
2	Professional Elective Courses relevant to chosen specialization/ branch	15	15
3	Open Elective Courses from other technical and / or emerging subjects	3	3
4	Project Work, Seminar and Internship in Industry or elsewhere	28	28
5	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]	2	2
Total		68	68

D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	PC	Professional Core Courses
5	PE	Professional Elective Courses
6	OE	Open Elective Courses
7	MC	Mandatory Courses
8	PW	Project/ Internships/ Sessional



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E. Courses in Different Categories:

Professional Core Courses							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	PC-MCE101	Advanced Communication Networks	3	0	0	3
2	I	PC-MCE102	Wireless and Mobile Communication	3	0	0	3
3	II	PC-MCE201	Antennas and Radiating Systems	3	0	0	3
4	II	PC-MCE202	Advanced Digital Signal Processing	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional							
1	I	PC- MCE191	Advanced Communication Networks Lab	0	0	4	2
2	I	PC-MCE192	Wireless and Mobile Communication Lab	0	0	4	2
3	II	PC-MCE291	Antennas and Radiating Systems lab	0	0	4	2
4	II	PC-MCE292	Advanced Digital Signal Processing Lab	0	0	4	2
Total Practical/ Sessional				0	0	16	8
Total				12	0	16	20

Professional Elective Courses relevant to chosen specialization/ branch							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	PE-MCE101	Professional Elective-I	3	0	0	3
2	I	PE-MCE102	Professional Elective-II	3	0	0	3
3	II	PE-MCE201	Professional Elective-III	3	0	0	3
4	II	PE-MCE202	Professional Elective-IV	3	0	0	3
5	III	PE-MCE301	Professional Elective-V	3	0	0	3
Total Theory				15	0	0	15
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				15	0	0	15



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Open Elective Courses from other technical and / or emerging subjects							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	III	OE-MCE301	Open Elective	3	0	0	3
Total Theory				3	0	0	3
Practical/ Sessional							
Total Practical/ Sessional				0	0	0	0
Total				3	0	0	3

Project Work, Seminar and Internship in Industry or elsewhere							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
Total Theory				0	0	0	0
Practical/ Sessional							
1	I	PW-MCE171	Audit Course-I	2	0	0	0
2	II	PW-MCE271	Audit Course-II	2	0	0	0
3	II	PW-MCE281	Mini Project with Seminar	0	0	4	2
4	III	PW-MCE381	Dissertation –I	0	0	20	10
5	IV	PW-MCE481	Dissertation -II	0	0	32	16
Total Practical/ Sessional				4	0	56	28
Total				4	0	56	28

Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge, Aptitude Skill]							
Sl No.	Semester	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	I	MC-MCE171	Research Methodology and IPR	2	0	0	2
Total Theory				2	0	0	2
Practical/ Sessional							



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<i>Total Practical/ Sessional</i>	0	0	0	0
Total	2	0	0	2



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Curriculum Postgraduate Degree (M.Tech.) in Electronics and Communication Engineering (w.e.f. AY: 2020-21)

Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-MCE101	Advanced Communication Networks	3	0	0	3
2	PC	PC-MCE102	Wireless and Mobile Communication	3	0	0	3
3	PE	PE-MCE101	Professional Elective-I	3	0	0	3
4	PE	PE-MCE102	Professional Elective-II	3	0	0	3
	Total Theory			12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PC	PC-MCE191	Advanced Communication Networks Lab	0	0	4	2
2	PC	PC-MCE192	Wireless and Mobile Communication Lab	0	0	4	2
3	PW	PW-MCE171	Audit Course-I	2	0	0	0
4	MC	MC-MCE171	Research Methodology and IPR	2	0	0	2
	Total Practical/ Sessional/ Mandatory Course			4	0	8	6
Total of First Semester				16	0	8	18

Second Semester (First Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PC	PC-MCE201	Antennas and Radiating Systems	3	0	0	3
2	PC	PC-MCE202	Advanced Digital Signal Processing	3	0	0	3
3	PE	PE-MCE201	Professional Elective-III	3	0	0	3
4	PE	PE-MCE202	Professional Elective-IV	3	0	0	3
Total Theory				12	0	0	12
Practical/ Sessional/ Mandatory Course							
1	PC	PC-MCE291	Antennas and Radiating Systems lab	0	0	4	2
2	PC	PC-MCE292	Advanced Digital Signal Processing Lab	0	0	4	2
3	PW	PW-MCE271	Audit Course-II	2	0	0	0
4	PW	PW-MCE281	Mini Project with Seminar	0	0	4	2



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<i>Total Practical/ Sessional/ Mandatory Course</i>	2	0	12	6
Total of Second Semester	14	0	12	18

Third Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	PE	PE-MCE301	Professional Elective-V	3	0	0	3
2	OE	OE-MCE301	Open Elective	3	0	0	3
Total Theory				6	0	0	6
Practical/ Sessional/ Mandatory Course							
1	PW	PW-MCE381	Dissertation –I	0	0	20	10
Total Practical/ Sessional/ Mandatory Course				0	0	20	10
Total of Third Semester				6	0	20	16

Fourth Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
Total Theory				0	0	0	0
Practical/ Sessional/ Mandatory Course							
1	PW	PW-MCE481	Dissertation -II	0	0	32	16
Total Practical/ Sessional/ Mandatory Course				0	0	32	16
Total of Fourth Semester				0	0	32	16

Total Credit Point of Program = 68



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List of Elective Courses	
PE-MCE101	Professional Elective–I
PE-MCE101A	Wireless Sensor Networks
PE-MCE101B	Optical Networks
PE-MCE101C	Statistical Information Processing
PE-MCE102	Professional Elective–II
PE-MCE102A	Cognitive Radio
PE-MCE102B	RF and Microwave Circuit Design
PE-MCE102C	DSP Architecture
PE-MCE201	Professional Elective–III
PE-MCE201A	Satellite Communication
PE-MCE201B	Internet of Things
PE-MCE201C	Voice and data networks
PE-MCE201D	Integrable circuits & Design
PE-MCE202	Professional Elective–IV
PE-MCE202A	Markov Chain and Queuing System
PE-MCE202B	MIMO System
PE-MCE202C	Programmable Networks –SDN, NFV
PE-MCE202D	Microwave Measurement Techniques
PE-MCE301	Professional Elective–V
PE-MCE301A	High Performance Networks
PE-MCE301B	Pattern Recognition and Machine Learning
PE-MCE301C	Remote Sensing
PE-MCE301D	Electromagnetic Interference and Electromagnetic Compatibility (EMI and EMC)



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List of Elective Courses	
OE-MCE301	Open Elective
OE-MCE301A	Business Analytics
OE-MCE301B	Operations Research
OE-MCE301C	Cost Management of Engineering Projects
OE-MCE301D	Industrial Safety
OE-MCE301E	Composite Materials
OE-MCE301F	Waste to Energy

List of Audit Courses	
PW-MCE171	Audit Course-I
PW-MCE101A	English for Research Paper Writing
PW-MCE101B	Pedagogy Studies
PW-MCE101C	Value Education
PW-MCE101D	Stress Management by Yoga
PW-MCE271	Audit Course-II
PW-MCE201A	Personality Development through Life Enlightenment Skills.
PW-MCE201B	Sanskrit for Technical Knowledge
PW-MCE201C	Constitution of India
PW-MCE201D	Disaster Management



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Curriculum for Postgraduate Degree (M.Tech.) in Electronics and Communication Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Course Name:	Advanced Communication Networks		
Course Code:	PC-MCE101	Category:	PC
Semester:	I	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Computer Network
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand advanced concepts in Communication Networking.
2	Design and develop protocols for Communication Networks
3	Understand the mechanisms in Quality of Service in networking
4	Optimise the Network Design.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Overview of Internet-Concepts, challenges and history. Overview of ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.	6
2	Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.; Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket algorithm and its properties.	6
3	Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.; Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.	6



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4	IP address lookup-challenges. Packet classification algorithms and Flow Identification Grid of Tries, Cross producing and controlled prefix expansion algorithms.	6
5	Admission control in Internet. Concept of Effective bandwidth. Measurement Based admission control. Differentiated Services in Internet (DiffServ). Diff Serv architecture and framework.	6
6	IPV4, IPV6, IP tunnelling, IPswitching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.	6
Total		36

Course Outcomes:

1	Understand advanced concepts in Communication Networking.
2	Design and develop protocols for Communication Networks
3	Understand the mechanisms in Quality of Service in networking
4	Optimise the Network Design

Learning Resources:

1	Jean Wairand and Pravin Varaiya, "High Performance Communications Networks", 2 nd edition, 2000.
2	Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Verlag, 2001
3	Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers, 2004.
4	George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers, 2005
5	Zhang Wang, "Internet QoS", Morgan Kaufman, 2001.

Course Name:	Wireless and Mobile Communication		
Course Code:	PC-MCE102	Category:	PC
Semester:	I	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Design appropriate mobile communication systems



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2	Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques
3	Distinguish various multiple-access techniques for mobile communications e.g. DMA, TDMA, CDMA, and their advantages and disadvantages.
4	Analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance
5	Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology
6	Understanding upcoming technologies like 3G, 4G etc

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel Interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM. 2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE	7
2	Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)	5
3	Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading	8
4	Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.	4
5	Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95	7



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	(CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.	
6	Higher Generation Cellular Standards: 3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G	5
Total		36

Course Outcomes:

1	Design appropriate mobile communication systems
2	Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques
3	Distinguish various multiple-access techniques for mobile communications e.g. DMA, TDMA, CDMA, and their advantages and disadvantages.
4	Analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance
5	Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology
6	Understanding upcoming technologies like 3G, 4G etc

Learning Resources:

1	V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008
2	V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
3	T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.
4	William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995
5	Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Boston, London, 1997.

Course Name:	Wireless Sensor Networks		
Course Code:	PE-MCE101A	Category:	PE
Semester:	I	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05



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Course Objectives:

1	Design wireless sensor network system for different applications under consideration
2	Understand the hardware details of different types of sensors and select right type of sensor for various applications.
3	Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
4	Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
5	Handle special issues related to sensors like energy conservation and security challenges

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.	
2	Hardware: Examples like mica2, mica Z, telos B, cricket, Imote2, t mote, b t node, and Sun SPOT, Software (Operating Systems): tiny OS, MANTIS, Contiki, and Ret OS	
3	Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)	
4	Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.	
5	Data dissemination and processing; differences compared with other database management systems, data storage; query processing.	
6	Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network	
Total		36

Course Outcomes:

1	Design wireless sensor network system for different applications under consideration
2	Understand the hardware details of different types of sensors and select right type of sensor for various applications.



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3	Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
4	Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
5	Handle special issues related to sensors like energy conservation and security challenges

Learning Resources:

1	H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012
2	C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.
3	F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
4	YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

Course Name:	Optical Networks		
Course Code:	PE-MCE101B	Category:	PE
Semester:	I	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Contribute in the areas of optical network and WDM network design.
2	Implement simple optical network and understand further technology developments for future enhanced network

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.	6
2	WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.	6



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3	Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.	6
4	Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes	6
5	WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.	6
6	Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.	6
Total		36

Course Outcomes:	
1	Contribute in the areas of optical network and WDM network design.
2	Implement simple optical network and understand further technology developments for future enhanced network

Learning Resources:	
1	Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3 rd edition, 2010
2	C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.

Course Name:	Statistical Information Processing		
Course Code:	PE-MCE101C	Category:	PE
Semester:	I	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations
2	Demonstrate mathematical modelling and problem solving using such models.
3	Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
4	Develop frameworks based in probabilistic and stochastic themes for modelling and

	analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete & Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.	
2	Random signal modelling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications, Linear System with random input, Forward and Backward Predictions, Levinson Durbin Algorithm.	
3	Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, Many Hypothesis Testing, Mini max Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate, Multiple Parameter Estimation Best Linear Unbiased Estimator, Least-Square Estimation Recursive Least-Square Estimator.	
4	Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals	
5	Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shannon-Fano, Arithmetic adaptive coding, RLE, LZW Data compaction, LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.	
6	Application of Information Theory: Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements, Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes, & Decoder, Reed-Solomon codes & Decoder,	



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	implementation of Reed Solomon encoders and decoders.	
Total		36

Course Outcomes:

1	Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations
2	Demonstrate mathematical modelling and problem solving using such models.
3	Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
4	Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.

Learning Resources:

1	Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill, 2002
2	D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.
3	Mourad Barkat, "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
4	R G. Gallager, "Information theory and reliable communication", Wiley, 1st edition, 1968.
5	F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", New York, North-Holland, 1977.
6	Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

Course Name:	Cognitive Radio		
Course Code:	PE-MCE102A	Category:	PE
Semester:	I	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand the fundamental concepts of cognitive radio networks
2	Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.



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3	Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
4	Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimisation techniques for better spectrum exploitation.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.	
2	Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).	
3	Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.	
4	Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.	
5	Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).	
6	Research Challenges in Cognitive Radio: Network layer and transport layer issues, crosslayer design for cognitive radio networks.	
Total		36

Course Outcomes:

1	Understand the fundamental concepts of cognitive radio networks.
2	Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
3	Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
4	Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimisation techniques for better spectrum exploitation.

Learning Resources:

1	Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
2	Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
3	Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
4	Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
5	Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
6	Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

Course Name:	RF and Microwave Circuit Design		
Course Code:	PE-MCE102B	Category:	PE
Semester:	I	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand the behaviour of RF passive components and model active components.
2	Perform transmission line analysis.
3	Demonstrate use of Smith Chart for high frequency circuit design.
4	Justify the choice/selection of components from the design aspects.
5	Contribute in the areas of RF circuit design.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Transmission Line Theory: Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.	6
2	Microwave Network Analysis: Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.	6



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3	Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.	6
4	Nonlinearity And Time Variance Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.	4
5	Microwave Semiconductor Devices And Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.	8
6	Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.	6
Total		36

Course Outcomes:

1	Understand the behaviour of RF passive components and model active components.
2	Perform transmission line analysis.
3	Demonstrate use of Smith Chart for high frequency circuit design.
4	Justify the choice/selection of components from the design aspects.

Learning Resources:

1	D.M.Pozar, "Microwave engineering", Wiley, 4th edition, 2011.
2	S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987.
3	Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", AuthorHouse, 2009..
4	R.E. Collin, Foundations of Microwave Engineering. McGraw Hill.
5	G.D. Vendelin, A.M. Pavoi, U. L. Rohde, "Microwave Circuit Design Using Linear And Non Linear Techniques", John Wiley 1990.

Course Name:	DSP Architecture		
Course Code:	PE-MCE102C	Category:	PE
Semester:	I	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Identify and formalize architectural level characterization of P-DSP hardware.
2	Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment.
3	Deployment of DSP hardware for Control, Audio and Video Signal processing applications.
4	Understanding of major areas and challenges in DSP based embedded systems.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.	
2	Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family, TMS320C25 – Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.	
3	VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.	
4	Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).	
5	FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.	



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6	High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.	
Total		36

Course Outcomes:

1	Identify and formalize architectural level characterization of P-DSP hardware.
2	Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment.
3	Deployment of DSP hardware for Control, Audio and Video Signal processing applications.
4	Understanding of major areas and challenges in DSP based embedded systems.

Learning Resources:

1	M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
2	Fayez Gebali, "Algorithms and Parallel Computing", 1st Edition, John Wiley & Sons, 2011.
3	Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald, "Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman, 2000.
4	Ann Melnichuk, Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press, 2010.
5	Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
6	E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands, 2007.

Course Name:	Research Methodology and IPR		
Course Code:	MC-MCE171	Category:	MC
Semester:	I	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand research problem formulation.



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2	Analyze research related information.
3	Follow research ethics.
4	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	4
2	Effective literature studies approaches, analysis Plagiarism, Research ethics,	3
3	Effective technical writing, how to write report, Paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	4
4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.	3
5	International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	3
6	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	3
7	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software	4



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	etc. Traditional knowledge Case Studies, IPR and IITs.	
Total		24

Course Outcomes:	
1	Understand research problem formulation.
2	Analyze research related information.
3	Follow research ethics.
4	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Learning Resources:	
1	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2	Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3	Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners".
4	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5	Niebel , "Product Design", McGraw Hill, 1974.
6	Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
7	T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Course Name:	Advanced Communication Networks Laboratory		
Course Code:	PC- MCE191	Category:	PC
Semester:	I	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	Computer Network
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05



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Course Objectives:

1	Identify the different types of network devices and their functions within a network.
2	Understand and build the skills of sub-netting and routing mechanisms.
3	Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP,RARP) and Network Configuration Files.	3
2	Linux Network Configuration. a. Configuring NIC's IP Address. b. Determining IP Address and MAC Address using if-config command. c. Changing IP Address using if-config. d. Static IP Address and Configuration by Editing. e. Determining IP Address using DHCP. f. Configuring Hostname in /etc/hosts file.	3
3	Design TCP iterative Client and Server application to reverse the given input sentence.	3
4	Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".	3
5	Design UDP Client Server to transfer a file.	3
6	Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.	3
7	Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.	6
8	Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.	3
9	Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.	3
10	Signaling and QoS of labeled paths using RSVP in MPLS.	3
11	Find shortest paths through provider network for RSVP and BGP.	3



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Total	36

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify the different types of network devices and their functions within a network.
2	Understand and build the skills of sub-netting and routing mechanisms.
3	Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Learning Resources:	
1	Laboratory manual

Course Name:	Wireless and Mobile Communication Laboratory		
Course Code:	PC-MCE192	Category:	PC
Semester:	I	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Understanding Cellular concepts, GSM and CDMA networks.
2	To study GSM handset by experimentation and fault insertion techniques.
3	Understating of 3G communication system by means of various AT commands usage in GSM.
4	Understanding CDMA concept using DSSS kit.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.	
2	Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.	



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3	Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).	
4	To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.	
5	To study various GSM AT Commands their use and developing new application using it. Understating of 3G Communication System with features like; transmission of voice and videocalls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.	
6	Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.	
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	Understanding Cellular concepts, GSM and CDMA networks.
2	To study GSM handset by experimentation and fault insertion techniques.
3	Understating of 3G communication system by means of various AT commands usage in GSM.
4	Understanding CDMA concept using DSSS kit.

Learning Resources:

1	
2	
3	

Course Name:	English for Research Paper Writing		
Course Code:	PW-MCE171A	Category:	PW
Semester:	I	Credit:	0
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination:	Continuous Assessment:	Attendance:

Course Objectives:

1	Understand that how to improve your writing skills and level of readability
2	Learn about what to write in each section.



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3	Understand the skills needed when writing a Title.
4	Ensure the good quality of paper at very first-time submission.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check .	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4
Total		24

Course Outcomes:	
1	Understand that how to improve your writing skills and level of readability
2	Learn about what to write in each section.
3	Understand the skills needed when writing a Title.
4	Ensure the good quality of paper at very first-time submission.

Learning Resources:	
1	Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2	Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3	Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4	Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.



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Course Name:	Pedagogy Studies		
Course Code:	PW-MCE171B	Category:	PW
Semester:	I	Credit:	0
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination:	Continuous Assessment:	Attendance:

Course Objectives:	
1	Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2	Identify critical evidence gaps to guide the development.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction and Methodology: - Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education. - Conceptual framework, Research questions. - Overview of methodology and Searching.	3
2	- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. - Curriculum, Teacher education	6
3	Evidence on the effectiveness of pedagogical practices - Methodology for the in depth stage: quality assessment of included studies. - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change. - Strength and nature of the body of evidence for effective pedagogical practices. - Pedagogic theory and pedagogical approaches. - Teachers' attitudes and beliefs and Pedagogic strategies.	6
4	Professional development: alignment with classroom practices and follow-up support - Peer support - Support from the head teacher and the community.	6



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	- Curriculum and assessment - Barriers to learning: limited resources and large class sizes	
5	Research gaps and future directions - Research design - Contexts - Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.	3
Total		24

Course Outcomes:	
1	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Learning Resources:	
1	Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2	Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3	Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4	Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
5	Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
6	www.pratham.org/images/resource%20working%20paper%202.pdf .

Course Name:	Value Education		
Course Code:	PW-MCE171C	Category:	PW
Semester:	I	Credit:	0
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination	Semester Examination:	Continuous	Attendance:



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Scheme:		Assessment:	

Course Objectives:	
1	Understand value of education and self- development.
2	Imbibe good values in students.
3	Let the should know about the importance of character.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgements	4
2	Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism. Love for nature, Discipline	6
3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	8
4	• Character and Competence –Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence ,Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	6
Total		24

Course Outcomes:	
1	Knowledge of self-development.
2	Learn the importance of Human values.
3	Developing the overall personality.



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Learning Resources:

1	Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Course Name:	Stress Management by Yoga		
Course Code:	PW-MCE171D	Category:	PW
Semester:	I	Credit:	0
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination:	Continuous Assessment:	Attendance:

Course Objectives:

1	To achieve overall health of body and mind.
2	To overcome stress.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	- Definitions of Eight parts of yog. (Ashtanga) - Yam and Niyam	8
2	Do's and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	- Asan and Pranayam i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam	8
Total		24

Course Outcomes:

1	Develop healthy mind in a healthy body thus improving social health also.
2	Improve efficiency.

Learning Resources:

1	'Yogic Asanas for Group Training-Part-I' : Janardan Swami Yogabhyasi Mandal, Nagpur .
2	"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.



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Second Semester

Course Name:	Antennas and Radiating Systems		
Course Code:	PC-MCE201	Category:	PC
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
2	Estimate the input impedance, efficiency and ease of match for antennas.
3	Compute the array factor for an array of identical antennas.
4	Design antennas and antenna arrays for various desired radiation pattern characteristics.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.	8
2	Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non-uniform current.	7
3	Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, planar array, and Design consideration.	7
4	Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.	6



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5	Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.	6
6	Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.	2
Total		36

Course Outcomes:

1	Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
2	Estimate the input impedance, efficiency and ease of match for antennas.
3	Compute the array factor for an array of identical antennas.
4	Design antennas and antenna arrays for various desired radiation pattern characteristics.

Learning Resources:

1	Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2	John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw- Hill, 2002.
3	R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
4	I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

Course Name:	Advanced Digital Signal Processing		
Course Code:	PC-MCE202	Category:	PC
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To understand theory of different filters and algorithms
2	To understand theory of multirate DSP, solve numerical problems and write algorithms
3	To understand theory of prediction and solution of normal equations
4	To know applications of DSP at block level.

Course Contents:



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Module No.	Description of Topic	Contact Hrs.
1	Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design & structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, parallel realization of IIR.	9
2	Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub-band coding.	6
3	Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.	7
4	Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm.	5
5	Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.	5
6	Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.	4
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	To understand theory of different filters and algorithms
2	To understand theory of multirate DSP, solve numerical problems and write algorithms
3	To understand theory of prediction and solution of normal equations
4	To know applications of DSP at block level.

Learning Resources:

1	J.G.Proakis and D.G.Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2	N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
3	Bruce W. Suter, "Multirate and Wavelet Signal Processing", 1st Edition, Academic Press, 1997.
4	M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons



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	Inc., 2002.
5	S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
6	D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Course Name:	Satellite Communication		
Course Code:	PE-MCE201A	Category:	PE
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2	State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3	Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.	6
2	Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.	6
3	Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.	6
4	Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.	6
5	Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise	8



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	power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.	
6	Modulation and Multiple Access Schemes used in satellite communication. Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS.	4
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2	State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3	Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Learning Resources:

1	Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition, 2010.
2	S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.
3	Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
4	Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008

Course Name:	Internet of Things		
Course Code:	PE-MCE201B	Category:	PE
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand what IoT technologies are used for today and what is required in certain scenarios.
2	Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.
3	Apply these technologies to tackle scenarios in teams of using an experimental



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platform for implementing prototypes and testing them as running applications.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Smart cities and IoT revolution, Fractal cities, From IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6.	
2	Software Defined Networks SDN, From Cloud to Fog and MIST networking for IoT communications, Principles of Edge/P2P networking, Protocols to support IoT communications, modular design and abstraction, security and privacy in fog.	
3	Wireless sensor networks: introduction, IoT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration.	
4	Smart objects as building blocks for IoT, Open source hardware and Embedded systems platforms for IoT, Edge/gateway, IO drivers, C Programming, multithreading concepts.	
5	Operating systems requirement of IoT environment, study of mbed, RIOT, and Contiki operating systems, Introductory concepts of big data for IOT applications.	
6	Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT, Security and legal considerations, IT Act 2000 and scope for IoT legislation.	
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	Understand what IoT technologies are used for today and what is required in certain scenarios.
2	Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.
3	Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications.

Learning Resources:

1	A Bahaga, V. Madiseti, "Internet of Things- Hands on approach", VPT publisher, 2014.
2	A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
3	CunoPfister, "Getting started with Internet of Things", Maker Media, 1st edition, 2011.
4	Samuel Greenguard, "Internet of things", MIT Press, 2015.



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Course Name:	Voice and Data Networks		
Course Code:	PE-MCE201C	Category:	PE
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Protocol, algorithms, trade-offs rationale.
2	Routing, transport, DNS resolutions
3	Network extensions and next generation architectures.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.	
2	Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.	
3	Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.	
4	Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks.	
5	Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR) , IP address lookup , Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.	
6	Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.	
Total		36

Course Outcomes:
After completion of the course, students will be able to:



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1	Protocol, algorithms, trade-offs rationale.
2	Routing, transport, DNS resolutions
3	Network extensions and next generation architectures.

Learning Resources:

1	D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
2	L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufman, 2011.
3	Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1 st Edition, Morgan Kaufman, 2004.
4	Walrand, "Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002.
5	Leonard Kleinrock, "Queueing Systems, Volume I: Theory", 1st Edition, John Wiley and Sons, 1975.
6	Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.
7	Vijay Ahuja, "Design and Analysis of Computer Communication Networks", McGraw Hill, 1987

Course Name:	Integrable Circuits & Design		
Course Code:	PE-MCE201D	Category:	PE
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand basic knowledge of Integrated circuit devices and Modeling
2	Understand basics of Current Mirrors, Single stage amplifiers.
3	Visualize the concept of MOS Inverters, Sequential and Combinational MOS Logic circuits.
4	Able to analyze the CMOS Timing and I/O systems and noise in integrable circuits.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Integrated circuit devices and modeling: Semiconductors and p-n junction, advanced MOS modeling, bipolar junction transistors MOS devices in weak inversion.	
2	Basic current mirrors and single stage amplifiers: Simple CMOS current mirror, common source amplifier, source follower, common gate amplifier, source generated current mirrors, high output impedance current mirrors, cascade gain stages, MOS differential pairs, bipolar current mirrors, bipolar gain stages, class AB output stages. Switched capacitor amplifiers, switched capacitor integrators. Non linear circuits: Phase locked loop.	
3	MOS inverter: Switching characteristics, static and dynamic behaviors delay. Combinational MOS logic circuits: pseudo NMOS, dynamic logic, domino logic, NORA, differential CMOS gates, X-gate and pass transistors. Sequential MOS logic circuits: CMOS clocked latches, static and dynamic CMOS latches, D, SR, JK, T and edge triggered SR flip-flop.	
4	Digital integrated system building blocks: Multiplexers and decoders, barrel shifters, counters, digital adders, modified booth multipliers.	
5	CMOS timing and I/O considerations: Delay of CMOS circuits, junction capacitors, interconnect capacitors, delay of CMOS logic gates, input protection circuits, output circuits and driving large capacitors, three state outputs.	
6	Noise in integrable circuits: Noise in circuits, types of noise, time domain analysis, frequency domain analysis, noise models for circuit elements – resistors, capacitors, diode, BJT and MOSFET.	
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	Understand basic knowledge of Integrated circuit devices and Modeling
2	Understand basics of Current Mirrors, Single stage amplifiers.
3	Visualize the concept of MOS Inverters, Sequential and Combinational MOS Logic circuits.
4	Able to analyze the CMOS Timing and I/O systems and noise in integrable circuits.



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Learning Resources:	
1	Analog integrated circuit design, David Johns and Ken Martin, John Wiley and sons (UK), 2002.
2	Digital integrated circuit design, Ken Martin, Oxford University Press, New York, 2000
3	Analysis and Design of Analog Circuits, Paul Grey, Paul Hurst, Stephen Lewis and Robert Mayer, John Wiley and Sons (UK), 4th edition.
4	Digital Integrated Circuits - A Design Perspective, <i>Rabaey, Chandrakasan and Nikolic</i> , PHI (2nd Edition), 2008.
5	CMOS Digital Integrated Circuits - Analysis and Design, <i>Sung-Mo Kang & Yusuf Lablebici</i> , Tata McGraw Hill, (New Delhi), 2003.

Course Name:	Markov Chains and Queuing		
Course Code:	PE-MCE202A	Category:	PE
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand Markov Chains and regenerative processes used in modelling a wide variety of systems and phenomena.
2	Model a system as queuing system with some aspect of the queue governed by a random process.
3	Understand telecommunication systems modeling using Markov chains with special emphasis on developing queuing models.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction: Review of basic probability, properties of nonnegative random variables, laws of large numbers and the Central Limit Theorem.	
2	Renewal Processes: Basic definitions, recurrence times, rewards and renewal reward theorem, point processes, Poisson process, Walds equation, Blackwell's theorem.	
3	Discrete time Markov chains: definitions and properties, matrix representation, Perron-Frobenius theory.	
4	Continuous time Markov chains: basic definitions, Q-matrix, birth-death processes, quasi birth death processes; Embedded Markov processes, semi Markov processes, reversible Markov chains, Random walks.	



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5	Fundamental queuing results: Little's theorem, invariance of the mean delay, Conservation law Markovian queues: Jackson and BCMP networks, Numerical algorithms, M/G/1 and G/M/1 queues.	
6	Advanced queuing models: priority, vacation and retrials in queues.	
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	Understand Markov Chains and regenerative processes used in modelling a wide variety of systems and phenomena.
2	Model a system as queuing system with some aspect of the queue governed by a random process.
3	Understand telecommunication systems modeling using Markov chains with special emphasis on developing queuing models.

Learning Resources:

1	Cliffs, "Stochastic Modelling and the Theory Queues", Prentice Hall, 1989.
2	P.Bremaud, "Markov Chains", Springer-Verlag, 1999.
3	E.Seneta, "Non Negative Matrices and Markov Chains", Springer Series in Statistics, Springer, 1981.
4	R.Gallager, "Discrete Stochastic Processes", Kluwer Academic Press, 1996.
5	L.Kleinrock, "Queuing Systems", vols I and II, John Wiley and Sons 1976.

Course Name:	MIMO Systems		
Course Code:	PE-MCE202B	Category:	PE
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO.
2	Understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE-Advanced, WiMAX).
3	Perform Mathematical modelling and analysis of MIMO systems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multiantenna systems.	3
2	Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation.	7
3	The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.	7
4	Codebooks for MIMO, Beam forming, Beam forming principles, increased spectrum efficiency, Interference cancellation, Switched beam former, Adaptive beam former, Narrowband beam former, Wideband beam former.	5
5	Case study: MIMO in LTE, Code words to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beam forming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models.	7
6	Channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.	7
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	Understand channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO.



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2	Understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE-Advanced, WiMAX).
3	Perform Mathematical modelling and analysis of MIMO systems.

Learning Resources:

1	Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications: From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2	Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.

Course Name:	Programmable Networks - SDN, NFV		
Course Code:	PE-MCE202C	Category:	PE
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand advanced concepts in Programmable Networks.
2	Understand Software Defined Networking, an emerging Internet architectural framework.
3	Implement the main concepts, architectures, algorithms, protocols and applications in SDN and NFV.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Programmable Networks, History and Evolution of Software Defined Networking (SDN), Fundamental Characteristics of SDN, Separation of Control Plane and Data Plane, Active Networking.	
2	Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the basics of Open Flow protocol.	
3	Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework, Mininet A simulation environment for SDN.	
4	Control Plane: Overview, Existing SDN Controllers including Floodlight and Open Daylight projects. Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts. Data Plane:	



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	Software-based and Hardware-based; Programmable Network Hardware.	
5	Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.	
6	Data Centre Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centres, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.	
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	Understand advanced concepts in Programmable Networks.
2	Understand Software Defined Networking, an emerging Internet architectural framework.
3	Implement the main concepts, architectures, algorithms, protocols and applications in SDN and NFV.

Learning Resources:

1	Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", O'Reilly Media, August 2013.
2	Paul Goransson, Chuck Black, Timothy Culver. "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann Publishers, 2016.
3	Fei Hu, "Network Innovation through Open Flow and SDN: Principles and Design", CRC Press, 2014.
4	Vivek Tiwari, "SDN and Open Flow for Beginners", Amazon Digital Services, Inc., ASIN: 2013.
5	Nick Feamster, Jennifer Rexford and Ellen Zegura, "The Road to SDN: An Intellectual History of Programmable Networks" ACM CCR April 2014.
6	Open Networking Foundation (ONF) Documents, https://www.opennetworking.org , 2015.
7	Open Flow standards, http://www.openflow.org , 2015.

Course Name:	Microwave Measurement Techniques		
Course Code:	PE-MCE202D	Category:	PE
Semester:	II	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	
Full Marks:	100		



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Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understand different techniques of Power, Frequency and Impedance Measurement in Microwave frequency range.
2	Acquire knowledge on Sensors and Detectors used in Microwave Measurement.
3	Visualize the measurement of various parameters using Vector Network Analyzer and Spectrum Analyzers.
4	Implement different measurement circuits of various parameters in microwave frequency.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Radio Frequency & Microwave Measurements- Introduction, Radio Frequency Band, microwave and millimeter wave. Power Measurement- High Power Measurement, calorimeter technique, Low power Measurement, bolometer technique, Very Low Power Measurement.	6
2	Frequency Measurement - Different Technique to measure frequency, Slotted Line Technique, maxima & minima, wavelength & frequency measurement. Distortion & Frequency Translation Measurement- Different types of distortion occurred at microwave frequencies, Procedures for frequency translation.	7
3	Impedance Measurement- Measurement of unknown load impedance of a transmission line, Slotted Line Technique to measure unknown impedance.	4
4	Detectors & Sensors: Definition of Detectors; Different type of microwave detectors functions and applications, Sensors Definition & working principle, applications.	7
5	Vector Network Analyzer (VNA): Concept of vector network analyzer, measurement of Scattering parameters, Basic block diagram of vector network analyzer (VNA), Application of vector network analyzers. Scalar Network Analyzer (SNA): Definition of network analyzer, Difference between SNA&VNA, Basic block diagram Scalar Network Analyzer.	7
6	Spectrum Analyzer: Basic block diagram of a spectrum analyzer, functions & applications of a spectrum analyzer. Time Domain Reflectrometer (TDR) : Introduction to Reflectrometer, Measurement of reflection coefficient using electrometer technique, Basic block diagram of a time domain reflectrometer.	5
Total		36

Course Outcomes:



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After completion of the course, students will be able to:	
1	Understand different techniques of Power, Frequency and Impedance Measurement in Microwave frequency range.
2	Acquire knowledge on Sensors and Detectors used in Microwave Measurement.
3	Visualize the measurement of various parameters using Vector Network Analyzer and Spectrum Analyzers.
4	Implement different measurement circuits of various parameters in microwave frequency.

Learning Resources:	
1	G.H.Bryant- Principles of Microwave Measurements- Peter Peregrinus Ltd.
2	D.M. Pozar- Microwave Engineering, 2nd Ed, John Wiley
3	T.S.Laverghetta- Hand book on Microwave Testing
4	S.F.Adam- Microwave Theory & Application- Prentice Hall, Inc
5	HP Application Notes
6	A.E. Bailey, Ed. Microwave Measurements- Peter Peregrinus Ltd
7	M. Engelson-Moder Spectrum Analyser: Theory & Applications, Artech House

Course Name:	Antennas and Radiating Systems Lab		
Course Code:	PC-MCE291	Category:	PC
Semester:	II	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Determine specifications, design, construct and test antenna.
2	Explore and use tools for designing, analysing and testing antennas. These tools include Antenna design and analysis software, network analysers, spectrum analysers, and antenna pattern measurement techniques.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Simulation of half wave dipole antenna.	



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2	Simulation of quarter wave, full wave antenna and comparison of their parameters.	
3	Simulation of monopole antenna with and without ground plane.	
4	Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.	
5	Simulation of a half wave dipole antenna array.	
6	Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.	
7	Study on Important characteristics of different types of transmission lines.	
8	Impedance measurement in microwave frequency range applying Smith chart.	
9	Study on Horn and microstrip antenna – radiation pattern, gain, impedance etc.	
10	Study of important parameters and practical considerations on different microwave circuit components related to antenna design.	
Total		36

Course Outcomes:

After completion of the course, students will be able to:

1	Determine specifications, design, construct and test antenna.
2	Explore and use tools for designing, analysing and testing antennas. These tools include Antenna design and analysis software, network analysers, spectrum analysers, and antenna pattern measurement techniques.

Learning Resources:

1	
2	
3	

Course Name:	Advanced Digital Signal Processing lab		
Course Code:	PC-MCE292	Category:	PC
Semester:	II	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	
Full Marks:	100		
Examination	Semester Examination:	Continuous	Attendance: 05



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Scheme:	60	Assessment: 35	

Course Objectives:	
1	Design different digital filters in software.
2	Apply various transforms in time and frequency domain.
3	Perform decimation and interpolation.

Course Contents:		
Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Basic Signal Representation	
2	Stability Using Hurwitz Routh Criteria	
3	Correlation Auto And Cross	
4	Sampling FFT Of Input Sequence	
5	Butterworth Low pass And High pass Filter Design	
6	Chebyshev Type I,II Filter	
7	State Space Matrix from Differential Equation Normal Equation Using Levinson Durbin	
8	Decimation And Interpolation Using Rationale Factors	
9	Maximally Decimated Analysis DFT Filter	
10	Cascade Digital IIR Filter Realization	
11	Convolution And M Fold Decimation & PSD Estimator	
12	Estimation Of PSD	
13	Inverse Z Transform	
14	Group Delay Calculation, Separation Of T/F	
Total		36

Course Outcomes:	
After completion of the course, students will be able to:	
1	Design different digital filters in software.
2	Apply various transforms in time and frequency domain.
3	Perform decimation and interpolation.

Learning Resources:	
1	



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2	
3	

Course Name:	Personality Development through Life Enlightenment Skills		
Course Code:	PW-MCE271A	Category:	PW
Semester:	II	Credit:	0
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination:	Continuous Assessment:	Attendance:

Course Objectives:	
1	To learn to achieve the highest goal happily
2	To become a person with stable mind, pleasing personality and determination
3	To awaken wisdom in students

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Neetisatakam-Holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) - Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (don't's) - Verses- 71,73,75,78 (do's)	8
2	- Approach to day to day work and duties. - Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, - Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, - Chapter 18-Verses 45, 46, 48.	8
3	- Statements of basic knowledge. - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 - Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, - Chapter 4-Verses 18, 38,39 - Chapter18 – Verses 37,38,63	8



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Total	24

Course Outcomes:	
1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3	Study of Neetishatakam will help in developing versatile personality

Learning Resources:	
1	"Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2	Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Name:	Sanskrit for Technical Knowledge		
Course Code:	PW-MCE271B	Category:	PW
Semester:	II	Credit:	0
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination:	Continuous Assessment:	Attendance:

Course Objectives:	
1	To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2	Learning of Sanskrit to improve brain functioning
3	Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Contents:		
Module No.	Description of Topic	Contact Hrs.



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1	- Alphabets in Sanskrit, - Past/Present/Future Tense, - Simple Sentences	8
2	- Order - Introduction of roots - Technical information about Sanskrit Literature	8
3	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8
Total		24

Course Outcomes:

1	Understanding basic Sanskrit language
2	Ancient Sanskrit literature about science & technology can be understood
3	Being a logical language will help to develop logic in students

Learning Resources:

1	“Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2	“Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3	“India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Name:	Constitution of India		
Course Code:	PW-MCE271C	Category:	PW
Semester:	II	Credit:	0
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination:	Continuous Assessment:	Attendance:

Course Objectives:

1	Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2	To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3	To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	History of Making of the Indian Constitution: •History •Drafting Committee, (Composition & Working)	4
2	Philosophy of the Indian Constitution: •Preamble •Salient Features	4
3	Contours of Constitutional Rights & Duties: • Fundamental Rights • Right to Equality • Right to Freedom • Right against Exploitation • Right to Freedom of Religion • Cultural and Educational Rights • Right to Constitutional Remedies • Directive Principles of State Policy • Fundamental Duties.	4
4	Organs of Governance: • Parliament • Composition • Qualifications and Disqualifications • Powers and Functions • Executive • President • Governor • Council of Ministers • Judiciary, Appointment and Transfer of Judges, Qualifications • Powers and Functions	4
5	Local Administration: • District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO	4



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	of Municipal Corporation. • Pachayati raj: Introduction, PRI: Zila Panchayat. • Elected officials and their roles, CEO Zila Panchayat: Position and role. • Block level: Organizational Hierarchy (Different departments), • Village level: Role of Elected and Appointed officials, • Importance of grass root democracy	
6	Election Commission: • Election Commission: Role and Functioning. • Chief Election Commissioner and Election Commissioners. • State Election Commission: Role and Functioning. • Institute and Bodies for the welfare of SC/ST/OBC and women.	4
Total		24

Course Outcomes:	
1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4	Discuss the passage of the Hindu Code Bill of 1956.

Learning Resources:	
1	The Constitution of India, 1950 (Bare Act), Government Publication.
2	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3	M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Name:		Disaster Management	
Course Code:	PW-MCE271D	Category:	PW
Semester:	II	Credit:	0
L-T-P:	2-0-0	Pre-Requisites:	
Full Marks:	100		
Examination	Semester Examination:	Continuous	Attendance:



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Scheme:		Assessment:	

Course Objectives:	
1	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4	Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.	4
4	Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4



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6	Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India	4
Total		24

Course Outcomes:	
1	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4	critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Learning Resources:	
1	R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2	Sahni, Pardeep Et.Al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3	Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep & Deep Publication Pvt. Ltd., New Delhi.

Course Name:	Mini Project with Seminar		
Course Code:	PW-MCE281	Category:	PW
Semester:	II	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination:	Continuous Assessment:	Attendance:

Course Objectives:	
1	Understand of contemporary / emerging technology for various processes and systems.
2	Share knowledge effectively in oral and written form and formulate documents.



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Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	The students are required to search / gather the material / information on a specific topic and comprehend it and present / discuss in the class.	24
Total		24

Course Outcomes:

After completion of the course, students will be able to:

1	Understand of contemporary / emerging technology for various processes and systems.
2	Share knowledge effectively in oral and written form and formulate documents.

Curriculum for Postgraduate Degree (MBA) in Business Analytics (w.e.f. AY: 2020-21)

Part I: Introduction, Theme & Category wise Credit Distribution

This curriculum book presents the broad objectives, structure, and contents of our two-year Post-Graduate program for MBA in Business Analytics. The curriculum is directional in scope and permits the much desirable flexibility to keep pace with the ever-growing body of knowledge, experiments and explorations in management education with special emphasis towards Business Analytics.

Some points related to the curriculum are as follows

1. The program is of two years duration divided over four semesters with 110 credit points
2. The program consists of core courses, data, programming and computer related courses along with mathematical and communication courses.
3. At the end of the second semester, the students will undergo Summer Training for about eight weeks duration in a Professional Organization dealing with data and Analytics
4. Two electives will be provided in the Fourth Semester
5. At the end of Fourth Semester there will be a Capstone Project/Dissertation along with Grand Viva.

A. Definition of Credit:

Sl. No.	Description	Credit
1	1 Hr. Lecture (L) Per Week	1.0
2	1 Hr. Tutorial (T) Per Week	1.0
3	1 Hr. Practical/ Lab (P) Per Week	0.5
4	2 Hrs. Practical/ Lab (P) Per Week	1.0

D. Course Code and Definition:

Sl. No.	Course Code	Definitions
1	L	Lecture
2	T	Tutorial
3	P	Practical
4	PGBA	Post Graduate in Business Analytics
5	MSH	Management Science and Humanities
6	BS	Basic Science
7	CSE	Computer Science and Engineering
8	IT	Information Technology
9	MCA	Masters in Computer Application

Curriculum for Postgraduate Degree (MBA) in Business Analytics (w.e.f. AY: 2020-21)

Part II: Course Structure & Semester wise Credit Distribution

First Semester (First Year)

Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	MSH	PGBA101	Managerial Economics	3	0	0	3
2	MSH	PGBA102	Financial Reporting, Statement and Analysis	4	0	0	4
3	MSH	PGBA103	Organizational Behaviour	2	0	0	2
4	MSH	PGBA104	Business Law	2	0	0	2
5	CSE/IT/MCA	PGBA105	Introduction to Business Analytics	2	0	0	2
6	CSE/IT/MCA	PGBA106	Database Management System (DBMS) & SQL	3	0	0	3
7	BS	PGBA107	Business Statistics and Quantitative Techniques	3	0	0	3
8	MSH	PGBA108	Corporate Communications	2	0	0	2
	Total Theory			21	0	0	21
Practical/ Sessional							
1	CSE/IT/MCA	PGBA191	Programming Practice Lab (Python)	1	0	3	2
2	CSE/IT/MCA	PGBA192	DBMS Lab	0	0	4	2
	Total Practical/ Sessional			1	0	6	4
Total of First Semester				22	0	6	25

Second Semester (First Year)

Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	MSH	PGBA201	Marketing and Consumer Behavior	3	0	0	3
2	MSH	PGBA202	Operations and Supply Chain Management	3	0	0	3
3	MSH	PGBA203	Human Resource Management	2	0	0	2
4	CSE/IT/MCA	PGBA204	Data Science using R/Python	3	0	0	3
5	CSE/IT/MCA	PGBA205	Introduction to Soft Computing	2	0	0	2



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6	CSE/IT/M CA	PGBA206	Management Information System	4	0	0	4
7	BS	PGBA207	Operations Research	3	0	0	3
8	MSH/BS	PGBA208	Business Research Methods	2	0	0	2
<i>Total Theory</i>				22	0	0	22
Practical/ Sessional							
1	MSH	PGBA291	Personality Development Lab	0	0	4	2
2	CSE/IT/M CA	PGBA292	Data Mining Techniques using R/Python	0	0	4	2
3	MSH/BS	PGBA293	Business Research Methods Lab including Excel and SPSS (Using Jamovi software)	0	0	4	2
4	MSH/CSE/ IT/MCA	PGBA 294	BRM Projects	0	0	0	0
<i>Total Practical/ Sessional</i>				0	0	12	6
Total of Second Semester				22	0	12	28

Third Semester (Second Year)							
Sl No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	MSH	PGBA301	Project Management	3	0	0	3
2	MSH	PGBA302	Strategic Management	2	0	0	2
3	CSE/IT/MCA	PGBA303	IOT & Cloud Computing	3	0	0	3
4	CSE/IT/MCA	PGBA304	Artificial Intelligence (Machine Learning and Deep Learning)	4	0	0	4
5	CSE/IT/MCA	PGBA305	Data Visualization using Business Intelligence	2	0	0	2
6	BS	PGBA306	Probability and Stochastic Processes	3	0	0	3
7	BS	PGBA307	Business Forecasting and Time series Analysis	3	0	0	3
Total Theory				20	0	0	20
Practical/ Sessional							
1	MSH	PGBA391	Summer Internship Training (held after Second Semester) credited after presentation and viva-voce	0	0	12	6
2	CSE/IT/MCA	PGBA392	IOT & Cloud Computing Lab	0	0	4	2
3	CSE/IT/MCA	PGBA393	Machine Learning and Data Visualization Lab	0	0	4	2



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4	BS	PGBA394	Time series Analysis with Excel and other softwares	0	0	2	1
<i>Total Practical/ Sessional</i>				0	0	22	11
Total of Third Semester				20	0	22	31

Fourth Semester (Second Year)							
SI No.	Category	Course Code	Course Name	Contact Hours			Credits
				L	T	P	
Theory							
1	MSH	PGBA401	Professional Elective-1	3	0	0	3
2	MSH	PGBA402	Professional Elective-2	3	0	0	3
3	CSE/IT/MCA	PGBA403	Cyber Security for Managers	2	0	0	2
4	CSE/IT/MCA/BS	PGBA404	Predictive & Prescriptive Analytics with Advanced Data	2	0	0	2
5	CSE/IT/MCA	PGBA405	Data Analytics with Big Data	2	0	0	2
Total Theory				12	0	0	12
Practical/ Sessional							
1	CSE/IT/MCA/BS	PGBA491	Multivariate Data Analysis	0	0	4	2
2	CSE/IT/MCA	PGBA492	Big Data Lab (Hadoop & Map reduce lab)	0	0	4	2
3	MSH/CSE/IT/MCA/BS	PGBA492	Dissertation/Capstone Project	0	0	12	6
4	MSH/CSE/IT/MCA/BS	PGBA493	Grand Viva	0	0	8	4
Total Practical/ Sessional				0	0	28	14
Total of Fourth Semester				10	0	24	26

List of Elective Courses	
PGBA 401	Professional Elective-I
PGBA401A	Marketing Metrics for Analytics
PGBA401B	Financial Analytics
PGBA401C	Operations Analytics
PGBA401D	Entrepreneurship
PGBA401E	Text and Web Analytics(sentiment analysis overview)
PGBA401F	HR Analytics
PGBA402	Professional Elective-II



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PGBA402A	Pricing Analytics for Revenue Management
PGBA402B	Advertising Analytics
PGBA402C	Health Care Analytics
PGBA402D	Brand Management Analytics
PGBA402E	Introduction to Natural Language Processing
PGBA402F	Sports Analytics
PGBA402G	Public Policy Analytics
PGBA402H	Business Development and Service Marketing



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Curriculum for Postgraduate Degree (MBA) in Business Analytics (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

First Semester

Course Name:	Managerial Economics		
Course Code:	PGBA 101	Category:	Management Science and Humanities Courses
Semester:	First	Credit:	03
L-T-P:	3-0-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

	To integrate the basic concepts of economics with the tools of mathematics and statistics in order to analyze and make optimal business decisions. Starting out with an exposition of the theory of decision making by households and firms, the participants will be made to comprehend the working of the markets, the determination of prices and the techniques of decision making that the players in the market can adopt to ensure that sound decisions are made.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Managerial Economics: Basic problems of an economic system; Meaning and nature of managerial economics and goals of managerial decision making; Fundamental economic concepts – incremental, opportunity – cost, discounting, equi-marginal principle; Resource allocation using PPC	3L
2	Demand Analysis A. Demand Functions – Law of Demand, Explaining the law of demand, Violations of the Law of Demand, Shifts in Demand; Elasticity of Demand: Price Elasticity, Factors affecting price elasticity, Price elasticity and Change in Total Revenue, AR, MR and Price elasticity, Range of Values of Price Elasticity; Income Elasticity, Inferior, Superior and Normal goods, Income Elasticity and Share in Total Expenditure; Cross-Price Elasticity, Substitutes and Complements B. Indifference curves, budget line and consumer equilibrium	7L

3	Production and Cost Analysis : A. Production Function, Short Run and Long Run, Production with One Variable Input, Total Product, Average and Marginal Products, Law of Variable proportions, Relationship between TP, AP and MP. B. Short Run Costs of Production, Fixed and Variable Costs, Short Run Total, Average and Marginal Cost and Relationship between them, Short Run Cost Curves, Relationship between AVC, MC, AP and MP; Long run cost curves, Relationship between LAC and SAC, Economies of Scale and Scope. C. Production with Two Variable Inputs, Isoquants – Characteristics, Marginal Rate of Technical Substitution, Laws of Returns to Scale, Isocost Curves. D. Law of supply, elasticity of supply, market equilibrium, changes in equilibrium.	8L
4	Alternate Goals of Managerial Firms: (A) Profit maximization (B) Revenue maximization (C) Managerial utility maximization	2L
5	Managerial Decision Making under Alternative Market Structures: A. Characteristics of Perfect Competition, Profit Maximization in Competitive Markets, Output Decision in the Short Run, Shut Down Point, Short Run Supply for the Firm and Industry; Output Decision in the Long Run, Break Even Point, Long Run Supply for the Perfectly Competitive Industry B. Price and output decision under different market structure – Monopoly, Monopolistic Competition, Oligopoly	4L
6	Pricing Decisions: A. Price Discrimination under Monopoly, Transfer Pricing. B. Market Failure C. Game theory & Asymmetric information	4L
7	Macro Economics and some of its measures- Introduction, Basic Concepts, Index Numbers, Concept of National Income ; Inflation - Meaning and Kinds, Measures to Control Inflation, Deflation; Monetary Policy, Fiscal Policy, Physical Policy or Direct Controls; Business Cycles and Business Decisions	5L
Total		33L



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Course Outcomes:

After completion of the course, students will be able to:

	After the completion of the course, students will be able to –
	- Understand the roles of managers in firms - Understand the internal and external decisions to be made by managers - Analyze the demand and supply conditions and assess the position of a company - Design competition strategies, including costing, pricing, product differentiation, and market environment according to the natures of products and the structures of the markets. - Analyze real-world business problems with a systematic theoretical framework. Make optimal business decisions by integrating the concepts of economics, mathematics and statistics.

Learning Resources:

1	<i>Pindyck and Rubinfeld - Micro Economics – Pearson Education</i>
2	Koutsoyiannis: Modern Micro Economics
3	<i>Geetika, Piyali Ghosh and Purba Roychowdhury: Managerial Economics</i>
4	<i>Damodaran, Suma – Managerial Economics – Oxford University Press</i>
5	<i>Lipsey & Chrystal – Economics – Oxford University Press</i>
6	<i>Peterson & Lewis – Managerial Economics – Pearson Education</i>
7	<i>H.L. Ahuja- Managerial Economics, S. Chand</i>
8	<i>D.N. Dwivedi- Managerial Economics, Prentice Hall</i>

Course Name:	Financial Reporting, Statement and Analysis		
Course Code:	PGBA102	Category:	Management Science and Humanities Courses
Semester:	First	Credit:	04
L-T-P:	4-0-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	The objective of this course is to provide with a framework for analyzing a firm's past performance, estimating its future performance, and valuing its equity. The course integrates key concepts from accounting, finance, economics, and business strategy and applies them to financial decision-making.
2	The course focuses on how to interpret numbers in the financial statements.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Basic Financial Accounting Concept: Meaning and Scope of Accounting -Definition of accounting- classification of accounting- GAAP- Accounting Concepts and Conventions –Accounting Equation	3L
2	Preparation of Books of Accounts: Event-Transaction- Accounting Cycle – Golden Rule- Journal-Ledger- Trial Balance	8L
3	Preparation of Financial Statement: Trading Account-Profit & Loss Account - Balance Sheet (As per Schedule III, 2013) with Adjustment Entries - Preparation and Interpretation of Annual Report –Income Statement – Human Resource Accounting-Value Added Statement	12L
4	Financial Statement Analysis: Comparative Statement- Common Size Statement, Trend Analysis- Ratio Analysis-Fund Flow Statement - Cash Flow Statement	10L
5	Cost Concept -Cost Unit- Technique of Costing Method of Costing- Cost Center- Cost Unit- Cost Sheet preparation and Interpretation-LIFO&FIFO	5L
6	The time value of money with Interest Formulas: Nominal and Effective Interest Rates; Capitalized Cost	4L
7	The Goal of Financial Management: Accounting profit vs Economic Profit: The Agency Relationship	2L
Total		44L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Make a framework for analyzing a business and apply their knowledge systematically to value a business
2	Become familiar with the organization and disclosure of information reported in files and the notes to the financial statements. They will have a detailed understanding of assets and liabilities reported on the balance sheet.
3	Be proficient at calculating and interpreting financial ratios and will understand how to use ratios to compare a firm to its competitors and to evaluate changes in ratios over time and also have an idea of how to use these ratios to help forecast the future.
4	Able to initiate a framework for forecasting future earnings and predicting the stock



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	market's response to quarterly earnings announcements and able to read and critically evaluate financial analyst reports on publicly listed companies.
5	Understand major interest valuation models.

Learning Resources:

1	<i>M. Hanif & A. Mukherjee : Financial Accounting. McGraw Hill</i>
2	<i>S. K. Paul: Financial Accounting, New Central book Agency</i>
3	<i>S. P. Jain & K. L. Narang: Cost and Management Accounting. Kalyani Publication</i>
4	<i>P. M. Rao: Financial Statement Analysis and Reporting. PHI</i>
5	<i>T. P. Ghosh, N. Ankarnath, K. J. Mehta & Y. A. Alkafazi: Understanding IFRS Fundamentals, Wiley</i>
6	<i>Tulsian & Tulsian: Corporate Financial Reporting, S. Chand</i>
7	T.Ramachandran: Management Accounting
8	Basu & Das: Financial Accounting
9	Khan & Jain: Accounting for Managers

Course Name:	Organizational Behaviour		
Course Code:	PGBA103	Category:	Management Science and Humanities Courses
Semester:	First	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	To know the existence of organization as a place for human livelihood
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To help the students to develop cognizance of the importance of human behavior and how to align it with basic organizational theories
2	To enable students to describe how people behave under different conditions and understand why people behave as they do
3	To provide the students to analyze specific strategic human resources demands for future action
4	To enable students to synthesize related information and evaluate options for the most logical and optimal solution such that they would be able to predict and control human behaviour and improve results

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction of Organizational Behaviour: Introduction, definition, historical development, fundamental principles of OB, contributing disciplines, challenges and opportunities	3L
2	Foundations of Individual Behavior: Individual behavior; Intellectual abilities, Physical ability, the role of disabilities. Personality: Meaning, formation, determinants, traits of personality, big five and MBTI, personality attributes influencing OB. Attitude: Formation, components of attitudes, relation between attitude and behavior. Perception: Process of perception, factors influencing perception, link between perception and individual decision-making; Transactional Analysis: An Introduction to Transactional Analysis; Johari window.	6L
3	Group Dynamics and Team Development: Group dynamics -definition and importance, types of groups, group formation, group development, group composition, group performance factors; Principle-centered-approach to team development; Learning.	3L
4	Motivation: Meaning, theories of motivation-needs theory, two factor theory, Theory X and Y, application of motivational theories. Leadership: Meaning, styles of leadership, leadership theories, trait theory, behavioral theories, managerial grid, situational theories.	4L
5	Power and Authority: Definition of Power – Types of Power; Power and Politics in Organization; Organizational Stress; Conflict: Nature of Conflict & Conflict Resolution; Case Study Analysis	4L
6	Organizational Change and Development: Planned Change & OB Techniques; Organizational Culture: Meaning & Definition, Culture & Organizational Effectiveness; Cross Cultural Management; Recent Managerial Trends	4L
Total		24L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate the applicability of the concept of organizational behavior to understand the behavior of people in the organization
2	Demonstrate the applicability of analyzing the complexities associated with



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	management of individual behavior in the organization.
3	Analyze the complexities associated with management of the group behavior in the organization
4	Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behaviour of people in the organization.

Learning Resources:

1	<i>Robbins, S.P. Judge, T.A. & Sanghi, S.: Organizational Behaviour, Pearson</i>
2	<i>Luthans, Fred: Organizational Behaviour, McGraw Hill</i>
3	<i>Newstrom J.W. & Davis K.: Organizational Behavior, McGraw Hill</i>
4	<i>Aswathappa, K.: Organisational Behaviour, Himalaya Publishing House</i>
5	<i>Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, Prentice Hall</i>
6	<i>Sekharan, Uma: Organisational Behaviour, The McGraw-Hill Companies</i>

Course Name:	Business Law		
Course Code:	PGBA 104	Category:	MBA
Semester:	First	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	NIL
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Acquire knowledge of terminology and concepts of laws and Contracts related to business
2	Acquire knowledge about Negotiable Instruments, Sale of Goods Act and agency contract

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	<i>Introduction to Business Law:</i> Introduction, Meaning and Nature of Law, Sources of Indian Law, Legal Environment of Business, Mercantile Law, Some Basic Legal Concepts, Essentials of Law.	3
2	<i>Law of contract</i> –Introduction, Objectives, Definition of a Valid Contract, Offer and Acceptance, Capacity to Contract, Consent, Consideration, Performance of Contracts, Discharge of Contracts, Breach of Contract and Void Agreements, Quasi Contracts, Freedom to Contract.	3

3	<i>Contract of Agency</i> – Introduction, Agent and Agency, Kinds of Agencies, Classification of Agents, Duties and Rights of Agents, Principal's Duties to the Agent and his Liability to Third Parties, Personal Liability of Agent, Termination of Agency, Power of Attorney.	4
4	Sale of Goods Act, 1930: introduction, contract of sale, agreement to sell, documents of title, conditions and warranties, doctrine of caveat emptor: transfer of property: significance of transfer of ownership, rules; performance: delivery of goods by seller, acceptance of delivery by buyer; remedies for breach: Rights of Unpaid-sellers.	4
5	Negotiable Instruments Act, 1881: definition and characteristics, promissory notes, bills of exchange, and cheques, parties to negotiable instruments; Methods of negotiation of instrument, endorsement and delivery of a negotiable instrument, negotiation by unauthorized parties, negotiation of dishonored and overdue instruments; banker and customer: introduction, crossing of a cheques, obligations of a banker, protection granted to bankers, obligations of a customer, bouncing of cheque	5
6	Consumer Protection Act, 1986: definition of consumer, goods and defect, services and deficiency, consumer forums, procedure to approach consumer forums Companies Act, 1956: definition of a company, formation of company, memorandum and articles of associations of a company, types of companies, management of companies: directors and meetings; winding up of companies	5
Total		24L

Course Outcomes:

After completion of the course, students will be able to:

1	Develop domain knowledge of various laws to set up and maintain a business unit
4	Understand of ethics and prevention of fraud in business and how to tackle that problem

Learning Resources:

1	Kuchhal MC – Business Law (Vikas), 2nd ed
2	N.D.Kapoor, Elements of mercantile law – Sultan chand and company, New Delhi
3	Tlsian- Business Law (Tata McGraw-Hill, 2nd edition)
4	Kuchhal- Mercantile Law (Vikas), 1998, 4th ed.



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Course Name:	Introduction to Business Analytics		
Course Code:	PGBA 105	Category:	MBA(CSE/IT/MCA)
Semester:	First	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To facilitate students with the basic concept of a Business Analytics
2	To develop the ability to apply knowledge of Analytics for solution of Business problems.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Business Intelligence: - Definitions and Examples in Business Intelligence - Need, Features and Use of Business Intelligence (BI) - BI Component - Data Warehouse - Business Analytics - Business Performance Management - User Interface.	5
2	Business Analytics: - Introduction to Business Analytics (BA) – Need - Components (Business Context, Technology, Data Science). - Types (Descriptive, Predictive and Prescriptive). - Business Intelligence versus Business Analytics. - Transaction Processing v/s Analytic Processing - OLTP v/s OLAP - OLAP Operations - Data models for OLTP (ER model) and OLAP (Star & Snowflake Schema)	5
3	Types of Digital Data: Definition, Sources, Storage and Characteristics of Structured, Unstructured and Semi Structured Data Data Warehouse: - Definition, characteristics, framework - Data lake Business Reporting, Visual Analytics:	6

	• Definition, concepts • Different types of charts and graphs • Emergence of data visualization and visual analytics	
4	Data Mining: • Concepts and applications • Data mining process. Text & Web Analytics: • Text analytics and text mining overview • Text mining applications • Web mining overview • Social media analytics • Sentiment analysis overview Big Data Analytics: • Definition and characteristics of big data • Fundamentals of big data analytics	6
5	Business Performance Management: • Business performance management cycle • KPI, Dashboard Analytics in Business Support Functions: • Sales & Marketing Analytics HR Analytics • Financial Analytics • Production and operations analytics • Analytics in Industries: Telecom, Retail, Healthcare, Financial Services	6
Total		28L

Course Outcomes:

After completion of the course, students will be able to:

1	Develop domain knowledge of various technology and its application to facilitates managerial decision /MIS
2	Enhance capabilities for innovative use of I.T
3	Understand the significance of global platform for data retrieval/process among different business cultures of the world
4	Understand of ethics and prevention of fraud through technology, theft of data etc
5	Able communication for data driven decision making
6	Encourage cross functional collaboration to enhance efficiency and productivity.

Learning Resources:

1	Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence: A Managerial Perspective on Analytics, Pearson
2	R.N.Prasad and Seema Acharya, Fundamentals of Business Analytics, Wiley



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3	U. Dinesh Kumar, Business Analytics – The Science of Data Driven Decision Making, Wiley
4	Anil Maheshwari, Data Analytics, McGraw Hill
5	Jesper Thorlund & Gert H.N. Laursen, Business Analytics for Managers: Taking Business Intelligence Beyond, Wiley
6	Sahil Raj, Business Analytics, Cengage
7	James R. Evans, Business Analytics, Pearson
8	Weaving Analytics for effective Decision Making by Arindam Banerjee and Tanushri Banerjee, SAGE Publications
9	Business Analytics: Text and Cases by Tanushri Banerjee and Arindam Banerjee, SAGE Publications

Course Name:	Database Management System & SQL		
Course Code:	PGBA 106	Category:	MBA Courses (CSE/IT/MCA)
Semester:	First	Credit:	03
L-T-P:	3-0-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the different issues involved in the design and implementation of a database system.
2	Study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3	Understand and use data manipulation language to query, update, and manage a database
4	Develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction Introduction and applications of DBMS, Purpose of data base, Data, Independence, Database System architecture- levels, Mappings, Database, users and DBA.	4L



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2	Entity Relationship Model Basic Concepts , Constraints, Keys , Design Issues , Entity Relationship Diagram, Weak Entity Sets, Extended E-R Features , Design of an E-R Database Schema Reduction of an E-R Schema to Tables.	4L
3	Relational Model Structure of Relational Databases, The Relational Algebra, Extended Relational Algebra Operations, Modifications of the Database Views, The Tuple Relational Calculus, The Domain Relational Calculus.	5L
4	SQL Basics of SQL, DDL,DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, , Any, All , view and its types. transaction control commands – Commit, Rollback, Savepoint.	5L
5	Relational Database Design First Normal Form, Pitfall of Relational-Database Condition, Functional Dependencies, Decomposition, Desirable Properties of Decomposition, Boyce-Codd Normal Form, Third Normal Form.	6L
6	PL/SQL Concepts Introduction, Cursors, Stored Procedures, Stored Functions, database Triggers.	6L
7	Overview of Storage and Indexing Data on External Storage – File Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing.	2L
8	Transaction Management Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism, solution to concurrency related problems, deadlock, , two-phase locking protocol, Isolation, Intent locking.	4L
9	Query Processing and Query Optimization Overview, Measures of Query Cost	2L
Total		38L

Course Outcomes:

After completion of the course, students will be able to:

1	Understand database concepts and structures and query language
2	To design and build a simple database system and demonstrate competence with the



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	fundamental tasks involved with modeling, designing, and implementing a DBMS.
3	Understand Functional Dependency and Functional Decomposition.
4	Apply various Normalization techniques
5	Perform PL/SQL programming using concept of Cursor Management, Error Handling, Package and Triggers
6	Execute various advance SQL queries related to Transaction Processing & Locking using concept of Concurrency control.

Learning Resources:	
1	A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts"
2	Rob, Coronel, "Database Systems"
3	C. J. Date, "An Introduction to Database Systems"
4	Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems"
5	R. Elmasri and S.B. Navathe, "Fundamentals of Database Systems"

Course Name:	Business Statistics & Quantitative Techniques		
Course Code:	PGBA 107	Category:	Basic Science Courses
Semester:	First	Credit:	03
L-T-P:	3-0-0	Pre-Requisites:	High School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart knowledge of basic statistical tools & techniques
2	To focus on more practical than theoretical.
3	To Learn application in Business decision process and Management.
4	To do statistical analysis informs the judgment of the ultimate decision-maker
5	Conceptual underpinnings of statistical analysis will be required

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction to Statistics: ➤ Collection of Data and Classification ➤ Measures of Central Tendency- Mean, Median, Mode ➤ Measures of Dispersion in Frequency Distribution- Variance, Standard Deviation	8L

2	Theory of Probability: ➤ Total probability theorem (Addition Rule) ➤ Conditional probability, Multiplication & Baye's Theorem ➤ Introduction to Random Variables- Discrete and continuous RVs, p.m.f. and p.d.f., c.d.f., Expectation and Variance ➤ Bernouli's Trial, Binomial, Poisson and Normal Distribution	8L
3	Bivariate Data Analysis: ➤ Covariance, Karl Pearson's Correlation Coefficient, Rank Correlation, Regression (linear) ➤ Least Square Curve Fitting- Linear and Non-linear	8L
4	Test of Hypothesis: ➤ Introduction to Statistic ➤ Estimation of Parameters- Unbiased and Consistent Estimator ➤ Hypothesis Testing – Statistical Hypothesis, Null Hypothesis and Alternative Hypothesis; Type-I and Type-II Error, Level of Significance, Acceptance and Critical Region; Test for Single Mean & Two Means ➤ Test of Goodness of Fit- Chi-Square test ➤ F test – ANOVA	8L
5	Tests: ➤ Index Numbers- Unweighted and Weighted-Test of Consistency ➤ Time Series Analysis- Measurement of Secular Trend-Seasonal Variations	8L
Total		40L

Course Outcomes:

After completion of the course, students will be able to:

1	Facilitate Objective Solutions in Business Decision Making
2	Enhance Knowledge in Probability Theory.
3	Describe Normality and its Distribution Concepts
4	Stress The Need For Collection Of Data and its Dispersion Techniques
5	Apply Time Series Analysis in Market Prediction Rates
6	Draw Conclusions over the Hypothetical Situations
7	Extract the variance among the factors of study concerned

Learning Resources:

1	R.S.N. Pillai, V. Bagavathi," Statistics", S.Chand Limited, 7th Ed,2008
2	N.D. Vohra, "Business Statistics", Tata McGraw-Hill Education, 2nd Ed,2013
3	G. V. Shenoy, Uma K. Srivastava, S. C. Sharma," Business Statistics", New Age International,2nd Ed, 2005
4	Beri, "Business Statistics" Tata McGraw Hill,2nd Ed,2009

REFERENCE BOOKS:

1.	Keller. G,"Statistics for Management", Cengage Learning, 1st Ed, 2009



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2.	J. K Sharma, "Business Statistics", Pearson, 2nd Ed, 2010.
3.	Arora PN & others, "Complete Statistical Methods", S. Chand, 3rd Ed, 2010

Course Name:	Corporate Communications		
Course Code:	PGBA108	Category:	Management Science & Humanities courses
Semester:	First	Credit:	2
L-T-P:	2-0-0	Pre-Requisites:	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop documented communication Skills so that it can be used suitably in Organizational life
2	Groom them as effective management professionals

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Basic Principles of Effective Communication: Introduction, Definition, Purposes, Types of communication, Understanding Communication, the Communication Process, Models and Barriers to Communication. The Nature of Business Communication: Introduction, Types of Business Communication, Communication Network in Organizations Types and Channels of Communication: Introduction, Types of Communication, Classification of Communication Channels.	2L
2	The Importance of Communication in the Workplace, Overview and objectives, Intrapersonal communication, Interpersonal Communication, Characteristics of successful communication, Importance of communication in management – communication structure in organization – communication in crisis.	1L
3	Oral communication -What is oral Communication – principles of successful oral communication – barriers to communication – what is conversation control – reflection and empathy: two sides of effective oral communication – effective listening – non – verbal communication.,	1L

	conducting seminars and conferences- Procedure of Regulating speech - evaluating oral presentation - Drafting speech	
4	The Importance of Listening in the Workplace: Introduction, what is listening? Barriers to Listening, Strategies for Effective Listening, Listening in a Business Context.	1L
5	Written Business Communication: Introduction, General Principles of Writing, Principles of Business Writing, Purpose of writing – clarity in writing, Stages of Writing, Composing Business Messages, Preparing Notes, Style, Punctuation, Using simple words, Proof Reading. Principles of effective writing – approaching the writing process systematically - The 3X3 writing process for business communication: Pre writing – Writing – Revising – Specific writing features – coherence – electronic writing process.	2L
6	Internal Business Communication: Guidelines for Meetings: Introduction, Types of Meetings, Before the Meeting, During the Meeting, After the Meeting, and Common Mistakes made at Meetings, Conducting Meetings, Procedure - preparing Agenda, Minutes and resolutions	2L
7	Internal Business Communication – Electronic Media and Stakeholder Communication: Introduction, what is an Intranet? Communicating through Email, Communication with Stakeholders, Circulars and Notices, Memos, Agenda and Minutes	2L
8	External Business Communication – Writing Business Letters: Introduction, Principles of Business Letter Writing, Types of Business Letters, Format for Business Letters, Writing routine and persuasive letters, Styles, Types – Request, Enquiry, Placing Order, Instruction, Action, Complaint, Adjustment, Sales, collection letters, Reference, Good News & Bad News, positive and negative messages. Using Facsimiles (Fax), E-mail. External Communication - Employment Communication – Resumes and Cover Letters: Introduction, writing a Resume, writing Job Application Letters, Other Letters about Employment	6L
9	Internal and External Business -Communication – Writing Business Reports: Introduction, Types of Business Reports, Format for Business Reports, Steps in Report Preparation - what is a report purpose, kinds and objectives of reports. Report Writing – Report Planning, Types of Reports, developing an outline, Nature of Headings, Ordering of Points, Logical Sequencing,	5L



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	Graphs, Charts, Executive Summary, List of Illustration, Report Writing. Structure of reports - long & short reports - formal & informal reports - writing research reports, technical reports, project reports - norms for including exhibits & appendices, Acknowledgement	
10	Other Forms of External Business Communication: Introduction, Communication with Media through News Releases, Communication about the Organization through Advertising Handling Business Information – Annual Report, House Magazine, Press Release, Press Report	2L
TOTAL		24L

Course Outcomes:

After completion of the course, students will be able to:

1	To demonstrate his/her ability to write error free while making an optimum use of correct Business Vocabulary & Grammar.
2	Distinguish among various levels of organizational communication and communication barriers while developing an understanding of Communication as a process in an organization.
3	Distinguish among various levels of organizational communication and communication barriers while developing an understanding of Communication as a process in an organization.
4	Stimulate their Critical thinking by designing and developing clean and lucid writing skills.

Learning Resources:

1	Monipally: Business Communication, Tata McGraw Hill
2	Business Communication Essentials (6th Edition) by Courtland L. Bovee & John V. Thill, Pearson
3	Business English: A Complete Guide for All Business and Professional Communications by Prem P. Bhalla; UBS Publishers
4	The Effective Presentation: Talk your way to success by Asha Kaul; SAGE
5	Madhukar: Business Communications; Vikas Publishing House
6	Senguin J: Business Communication; Allied Publishers
7	Assignment & Thesis Writing by Jonathan Anderson & Millicent Poole.
8	Business Communication : Rajendrapal & Korlahalli



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Course Name:	Programming Practice Lab (Python)		
Course Code:	PGBA 191	Category:	MBA Courses(CSE/IT/MCA)
Semester:	First	Credit:	02
L-T-P:	1-0-3	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	Master the fundamentals of writing Python scripts Learn core Python scripting elements such as variables and flow control structures
2	Use Python to read and write files Make their code robust by handling errors and exceptions properly
3	Explore Python's object-oriented features Search text using regular expressions

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Python Programming:- Introduction :- History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator	6
2	Conditional Statements If, If-else, Nested if-else, Looping, For, While, Nested loops Control Statements - Break, Continue, pass	6
3	String Manipulation Accessing Strings, Basic Operations, String slices, Function and Methods	6
4	Lists Introduction, Accessing list, Operations, Working with lists, Function and Methods Tuple Introduction, Accessing tuples, Operations, Working, Functions and Methods Dictionaries Introduction, Accessing values in dictionaries, Working with dictionaries, Properties	10



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5	Functions Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables	6
6	Exception Handling Exception, Exception Handling, Except clause, Try ? finally clause, User Defined Exceptions	6
7	Data Structure Using Python 1D Array, 2D Array, Stack, Queue, Linked List	6
Total		46P

Course Outcomes:

At the end of the course, the student should be able to:

1	knowledge of the structure and model of the Python/R/Java programming language.
2	Populate simple data structure operations using PYTHON
3	Acquiring Inheritance concept with real life examples using JAVA.

Learning Resources:

1	"Core Python Programming" by R.Nageswar Rao
2	"Python:the complete reference" by Martin C.Brown
3	"Let us Python" by Yashvant Kanetkar
4	"R Programming for beginners" by Sandip Rakshit
5	"Statistics with R Programming" by Sandip Rakshit
6	"Core JAVA:An integrated approach" by R.Nageswar Rao
7	"JAVA-the complete reference" by Herbert Schildt

Course Name:	DBMS Lab		
Course Code:	PGBA 192	Category:	MBA Courses(CSE/IT/MCA)
Semester:	First	Credit:	02
L-T-P:	0-0-4	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	Learn to create and use a database.
2	Be familiarized with a query language.



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3	Have a good understanding of DDL ,DML and DCL commands.
4	Familiarize advanced SQL queries.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Structured Query Language 1. Creating Database 2. Creating a Table 3. Specifying Relational 4. Data Types 5. Specifying Constraints 6. Creating Indexes .	4
2	Table and Record Handling 1. INSERT statement 2. Using SELECT and INSERT together 3. DELETE, UPDATE, TRUNCATE statements 4. DROP, ALTER statements .	8
3	Retrieving Data from a Database 1. The SELECT statement 2. Using the WHERE clause 3. Using Logical Operators in the WHERE clause 4. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause 5. Using Aggregate Functions 6. Combining Tables Using JOINS 7. Subqueries	12
4	Database Management Creating Views, Creating Column Aliases, Creating Database, Users Using GRANT and REVOKE commands – Commit, Rollback, Save point.	8
5	PL/SQL Concepts 1. Introduction 2. Cursors 3. Stored Procedures 4. Stored Functions 5. database Triggers.	16
Total		48P

Course Outcomes:

At the end of the course, the student should be able to:

1	Design and implement a database schema for a given problem-domain



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Approved by AICTE & affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal

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2	Populate and query a database
3	Create and maintain tables using PL/SQL.

Learning Resources:	
1	Beginning SQL Programming, Kauffman, SPD/WROX
2	Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle"