P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Sevalpatti (P.O), Sivakasi – 626140.

B.E. Electrical and Electronics Engineering

CURRICULUM AND SYLLABI

UG Regulations 2019

Department of Electrical and Electronics Engineering

CANDIDATES ADMITTED DURING 2019-2020 AND ONWARDS

Institute Vision and Mission

Vision

- To contribute to the society through excellence in technical education with societal values and thus a valuable resource for industry and the humanity.

Mission

- To create an ambience for quality learning experience by providing sustained care and facilities.
- To offer higher level training encompassing both theory and practices with human and social values.
- To provide knowledge based services and professional skills to adapt tomorrow's technology and embedded global changes.

Department Vision and Mission

Vision

- To be a technical hub of creating Electrical and Electronics Engineers with superior quality, human values and ethical views

Mission

- To provide an excellent, innovative and comprehensive education in electrical and electronics engineering.
- To create a conducive learning environment and train the students in the latest technological development domain to enhance carrier opportunities
- To produce competent and disciplined engineers suitable for making a successful career in industry/research.

Programme Educational Objectives

1. Lead a professional career by acquiring the basic knowledge in the field of specialization and allied Engineering.
2. Assess the real life problems and deal with them confidently relevance to the society.
3. Engage in lifelong learning by pursuing higher studies and participating in professional organizations.
4. Exhibit interpersonal skills and able to work as a team for success.

Program Outcomes

Engineering Graduates will be able to:

1. Engineering Knowledge: Apply knowledge of mathematics, physical sciences and Electrical and Electronics Engineering fundamentals.
2. Problem Analysis: Able to identify, formulate, analyze and solve Electrical and Electronics Engineering problems.
3. Design/development of solutions: Able to design and realize Electrical and Electronics systems to meet desired needs within practical constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

4. Investigations: Able to investigate and conduct experiments, as well as to analyze and interpret data.
5. Modern tool usage: Use of techniques, skills, and modern engineering tools necessary for engineering practice.
6. The Engineer and society: Contextual knowledge to assess societal, health, safety, legal and cultural issues related to Engineering.
7. Environment and sustainability: Realize the impact of Electrical Engineering solutions in a global, economic and environmental context.
8. Ethics: Apply ethical principles and commitment to professional ethics and responsibility.
9. Individual and team work: Function as an individual and as a member or leader in multidisciplinary teams.
10. Communication: Communicate effectively with the engineering community and society at large.
11. Project management and finance: Knowledge and understanding of management and business practices and their limitations.
12. Lifelong learning: Recognize the need for, and have the ability to engage in life-long learning.

Program Specific Outcomes

Engineering Graduates will be able to:

1. Skilled to analyze, design and test various electrical and electronic circuits, control systems, instrumentation systems, computer systems, microprocessor and microcontroller based systems.
2. Exhibit knowledge and hands-on competence in the application of Electrical machines and Power Electronics based drives systems.
3. Design and investigate problems in power system network along with protection schemes and effective utilization of electrical energy.
4. Develop a project management tool for solving complex electrical / electronic problems by applying the knowledge of basic sciences, mathematics and engineering fundamentals.

P.S.R.ENGINEERING COLLEGE, SIVAKASI-626140
UG REGUALTIONS-2019
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
CURRICULUM
[I – VIII SEMESTERS - FULL TIME]

Total Credits: 160

SEMESTER - I

Sl	Code	Course Title	Category	L-T-P	C
1	191HS11	Communicative English	HSMC	2-0-0	2
2	191HS12	Calculus and Linear Algebra	BSC	3-1-0	4
3	191HS13	Engineering Physics	BSC	2-0-0	2
4	191HS14	Engineering Chemistry	BSC	2-0-0	2
5	191CSF1	Programming for Problem Solving	ESC	3-0-0	3
6	191MEF7	Mechanical Workshop	ESC	1-0-4	3
7	191HS17	Physics and Chemistry Laboratory – I	BSC	0-0-2	1
8	191CSF7	C Programming Laboratory	ESC	0-0-2	1
					No. of Credits: 18

SEMESTER – II

Sl	Code	Course Title	Category	L-T-P	C
1	191HS21	Technical English	HSMC	2-0-0	2
2	191HS22	Differential Equations and Numerical methods	BSC	3-1-0	4
3	191HS23	Physics of Materials	BSC	2-0-0	2
4	191HS24	Environmental Science	BSC	3-0-0	2
5	191MEF1	Engineering Graphics	ESC	1-0-4	3
6	191EE21	Electric Circuits Analysis	ESC	3-0-0	3
7	191HS27	Physics and Chemistry Laboratory -II	BSC	0-0-2	1
8	191EE27	Electric Circuits Laboratory	ESC	0-0-2	1
					No. of Credits: 18

SEMESTER – III

Sl	Code	Course Title	Category	L-T-P	C
1	191HS31	Transforms and Discrete Mathematics	BSC	2-1-0	3
2	191BS31	Biology for Engineers	BSC	3-0-0	3
3	191EE31	Electromagnetic Theory	PC	3-1-0	4
4	191EE32	DC Machines and Transformer	PC	3-0-0	3
5	191EE33	Electronic Devices and Circuits	PC	3-0-0	3
6	191EE34	Measurements and Instrumentation	PC	3-0-2	4
7	191EE37	DC Machines and Transformer Laboratory	PC	0-0-2	1
8	191EE38	Electronic Devices and Circuits Laboratory	PC	0-0-2	1
9	191HS37	Communication Skills – I	HSMC	2-0-2	0
					No. of Credits: 22

SEMESTER – IV

Sl	Code	Course Title	Category	L-T-P	C
1	191HS42	Probability and Statistics	BSC	2-1-0	3
2	191CS46	Python Programming	ESC	3-0-2	4
3	191EC32	Linear Integrated Circuits	PC	3-0-0	3
4	191EE41	AC Machines	PC	3-1-0	4
5	191EE42	Control Systems	PC	3-0-0	3
6	191EE43	Transmission and Distribution	PC	3-1-0	4
7	191EE47	AC Machines Laboratory	PC	0-0-2	1
8	191EE48	Control Systems Laboratory	PC	0-0-2	1
9	191HS47	Communication Skills – II	HSMC	2-0-2	0
10		Mandatory Course	MC		0
					No. of Credits: 23

SEMESTER – V

Sl	Code	Course Title	Category	L-T-P	C
1	191EE51	Power System Analysis	PC	3-1-0	4
2	191EE52	Power Electronics	PC	3-0-0	3
3	191EE53	Protection and switch gear	PC	3-0-0	3
4	191EE54	Digital Logic Circuits	PC	3-0-0	3
5	191EE55	Digital Signal Processing	PC	3-0-2	4
6	191EEEX	Program Elective – I	ESC	3-0-0	3
7	191EE57	Integrated Circuits Laboratory	PC	0-0-2	1
8	191EE58	Power Electronics Laboratory	PC	0-0-2	1
9	191HS57	Business English	HSMC	2-0-2	0
					No. of Credits: 22

SEMESTER – VI

Sl	Code	Course Title	Category	L-T-P	C
1	191EE61	Design of Electrical Machines	PC	3-1-0	4
2	191EE62	Electrical Drives and control	PC	3-0-0	3
3	191EE63	Microprocessor and Microcontrollers	PC	3-0-0	3
4	191EEEX	Program Elective – II	PE	3-0-0	3
5	191OEXX	Open Elective – I	OE	3-0-0	3
6	191BAEX	Management Elective	HS	3-0-0	3
7	191EE67	Industrial Drives and Control Laboratory	PC	0-0-2	1
8	191EE68	Microprocessor and Microcontroller Laboratory	PC	0-0-2	1
9	191EE69	Mini Project	PROJ	0-0-2	1
10	191HS67	Career English	HSMC	2-0-2	0
11		Mandatory Course	MC		0
					No. of Credits: 22

SEMESTER – VII

Sl	Code	Course Title	Category	L-T-P	C
1.	191EE71	Power System Operation and Control	PC	3-1-0	4
2.	191EE72	High Voltage Engineering	PC	3-0-0	3
3.	191EE73	Wiring, Estimation and Costing	PC	3-0-0	3
4.	191EE74	Utilization of electrical energy	PC	3-0-0	3
5.	191EEEX	Program Elective – III	PE	3-0-0	3
6.	191OEXX	Open Elective – II	OE	3-0-0	3
7.	191EE77	Power System Simulation Laboratory	PC	0-0-2	1
8.	191EE78	Comprehension and Design Laboratory	PC	0-0-2	1
9.	191EE79	Project - I	PROJ	0-0-4	2
					No. of Credits: 23

SEMESTER – VIII

Sl	Code	Course Title	Category	L-T-P	C
1	191EEEX	Program Elective – IV	PE	3-0-0	3
2	191EEEX	Program Elective – V	PE	3-0-0	3
3	191EE89	Project - II	PROJ	0-0-12	6
					No. of Credits: 12

PROGRAM ELECTIVES

Sl	Code	Course Title	Category	L-T-P	C
1.	191BM51	Bio Medical Instrumentation	PE	3-0-0	3
2.	191CSEI	Internet of Everything	PE	3-0-0	3
3.	191CS56	Object Oriented Programming using C++	PE	3-0-0	3
4.	191EEEA	Communication Engineering	PE	3-0-0	3
5.	191EEEB	Distributed Generation and Micro Grids	PE	3-0-0	3
6.	191EEEC	Electrical Safety	PE	3-0-0	3
7.	191EEED	Embedded System	PE	3-0-0	3
8.	191EEEE	Fiber Optics and Laser Instruments	PE	3-0-0	3
9.	191EEEF	Flexible AC Transmission Systems	PE	3-0-0	3
10.	191EEEG	Green Energy Resources & System	PE	3-0-0	3
11.	191EEEH	High Voltage Direct Current Transmission	PE	3-0-0	3
12.	191EEEI	Illumination Engineering	PE	3-0-0	3
13.	191EEEJ	Industrial Electronics	PE	3-0-0	3
14.	191EEEK	Intelligent control system	PE	3-0-0	3
15.	191EEEL	Nano-Dielectrics	PE	3-0-0	3
16.	191EEEM	PLC and Distributed control system	PE	3-0-0	3
17.	191EEEN	Power plant engineering	PE	3-0-0	3
18.	191EEEO	Power Quality	PE	3-0-0	3
19.	191EEEP	Robotics and Automation	PE	3-0-0	3
20.	191EEEQ	Smart Grid Technologies	PE	3-0-0	3
21.	191EEER	SMPS and UPS	PE	3-0-0	3
22.	191EEES	Special Electrical Machines	PE	3-0-0	3
23.	191EEET	Transformer Engineering	PE	3-0-0	3

OPEN ELECTIVES

Sl	Code	Course Title	Category	L-T-P	C
1.	191OE4A	Battery Technology	OE	3-0-0	3
2.	191OE4B	Domestic & Industrial Electrical Installation	OE	3-0-0	3
3.	191OE4C	Energy Auditing and Conservation	OE	3-0-0	3
4.	191OE4D	Electric Vehicle	OE	3-0-0	3
5.	191OE4E	Renewable & Sustainable Energy	OE	3-0-0	3
6.	191OE4F	Smart Materials for Engineers	OE	3-0-0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF CSE

Sl	Code	Course Title	Category	L–T–P	C
1	191OE1A	Green Computing	OE	3–0–0	3
2	191OE1B	Java Scripts	OE	3–0–0	3
3	191OE1C	Python Foundations	OE	3–0–0	3
4	191OE1D	Web Development using PHP	OE	3–0–0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF ECE

Sl	Code	Course Title	Category	L–T–P	C
1	191OE2A	Agriculture Electronics	OE	3–0–0	3
2	191OE2B	Consumer Electronics	OE	3–0–0	3
3	191OE2C	Medical Electronics	OE	3–0–0	3
4	191OE2D	Multimedia Compression and Communication	OE	3–0–0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF BIO-TECHNOLOGY

Sl	Code	Course Title	Category	L–T–P	C
1	191OE5A	Biomaterials	OE	3–0–0	3
2	191OE5B	Biosensors	OE	3–0–0	3
3	191OE5C	Bioweapons and Security	OE	3–0–0	3
4	191OE5D	Food and Nutrition Technology	OE	3–0–0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF MECHANICAL ENGINEERING

Sl	Code	Course Title	Category	L–T–P	C
1.	191OE6A	Maintenance Engineering	OE	3–0–0	3
2.	191OE6B	Non-Destructive Testing and Materials	OE	3–0–0	3
3.	191OE6C	Operations Research and Management	OE	3–0–0	3
4.	191OE6D	Renewable Sources of Energy	OE	3–0–0	3
5.	191OE6E	Robotics	OE	3–0–0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF CIVIL ENGINEERING

Sl	Code	Course Title	Category	L–T–P	C
1	191OE7A	Air and Noise Pollution Control	OE	3–0–0	3
2	191OE7B	Energy Science and Engineering	OE	3–0–0	3
3	191OE7C	Environment and Ecology	OE	3–0–0	3
4	191OE7D	Fundamentals of Fire Safety	OE	3–0–0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF BIOMEDICAL ENGINEERING

Sl	Code	Course Title	Category	L–T–P	C
1	191OE8A	Brain Computer Interface and its Applications	OE	3–0–0	3
2	191OE8B	Internet of Things in Medicine	OE	3–0–0	3
3	191OE8C	Speech Processing	OE	3–0–0	3
4	191OE8D	Telehealth Technology	OE	3–0–0	3

MANAGEMENT ELECTIVES OFFERED TO UNDER GRADUATION [B.E. /B.Tech]

Sl	Code	Course Title	Category	L-T-P	C
1	191BAEA	Engineering Economics and Accounting	HS	3-0-0	3
2	191BAEB	Entrepreneurship	HS	3-0-0	3
3	191BAEC	Essentials of Management	HS	3-0-0	3
4	191BAED	Intellectual Property Rights	HS	3-0-0	3
5	191BAEE	Professional Ethics in Engineering	HS	3-0-0	3
6	191BAEF	Women Studies and Women Empowerment	HS	3-0-0	3

MANDATORY COURSES

Sl	Code	Course Title	Category	L-T-P	C
1.	191MC01	Design Thinking	MC	2-0-0	0
2.	191MC02	Essence of Indian Traditional Knowledge	MC	2-0-0	0
3.	191MC03	Indian Constitution	MC	2-0-0	0
4.	191MC04	Universal Human Values	MC	2-0-0	0

PC - Program Core, PE - Program Elective, OE – Open Elective, HSMC-Humanities and Science Mandatory Course, ESC – Engineering Science Course, BSC-Basic Science course, PROJ – Project, MC – Mandatory Course, HS - Humanities and Science

SEMESTER - I

191HS11	COMMUNICATIVE ENGLISH	L-T-P	C
		2-0-0	2

Programme: B.E./B.Tech. (Common to all Branches) **Sem:** I **Category:** HSMC

Prerequisites: Acquire Language proficiency.

Aim: To acquire basic Language Skills in order to communicate with English Language Speakers.

Course Outcomes:

The Students will be able to

CO1: Develop the basic reading and writing skills.
CO2: Listen actively and grasp the contents of the speech.
CO3: Develop their speaking skills and speak fluently in real contexts.
CO4: Develop vocabulary of a general kind by developing their reading skills.
CO5: Use the grammar effectively to exhibit their speaking and writing skill.
CO6: Speak in English with clarity.

SHARING INFORMATION RELATEDTO ONESELF, FAMILY AND FRIENDS. **6**

Reading – Short comprehension passages, Practice in skimming and scanning. **Writing –** Sentence structures, Developing Hints. **Listening–** Short texts, Short formal and informal conversations. **Speaking** – Introducing oneself, Exchanging personal information. **Language Development** – WH questions, Asking and answering YES or NO questions, Parts of Speech. **Vocabulary Development –** Prefixes & Suffixes, Subject verb Agreement.

GENERAL READING AND FREE WRITING **6**

Reading – **Comprehension** – Pre-reading & Post-reading. Comprehension questions (Multiple choice questions, Short questions, Open-ended questions), Short narratives and Descriptions from Newspapers including Dialogues. **Writing –** Paragraph writing, Use of Phrases and Clauses in sentences, Listening Telephonic conversations. **Speaking** – Sharing information of a personal kind, Greetings.

Language Development – Noun Pronoun agreement. **Vocabulary Development** – The Concept of Word Formation. (Norman Lewis' *Word Power Made Easy*)

GRAMMAR AND LANGUAGE DEVELOPMENT **6**

Reading – Short texts & Longer passages (Cloze reading). **Writing** – Importance of proper punctuation, Jumbled sentences. **Listening –** Listening to longer texts and filling up the table, Product description, Narratives from different sources. **Speaking –** Asking about routine actions and Expressing opinions.

Language Development – Degrees of Comparison, Pronouns. **Vocabulary Development –** Misplaced modifiers, Relative clauses.

READING AND LANGUAGE DEVELOPMENT. **6**

Reading- Comprehension. **Reading** longer texts- reading different types of texts. **Writing-** letter Writing, informal or personal letters-Achieving Coherence. **Listening**- listening to dialogues or conversations and completing exercises based on them. **Speaking**- Speaking about oneself- Speaking about one's friend. **Language Development**- Articles. **Vocabulary Development** – Root words from foreign languages and

their use in English.

EXTENDED WRITING **6**

Reading- Longer texts- close reading. **Writing**- Organizing principles of paragraphs in documents. **Listening** – Listening to talks, conversations. **Speaking** – Participating in conversations, short group conversations. **Language Development** - Cliches, Tenses. **Vocabulary Development** - Prepositions.

Total Periods: 30

Text books:

1. Board of Editors. *Fluency in English: A course book for Engineering and Technology*. Orient Blackswan, Hyderabad: 2016.
2. Kumar, Sanjay and Pushp Lata. *Communication Skills: A Workbook*. New Delhi: OUP, 2018

References:

1. www.oxfordonlineenglish.com
2. www.ielts.up.com
3. www.ted.com
4. www.testpreppractice.com
5. www.beccambridgeenglish.org

Extensive Reading

1. Shiv Khera, *You Can Win*, Macmillan Books, New Delhi, 2003.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1												2	1			3
CO2								1					1			3
CO3										3			1			3
CO4								1					1			3
CO5									2				1			3
CO6										2			1			3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS12	CALCULUS AND LINEAR ALGEBRA	L-T-P	C
		3-1-0	4

Programme: **B.E./B.Tech. (Common to all Branches)** **Sem:** **I** **Category:** **BSC**

Prerequisites: Matrices, Differentiation and Integration.

Aim: The course is aimed at developing the basic mathematical skills of engineering students,

Course Outcomes:

The students will be able to

CO1: Find the inverse and the positive powers of a square matrix

CO2: Apply the concept of orthogonal reduction to diagonalise the given matrix

CO3: Determine the evolute of curves, Beta and Gamma Functions.

CO4: Apply Lagrangian multiplier method for finding maxima and minima of an unconstrained problem

CO5: Apply the concepts of Differentiation and Integration in Vectors.

CO6: Predict an analytic function, when its real or Imaginary part is known.

MATRICES **12**

Characteristic equation - Eigen Values and Eigen vectors of a real matrix - Properties of Eigen values - Cayley-Hamilton Theorem (without proof) and its application - Orthogonal Transformation of a Symmetric matrix to diagonal form - Quadratic form - Orthogonal reduction to canonical form.

CALCULUS **12**

Radius of Curvature - Cartesian and Parametric Coordinates - Circle of Curvature - Involutes and Evolutes – Beta and Gamma functions and their properties.

MULTIVARIABLE CALCULUS **12**

Partial Derivatives - Total Derivative - differentiation of Implicit function – Jacobian - Taylor's Expansion - Maxima/Minima for function of two variables - Method of Lagrange's multipliers.

VECTOR CALCULUS **12**

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepiped.

COMPLEX VARIABLE – DIFFERENTIATION **12**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy– Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function(without proof) – Harmonic conjugate – Construction of analytic functions – Conformal mapping : $w = z + c$, cz, $1/z$, and bilinear transformation.

Total Periods **60**

Text books:

1. B.S. Grewal, "**Higher Engineering Mathematics**", Khanna Publishers, New Delhi, 43rd Edition, 2001.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th edition, Pearson, Reprint, 2002

References:

1. Veerarajan.*T.*, "**Engineering Mathematics for first year**", Fourth Edition, Tata Mc-Graw – Hill, New Delhi, 2008.
2. Erwin *Kreyszig*, **Advanced Engineering Mathematics**, 9th Edition, John Wiley & Sons, 2006.
3. G.B. Thomas and R.L. Finney, "**Calculus and Analytic Geometry**" 9th Edition, Pearson, Reprint,2002
4. N.P. Bali and Manish Goyal, "**A text book of Engineering Mathematics**", Laxmi Publications, Repri 2008.
5. B.S. Grewal, "**Higher Engineering Mathematics**", Khanna Publishers, 36th Edition, 2010.
6. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition., Mc-Graw Hill, 2004

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		1								3	3	1	1	1
CO2	2	3		3								2	3	1		1
CO3	3	3										2	3			1
CO4	1	1											3	1		1
CO5	3	2		2									3	1	1	1
CO6	2	2		1								3	3	1		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS13	ENGINEERING PHYSICS			L-T-P	C
				2-0-0	2
Programme:	**B.E./B.Tech. (Common to all Branches)**	**Sem:**	**I**	**Category:**	**BSC**

Prerequisites: School Level Physics

AIM: To endow the students with the fundamentals of Physics and apply new ideas in the field of Engineering and Technology.

Course Outcomes:

The Students will be able to

CO1: Understand the theory and various crystal structures.

CO2: Know about the basic configuration of a Laser, types of lasers and the industrial applications of Laser.

CO3: Understand principle behind fiber optic communication and the electronic devices involved in the transmission and reception of data.

CO4: Know about basics of properties of matter and its applications,

CO5: Gain knowledge about basic equations of Quantum mechanics and its applications.

CO6: Understand the basic concepts of acoustics and ultrsonics.

SOLID STATE PHYSICS **6**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal Defects-point, Line and surface defects - burger vector.

WAVE OPTICS **6**

LASERS: Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping. Einsteins A and B coeffcients – Derivation- Types of lasers – CO_2, Nd-YAG - Industrial Applications - Lasers in welding, cutting and Soldering

FIBER OPTICS: Optical Fiber-Classification- Principle and propagation of light in optical fibres-Numerical aperture and Acceptance angle-Fibre optical communication system- Sensors (Active and passive) –Displacement and Temperature Sensors.

PROP ERTIES OF MATTER **6**

Elasticity–Stress - strain diagram and its uses -factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple- torsion pendulum: theory and experiment -bending of beams -bending moment –cantilever: theory and experiment–uniform and non-uniform bending: theory and experiment – I shaped girders - stress due to bending in beams.

QUANTUM PHYSICS **6**

Black body radiation – Planck's theory -Photoelectric effect - Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box.

ACOUSTICS AND ULTRASONICS **6**

ACOUSTICS: Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - Sabine's formula - absorption

coefficient and its determination – factors affecting acoustics of buildings : focusing, interference, echo, Echelon effect, resonance - noise and their remedies

Ultrasonics: Ultrasonics - production - magnetostriction and piezoelectric methods - acoustic grating - industrial applications - NDT.

Total Periods 30

Text books:

1. Gaur R. K., Gupta S. C., "Engineering Physics" Dhanpat Rai Publications, New Delhi (2016)
2. Avadhanulu M. N., Kshirsagar, P. G., "A Text book of Engineering Physics", S.Chand and company, Ltd., New Delhi, 2017.

References:

1. Serway and Jewett., "Physics for Scientists and Engineers with Modern Physics",6th Edition, Thomson Brooks/Cole, Indian reprint (2016)
2. Arither Beiser, Concepts of Modern Physics, Tata Mc Graw Hill, NewDelhi (2015)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2						3				3			1
CO2	2	3	1		2	1			1			2	2			2
CO3	2	1	2		1	1	2			1			2	2		2
CO4	2	3	1	1	3								2		1	1
CO5	1	1		2									2		1	1
CO6	1	2	3	1	1	2	3						1			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS14	ENGINEERING CHEMISTRY			L-T-P	C
				2-0-0	2
Programme:	**B.E./B.Tech. (Common to all Branches)**	**Sem:**	I	**Category:**	BSC
Prerequisites:	Basic Science				
Aim:	To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.				

Course Outcomes:

At the end of the course the student will be able to

CO1: Demonstrate the essential concept of water and their properties and applications.
CO2: The treatment of water for potable and industrial purposes
CO3: Understand the operating principles and the reaction involved in electrochemistry.
CO4: Know the principles and application of spectroscopy
CO5: Learn the basic ingredients required for paint formulation
CO6: Know the preparation techniques of consumer products

WATER TECHNOLOGY **6**

Hardness -Types and Estimation by EDTA method- alkalinity –types of alkalinity and determination -Domestic water treatment –disinfection methods – Boiler feed water– internal conditioning– external conditioning – desalination and reverse osmosis.

ELECTROCHEMISTRY **6**

Electrochemical cells – reversible and irreversible cells – EMF –measurement of emf – Single electrode potential – Nernst equation– reference electrodes –Standard Hydrogen electrode – Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series

SPECTROSCOPIC TECHNIQUES AND APPLICATIONS **6**

Introduction of UV-Visible and IR spectroscopy and selection rules- principles and instrumentation of UV-Visible (electronic) spectroscopy – IR (vibrational) spectroscopy - its applications. Fluorescence spectroscopy and its applications in medicine-colorimetry – estimation of iron by colorimetry.

INORGANIC & ORGANIC COATINGS **6**

Paint–Definition–Components of Paints and their functions–Varnish–Definition–Preparation of Oil Varnish–Differences between Paint and Varnish–Special Paints–Luminescent Paints, Fire Retardant Paints- Aluminium Paints - Distemper.corrosion control– electroplating (Au) and electroless (Ni) plating.

PREPARATION OF CONSUMER PRODUCTS **6**

Washing Powder- Cleaning powder - phenoyls (white, Black & coloured)- Shampoo- liquid blue- inks - blue –red - green inks – Soap - bathing & detergent – oils - Face powder and bleaching powder.

Total Periods: 30

Text books:

1. P. Kannan, A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009.
2. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi (2002)

References:

1. S.S. Dara, S.S. Umare, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010.
2. B.K.Sharma, "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
3. B.Sivasankar, "Engineering chemistry" Tata McGraw Hill Publishing Company (P) Ltd., New Delhi, 2006

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		1	1	1	1				2	2	2		1	1
CO2	2	2	1	2	1	2	1				1	1	2	1		1
CO3	2	1	1	2	2							2	1	1		1
CO4	2	2	1		1						2	1	1			1
CO5	2	2	1		1	1						2	1			1
CO6	2	2	1	1	2	1			1	1	1	1	1	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191CSF1	PROGRAMMING FOR PROBLEM SOLVING			L-T-P	C
				3-0-0	3
Programme:	**B.E./B.Tech. (EEE, CIVIL, MECH, BIO-TECH))**	**Sem:**	**I**	**Category:**	**ESC**

Prerequisites: Nil

Aim: To provide an awareness to Computing and Programming.

Course Outcomes:

The students will be able to

CO1: Understand the basic terminologies of Computer and various Problem solving techniques.

CO2: Write, compile and debug programs in C language.

CO3: Use different data types in a computer program.

CO4: Design programs involving decision structures, loops and functions.

CO5: Understand the dynamics of memory by the use of pointers.

CO6:Use different data structures and create/update basic data files.

INTRODUCTION **9**

Generation and Classification of Computers- Basic Organization of a Computer - Number System - Binary - Decimal - Conversion - Problems. Software - Types, Development Steps. Algorithm - Pseudo code - Flow Chart. Problem formulation - Problem Solving.

C PROGRAMMING BASICS **9**

Introduction to Unix Operating System - Introduction to ' C' programming - fundamentals - structure of a 'C' program - compilation and linking processes - Constants, Variables - Data Types - Expressions using operators in 'C' - Managing Input and Output operations - Decision Making and Branching - Looping statements - solving simple scientific and statistical problems.

ARRAYS AND STRINGS **9**

Arrays - Initialization - Declaration - One dimensional and Two dimensional arrays. String- String operations - String Arrays. Simple programs –Bubble Sort – Linear Search -Matrix Operations.

FUNCTIONS AND POINTERS **9**

Function - Definition of function - Declaration of function - Pass by value - Pass by reference - Recursion - Pointers - Definition - Initialization - Pointers arithmetic - Pointers and arrays- Example Problems.

STRUCTURES AND FILES **9**

Introduction - need for structure data type - structure definition - Structure declaration - Structure within a structure - Union - Programs using structures and Unions - File Manipulation - Storage classes - Pre-processor directives.

Total Periods 45

Text books:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2017.
2. Balagurusamy E, "Programming in ANSI C", Tata Mcgraw-Hill Education, 2016
3. ReemaThareja, "Computer Fundamentals and Programming in C", 2e, Oxford University Press, 2016.

References:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, 3rdEdition, McGraw-Hill, 2017.
2. Dromey R.G., "How to Solve it by Computer", Pearson Education, 4th Reprint, 2007.
3. Kernighan.B.W and Ritchie,D.M, "The C Programming language", 2nd Edition, Pearson Education, 2006.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2						3	2		3	3			1
CO2	3	3	3						2	1		3	1			1
CO3		3	2						2			2	2			2
CO4		3	3						3			3	1			2
CO5	2	3	2									2	1			2
CO6		2	3						2			3	2			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191MEF7	MECHANICAL WORKSHOP	L-T-P	C
		1-0-4	3

Programme: B.E./B.Tech. (EEE, CIVIL, MECH, BIO-TECH) **Sem:** I **Category:** ESC

Prerequisites: Nil

Aim: To Provide exposure to the students with hands on experience on various basic Engineering Practices

Course Outcomes:

The students will be able to

CO1: Make the square fitting, vee & step fitting

CO2: Produce simple wooden joints using wood working tools

CO3: Fabricate tray and funnel in sheet metal

CO4: Create simple lap, butt and tee joints using arc welding equipments

CO5: Identify the various pipe joints

CO6: Make the pipe connections

FITTING OPERATIONS & POWER TOOLS **12**

Preparation of square fitting, vee & step – fitting models

CARPENTRY **12**

Study of the joints in roofs, doors, windows and furniture; Hands-on-exercise: Dismantling & Assembling of various wooden furniture; Preparation of T Joint, dove tail joint

SHEET METAL FORMING **12**

Preparation of tray and funnel

WELDING **12**

Preparation of arc welding of butt joints and lap joints

PLUMBING **12**

Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings; Hands-on-exercise - basic pipe connections – Mixed pipe material connection – Connections with different joining components

Total Periods: 60

LIST OF EQUIPMENTS (For a batch of 30 students)

1. Fitting vice (fitted to work bench) - 15Nos
2. Fitting Tools – 15 set
3. Carpentry vice (fitted to work bench) - 15 Nos.
4. Models of industrial trusses, door joints, furniture joints - 5 Nos.
5. Standard woodworking tools - 15 Sets
6. Hand Shear - 01
7. Standard tools and calipers for sheet metal work - 05
8. Arc welding transformer with cables and holders - 5Nos.

9. Welding booth - 5 Nos.
10. Welding accessories like welding shield, chipping hammer, Wire brush, etc., - 5Sets
11. Assorted components for plumbing consisting of metallic pipes, Plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings - 15 Sets.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1		1				2	1	1		1			1
CO2	3	2	1		1				2	1	1		1			1
CO3	3	2	2		1				2	1	1		1			1
CO4	3	2	2		1				2	1	1		1			1
CO5	3	2	1		1				2	1	1		1			1
CO6	3	2	1		1				2	1	1	2	1			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS17	PHYSICS AND CHEMISTRY LABORATORY-I	L-T-P	C
		0-0-2	1
Programme:	**B.E./B.Tech. (Common to all Branches)**	**Sem: I**	**Category: BSC**
Pre/Corequisites:	Engineering Physics & Engineering Chemistry		
AIM:	To introduce the basic Physics concepts through experiments and to impart the basic analysis in chemistry.		

Course Outcomes:

The Students will be able to

CO1: Understand the laser light propagation in optical fibre and the rigidity modulus of the materials
CO2: Understand the velocity of sound in liquid and propagation light in the medium
CO3: know about the stress analysis and thermal conductivity of the material
CO4: Gain knowledge of water quality parameter of potable water
CO5: Determine the unknown concentrations of chemicals
CO6: Apply the instrumental technique for calculating the amount of unknown substance

LIST OF EXPERIMENTS - PHYSICS PART
(A minimum of five experiments shall be offered)

S.No	NAME OF THE EXPERIMENT
1)	(a) Determination of Particle Size using Diode LASER. (b) Determination of wavelength of the LASER source. (c) Determination of Acceptance angle and Numerical aperture of an optical fibre.
2)	Torsional pendulum – Determination of rigidity modulus
3)	Determination of Velocity of sound and compressibility of liquid - Ultrasonic Interferometer.
4)	Determination of Dispersive power of a prism using Spectrometer.
5)	Determination of Young's modulus of the material - Non uniform bending
6)	Determination of thermal conductivity of a bad conductor - Lee's Disc method

LIST OF EXPERIMENTS – CHEMISTRY PART

S.No	NAME OF THE EXPERIMENT
1)	Estimation of Total Hardness of their home town Water by EDTA method.
2)	Estimation of Alkalinity of Water sample
3)	Estimation of Chloride ion in water sample by Argentometric method.
4)	Estimation of Ferrous Ion by Potentiometric Titrations.
5)	Conductometric Titration of strong acid Vs strong base

Total Periods: 45

References

1) Text book of Quantitative Inorganic Analysis, A.I.Vogel, ELBS,London,(2006)
2) "Practical A. Ravikrishnan Engineering Chemistry", Sri Krishna Publications, Chennai (2002)
3) Engineering Physics Laboratory Manual
4) Engineering Chemistry Laboratory Manual

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1		2		1		3	1		1	1	1		1
CO2	1	2	2				1		3	1		1	2			1
CO3	2	2	2				1		3	1		1	2		1	1
CO4	2	2	1		1		2		3	1		1	2		1	1
CO5	3	2	1	2	2		1		3	1		2	2		1	1
CO6	2	1	3		2		2		3	1		2	2			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191CSF7 **C PROGRAMMING LABORATORY** **L-T-P** **C**
0-0-2 **1**

Programme: **B.E./B.Tech. (EEE, CIVIL, MECH, BIO-TECH)** **Sem:** **1** **Category:** **ESC**

Pre/Corequisites: Nil

AIM: To provide practical knowledge in developing C Programming.

Course Outcomes:
The Students will be able to
CO1: Able to have fundamental concept on basics commands in Linux.
CO2: Able to write, compile and debug programs in C language.
CO3: Able to formulate problems and implement algorithms in C.
CO4: Able to effectively choose programming components that efficiently solve computing problems in real-world.
CO5: Able to design application oriented programs in C.
CO6: Structures and unions through which derived data types can be formed.

LIST OF EXPERIMENTS:
1. Draw a flowchart for various algorithms using Raptor
2. C Programming using Simple statements and expressions.
3. Scientific problem solving using decision making and looping.
4. Simple programming for one dimensional and two dimensional arrays.
5. Solving problems using String functions.
6. Programs with user defined functions - Includes Parameter Passing.
7. Program using Recursive Function and conversion from given program to flow chart.
8. Programs using pointers
9. Program using structures and unions.
10. Program using files.

Total Periods 45

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
Standalone desktops with C compiler 30 Nos.
(or)
Server with C compiler supporting 30 terminals or more.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2						2	1			3			1
CO2	3	2	2						2	1			3			1
CO3	3	2	3						2	1			3			1
CO4	2	3	2						2	1			3			1
CO5	3		2						2	1			3			1
CO6	2		2							1			3			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SEMESTER – II

191HS21	TECHNICAL ENGLISH	L-T-P	C
		2-0-0	2

Programme: **B.E./B.Tech. (Common to all Branches)** **Sem: II** **Category: HSMC**

Prerequisites: Acquire Proficiency in Technical Communication

Aim: To develop the students' intellectual, personal & Professional abilities.

Course Outcomes:

The Students will be able to
CO1: Remember words and its meanings for the specific purpose.
CO2: Understand the basic nuances of language
CO3: Apply written communication methodologies at workplace.
CO4: Develop Listening skill to respond and to gather information.
CO5: Interpret the text using comprehending skill.
CO6: Involve in professional correspondences confidently.

Introduction to Technical English **6**

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises. **Speaking** – Asking for and giving directions. **Reading** – reading short technical texts, Newspapers. **Writing** - Purpose statements, Extended definitions, Writing Instructions & Recommendations, Checklists. **Vocabulary Development** - Technical Vocabulary. **Language Development** – Subject Verb Agreement.

Reading and Study Skills **6**

Listening - Listening to longer technical talks and completing exercises based on them. **Speaking** – Describing a process. **Reading** – Reading longer technical texts, News papers identifying various transitions in a text- paragraphing. **Writing** - Techniques for writing Precisely. **Vocabulary Development** -vocabulary used in formal letters/emails and reports. **Language Development** - Personal & Impersonal Passive voice, Numerical adjectives.

Technical Writing and Grammar **6**

Listening - Listening to classroom lectures on Engineering / Technology. **Speaking** – Introduction to Technical presentations. **Reading** – Reading longer texts both general and Technical, practice in rapid reading. **Writing**- Describing a process, Use of sequence words, Causes and Effects **Vocabulary Development** - Sequence words, Nominal compounds, Misspelled words. **Language Development** - Embedded sentences.

Report Writing **6**

Listening- Listening to documentaries and Making notes. **Speaking** – Mechanics of presentations. **Reading** – Reading for detailed comprehension. **Writing** - Job application, cover letter, Resume preparation. **Vocabulary Development** - Finding suitable synonyms, Paraphrasing. **Language Development** – Clauses, If conditionals.

Group Discussion and Job Applications **6**

Listening - TED/Ink talks. **Speaking** – Participating in a Group discussion. **Reading** – Reading and Understanding Technical articles. **Writing** – Writing reports, Minutes of Meeting, Introduction and Conclusion. **Vocabulary Development** - Verbal analogies**. Language Development** - Reported speech.

Total Periods: 30

Text books:

1. Sudharshana,N.P. and C.Savitha. English for Technical Communication. New Delhi: Oxford University Press, 2017.

References:

1. www.bbc.co.uk/learning english
2. www.bec cambridge english.org
3. www.englishenglish101.com
4. www.islcollective.com

Extensive Reading

1. Kalam, Abdul. *The Wings of Fire*. Hyderabad: UP, 1999. Print.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1												2	1			3
CO2													1			3
CO3								1		2			1			3
CO4													1			3
CO5				2									1			3
CO6											2		1			3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS22	DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS	L-T-P	C
		3-1-0	4

Programme: **B.E. / B.Tech. (Common to all branches)** **Sem:** **II** **Category:** **BSC**

Prerequisites: Engineering Mathematics-I

Aim: To analyze the engineering problems using the techniques and the mathematical skills acquired by studying ODE and PDE uses numerical methods.

Course Outcomes:

The students will be able to

CO1: Use suitable method to solve higher order Differential Equations

CO2: Use suitable method to solve higher order PDE

CO3: Interpolate discrete data by means of continuous function.

CO4: Discover Numerical integration using Trapezoidal and Simpson's $1/3^{rd}$ rules

CO5: Find the solution for the IVPs in ODE using single step and Multistep methods

CO6: Find the solution of BVPs in PDE using finite difference methods

ORDINARY DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

PARTIALDIFFERENTIALEQUATIONS **12**

Formationofpartialdifferentialequations–Lagrange'slinearequation–Solutionsof standard types of first order partial differential equations (without reducing the standard type) –Linear homogenous partial differential equations of second and higher order with constant coefficients.

SOLUTION OF EQUATION & INTERPOLATION, NUMERICAL DIFFERENTIATION **12**

Solutions of Polynomial and transcendental equations – Newton Raphson method - Interpolation using Newton's forward and backward difference formulae - Interpolation with unequal intervals- Newton's divided difference and Lagrange's formulae - Numerical differentiation using Newton's forward and backward difference formula - Numerical Integration – Trapezoidal rule and Simpson's $1/3^{rd}$ rule.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12**

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method – Milne's predictor – corrector methods for solving first order equations – Finite difference methods for solving second order equation.

BOUNDARY VALUE PROBLEMS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Finite differences solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

Total Periods: 60

Text books:

1. B.S. Grewal, 'Higher Engineering Mathematics', Thirty Sixth Edition, Khanna Publishers, Delhi, 2005.
2. Grewal B.S. and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, (2004).

References:

1. Greenberg. *M.D.* "Advanced Engineering Mathematics, Second Edition, Pearson Education Inc. (First Indian reprint), 2002
2. Venkataraman. M.K., "Engineering Mathematics", Volume I and II Revised enlarged Fourth Edition, The National Publishing Company, Chennai, 2004.
3. Kreyszig, E., Advanced Engineering Mathematics, 8th edition, John Wiley Sons, 2001.
4. Chapra S.C. and Canale R.P., "Numerical Methods for Engineers", Tata Mc-Graw Hill, New Delhi, (2007).
5. Gerald C.F., and Wheatley P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, (2006).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1		1								3	3	2		1
CO2	2	2		2									3	1		1
CO3	2	1		2								1	1	1		1
CO4	1	2		3								2	2	1	1	1
CO5	2	3											3		1	1
CO6	3	3			3				1			2	2			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS23	PHYSICS OF MATERIALS			L-T-P	C
				2-0-0	2
Programme:	**B.E., (CSE, EEE,ECE & Bio Medical)**	**Sem:**	**II**	**Category:**	**BSC**

Prerequisites: Engineering Physics

AIM: To endow the students with the fundamentals of physics, materials and apply new ideas in the field of Engineering and Technology.

Course Outcomes:

The Students will be able to

CO1: Understand the theory and processing of conducting, superconducting materials.

CO2: Acquire knowledge of classification of semi conducting materials.

CO3: Gain knowledge about the types of magnetic materials and their applications.

CO4: Enhance the knowledge about dielectric materials and their applications

CO5: Understanding on the functioning of optical materials for optoelectronics.

CO6: Know about the basics of quantum structures and their applications in spintronics

ELECTRICAL PROPERTIES OF MATERIALS **6**

Conductors: classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory –Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

Super Conductors: properties - Types of super conductors - Applications of superconductors – SQUID, cryotron, magnetic levitation.

SEMICONDUCTOR PHYSICS **6**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration– Hall effect – Determination of Hall coefficient – Applications.

MAGNETIC AND DIELECTRIC MATERIALS **6**

Magnetic Materials: Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications.

Dielectric Materials: Polarization - electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation –dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

OPTICAL PROPERTIES OF MATERIALS **6**

Classification of optical materials–carrier generation and recombination processes-Absorption -emission and scattering of light in metals, insulators and Semiconductors (concepts only)- photocurrent in a P-N diode –solar cell–photo detectors-LED-optical storage techniques

NANOELECTRONIC DEVICES **6**

Introduction-electron density in bulk material–Size dependence of Fermi energy–quantum confinement – quantum structures-Density of states in quantum well, quantum wire and quantum dot structures – Zener -

Bloch oscillations–resonant tunneling – Carbon nanotubes: Properties and applications.

Total Periods 30

Text books:

1. William D. Callister, Jr., **"Material Science and Engineering",** John Wiley & Sons Inc., Seventh Edition, New Delhi (2017).
2. Ragavan, V., **"Material science and Engineering"**, Prentice Hall of India (2004).
3. Kasap, S.O. **"Principles of Electronic Materials and Devices**", McGraw -Hill Education, 2016.
4. Umesh K Mishra & Jasprit Singh, "**Semiconductor Device Physics and Design**", Springer, 2014.

References:

1. Koch C., **"Nanostructured materials: processing, properties and applications",** William Andrew pub. (2011).
2. Charles P. Poole and Frank J.Ownen., **"Introduction to Nanotechnology"**, Wiley India (2016)
3. Charles Kittel., **"Introduction to solid state Physics"**, John Wiley & Sons, 7th editions, Singapore (2012)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1			3			1			1	2	1		1
CO2	3	2	2	1		1						1	3	3		1
CO3	1		2	1		2	1		1				3	3		1
CO4	2	2	1	1		2		1					3	2		1
CO5	3	1	3	2	2								2		1	1
CO6	3	3	3	2	3	2	1			1			2		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS24	ENVIRONMENTAL SCIENCE			L-T-P	C
				2-0-0	2
Programme:	**B.E. / B.Tech. (Common to all branches)**	**Sem:**	**II**	**Category:**	**BSC**

Prerequisites: Basic Science

Aim: To Impart the social groups and individuals to acquire knowledge of pollution and environmental degradation

Course Outcomes:

At the end of the course the student will be able to

CO1: Understand the basic concepts of environment and energy resources
CO2: Get knowledge about the ecosystem
CO3: Identify and analyze causes, effects and control measures of various types of pollution.
CO4: Get the knowledge about types of disaster and mitigation measures
CO5: Understand the impact of social issues and climate change
CO6: Understand to create the green environment.

ENVIRONMENT AND ENERGY RESOURCES **6**

Environment- definition, scope and importance – Need for public awareness – Forest resources-deforestation–Energy resources: Growing energy needs, renewable (solar energy and wind energy) and non renewable energy sources- Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generation (block diagram only), Petroleum processing and fractions

ECOSYSTEM **6**

Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem-Nitrogen cycle, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the Forest ecosystem and Aquatic ecosystems (lake and rivers)

ENVIRONMENTAL POLLUTION **6**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution . Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution –Disaster management: floods-landslides.

SOCIAL ISSUES AND EARTH'S CLIMATE SYSTEM **6**

Population-variation among nation-Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting– climate change, global warming, acid rain, Ozone layer depletion.

GREEN CHEMISTRY **6**

Introduction to green chemistry- 12 principles of green chemistry-toxicology and green chemistry- energy and green chemistry-education in green chemistry. Reuse and recycling technologies-material selection for green design-recycled water technology.

Total Periods: 30

Text books:

1. A. Ravikrishnan, "Environmental Science and Engineering, Sri Krishna Hitech Publishing Company Private Limited, 2010.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

References:

1. Anubha Kaushik, C.P. Kaushik, "Environmental Science and Engineering", New Age International Publishers, 2016.
2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill Publishing Company Ltd, New Delhi, ISBN: 0070601690, 2006.
3. Raman Sivakumar, *Introduction to Environmental Science and Engineering*, Tata McGraw Hill Education Private Limited, New Del2010.
4. P.Meenakshi, Elements of Environmental Science and Engineering, PHI learning (P) Ltd., India.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		1	1	1	1				2	3	1			1
CO2	2	2	1		1	2	1				1	2	1			1
CO3	2	1	1	2	2			1				2	1	1		1
CO4	2	2	1		1						2	2	1		1	1
CO5	2	2	1		1	1						2	1		1	1
CO6	2	2	1		2	1			1	1	1	2	1			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191MEF1	ENGINEERING GRAPHICS			L-T-P	C
				1-0-4	3
Programme:	**B.E. / B.Tech. (EEE, CIVIL, MECH, BIO-TECH))**	**Sem:**	**II**	**Category:**	**ESC**

Prerequisites: Nil

Aim: To develop graphic skills in students

Course Outcomes:

The students will be able to

CO1: Follow the conventions used in engineering graphics

CO2: Practice plane curves and free hand sketching

CO3: Draw the projections of points, lines and plane

CO4: Draw the projections of simple solids and their sectional views

CO5: Describe the applications of development of surfaces

CO6: Practice isometric and perspective projections

Concepts and conventions (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning

PLANE CURVES **12**

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

PROJECTION OF POINTS, LINES AND PLANE SURFACES **12**

Projection of Points in all four quadrants - Projection of straight lines located in the first quadrant – inclined to both planes – Determination of true lengths and true inclinations – Projection of regular polygonal and circular lamina inclined to both reference planes.

PROJECTION OF SOLIDS **12**

Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to one reference plane

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **12**

Sectioning of above solids in simple vertical position by cutting planes inclined to HP and perpendicular to VP – Obtaining true shape of section; Development of lateral surfaces of truncated solids – Prisms, Pyramids, Cylinder and Cone

ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS **12**

Principles of isometric projection – isometric scale – isometric projections of truncated Prisms, Pyramids, Cylinder and Cone; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Total Periods: 60

Text books:

1. Natrajan K.V., **"A text book of Engineering Graphics",** Dhanalakshmi Publishers, Chennai (2015)
2. Basant Agarwal and Agarwal C.M., **"Engineering Drawing",** Tata McGraw Hill Publishing Company Limited, New Delhi, (2016)

References:

1. Venugopal K. and Prabhu Raja V., **"Engineering Graphics",** New Age International (P) Limited (2016)
2. Shah M.B. and RanaB.C., **"Engineering Drawing",** Pearson Education (2009)
3. John K.C., **"Engineering Graphics for degree"** PHI Learning Pvt. Ltd., New Delhi, (2015)
4. KumarM.S., **"Engineering Graphics",** D.D. Publications, (2015)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2			1						1		1			1
CO2	3	2			1						1		1			1
CO3	3	2			1						1		1			1
CO4	3	2	3		1						1		1			1
CO5	3	2	2		1								1			1
CO6	3	2	1		1								1			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE21	**ELECTRIC CIRCUITS ANALYSIS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E. Electrical and Electronics Engineering **Sem: II Category: ESC**

Prerequisites: Engineering Mathematics, Engineering Physics

AIM: To expose the students to the basic networks in circuits and learn about the various types of circuits.

Course Outcomes:

The Student will be able to

CO1. Apply basic electrical laws and also analyze mesh and nodal analysis for DC and AC circuits.
CO2. Compare various network theorems for DC and AC circuits.
CO3. Identify various resonance conditions.
CO4. Identify transient response in DC and AC circuits.
CO5. Convert one parameter to another parameter in two port network.
CO6. Calculate electrical quantities in three phase balanced and unbalanced circuits.

BASIC CIRCUITS ANALYSIS **9**

Ohm's Law – Kirchhoff's laws – DC and AC Circuits – Resistors in series and parallel circuits - Network reduction: voltage and current division, source transformation – star delta conversion – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

NETWORK THEOREMS FOR DC AND AC CIRCUITS **9**

Thevenin's and Norton's Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem - Millman's Theorem.

RESONANCE AND COUPLED CIRCUITS **9**

Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Selfand mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TRANSIENT RESPONSE ANALYSIS **9**

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal Input

THREE PHASE CIRCUITS **9**

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced and un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

Total Periods 45

Text books:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.

3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.

References:

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGrawHill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.
8. NPTEL Course on ‘Circuit Theory’ by IIT Delhi.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	1						3	3	3	1		2
CO2	3	3	1	1	1						3	3	3	1	2	2
CO3	3	3	1	1	1						2		3		1	2
CO4	3	3	1	2	2						2		3		1	2
CO5	3	3	2	2	2		1				2		3	2	1	2
CO6	3	3	2	1	1		1				3	3	3	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS27	**PHYSICS AND CHEMISTRY LABORATORY-II**	**L-T-P**	**C**
		0-0-2	**1**

Programme: B.E/B.Tech (Common to all Branches) **Sem: II** **Category: BSC**

Pre/Corequisites: Engineering Physics & Engineering Chemistry

AIM: To introduce the basic Physics concepts through experiments and to impart knowledge on the application of chemistry in engineering branches.

Course Outcomes:

The Students will be able to

CO1: Learn the interference of light and young's modulus of the materials
CO2: Understand the properties of flow of the liquid.
CO3: Know the band gap of material and resistance of the given coil.
CO4: Determine the quantity of unknown solution by instrumental technique.
CO5: Determine the concentration of an identified analyte by volumetric analysis
CO6: Analyze the characteristics of water.

LIST OF EXPERIMENTS - PHYSICS PART

(A minimum of five experiments shall be offered)

S.No	**NAME OF THE EXPERIMENT**
1)	Determination of thickness of thin wire – Air wedge method
2)	Determination of Young's modulus of the material – Uniform bending
3)	Determination of viscosity of liquid – Poiseuille's method.
4)	Determination of wavelength of mercury spectrum- Spectrometer Grating.
5)	Determination of Band Gap of a semiconductor material.
6)	Determination of specific resistance of a given coil of wire – Carey Foster Bridge.

LIST OF EXPERIMENTS – CHEMISTRY PART

S.No	**NAME OF THE EXPERIMENT**
1)	Esimation of HCl by pH metry
2)	Estimation of Copper in brass by EDTA method.
3)	Estimation of iodine in iodized salt with thiosulfate
4)	Determination of percentage of calcium in limestone by EDTA method
5)	Determination of DO in water (Winkler's method)

Total Periods: 45

References

1) Text book of Quantitative Inorganic Analysis, A.I.Vogel, ELBS,London, (2006).
2) "Practical A. Ravi Krishnan Engineering Chemistry", Sri Krishna Publications, Chennai (2002)
3) Engineering Physics Laboratory Manual
4) Engineering Chemistry Laboratory Manual

Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	2	1	1	1		1					1	3	1		1
CO2	2		1	1	1		1					1	2		1	1
CO3	2	2		1	1		1					1	3	2		1
CO4	2	2	1		2		1						3	1		1
CO5	3	2	2		2							2	3		2	1
CO6	3	2	2	2			2					2	2		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE27 ELECTRIC CIRCUITS LABORATORY L-T-P C

0-0-2 1

Programme: B.E –Electrical and Electronics Engineering **Sem: II Category: ESC**

Pre/Corequisites: Engineering Physics & Electric Circuits Analysis

AIM: To motivate the students for solving AC and DC circuits, various networks theorems and to solve the transient and frequency response.

Pre-requisite:

Course Outcomes:

The Students will be able to

CO1. Illustrate the basic concepts of electric circuits.

CO2. Reduce more complicated circuits into the Thevenin's and Norton's equivalent circuits and Maximum power transfer circuits.

CO3. Design simple circuits for maximum power transfer to a load.

CO4. Examine the electric circuits using mesh and nodal analysis.

CO5. Illustrate the transient response of RLC circuits.

CO6. Compute the frequency response of resonant and tuned circuits.

LIST OF EXPERIMENTS

1. Verification of ohm's laws and Kirchhoff's laws.
2. Verification of Thevenin's and Norton's Theorem
3. Verification of Superposition Theorem
4. Verification of Maximum Power Transfer Theorem.
5. Verification of Reciprocity Theorem
6. Measurement of self-inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
9. Frequency response of series and parallel resonance circuits.
10. Frequency response of single tuned coupled circuits.

Total Periods 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	1				3	1	3	3	3	1		2
CO2	3	3	3	2	1				3	1	3		3	1		2
CO3	2	3	3	2	1				3	1	3		3	1		3
CO4	3	3	3	2	1				3	1	3		3	1		2
CO5	3	3	3	2	1				3	1	2		3		1	3
CO6	3	3	2	2	1				3	1	2		3		1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SEMESTER – III

191HS31 TRANSFORMS AND DISCRETE MATHEMATICS L-T-P C
2-1-0 3

Programme: B.E./B.Tech. (Common to all branches) Sem: III Category: BSC

Prerequisites:

Aim: To introduce basic mathematical ideas such as reasoning techniques, basic counting techniques and their applications .

Course Outcomes:

The students will be able to

CO1. Apply Laplace transform to solve first and second order differential equations with elementary function.

CO2. Explain the Fourier transform and with their properties.

CO3. Determine Z-inverse transform using convolution theorem and partial fraction method.

CO4. Apply mathematical induction and prove a relation.

CO5. Invent Eulerian and Hamiltonian paths to find shortest paths

CO6. Make use of graph theoretic models to solve basic problems in networks.

LAPLACE TRANSFORMS 9

Laplace transform —Properties of Laplace Transforms – Laplace Transform of periodic functions – Inverse Laplace transforms by partial fraction method and Convolution theorem (excluding proof) – Solving ODE using Laplace transformation techniques.

FOURIER TRANSFORMS 9

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosinetransforms– Properties–Transformsofsimplefunctions–Convolutiontheorem –Parseval's identity.

Z-TRANSFORMS 9

Z-transforms–Elementary properties–Inverse Z-transform–Convolution theorem– Formation of difference equations–Solution of difference equations using Z-transform.

INTRODUCTION TO COUNTING 9

Decision problems on Propositional logic – Basic counting techniques – inclusion & exclusion - Pigeonhole principle –Permutations and combinations-Recurrence relations-Solving Linear recurrence relations and generating functions

INTRODUCTION TO GRAPHS 9

Graphs andtheir basic properties– Graph terminology and special types of graphs - Representing graphs and graph isomorphism – Euler and Hamilton paths.

Total Periods: 45

Text Book

1. B.S.Grewal, 'Higher Engineering Mathematics', Thirty Sixth Edition, Khanna Publishers, Delhi, 2005.
2. Grewal B.S. and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, (2004).

Reference

1. Greenberg. *M.D*. "Advanced Engineering Mathematics, Second Edition, Pearson Education Inc. (First Indian reprint), 2002

2. Venkataraman.M.K., "Engineering Mathematics", Volume I and II Revised enlarged FourthEdition, The National Publishing Company, Chennai, 2004.
3. Trembly J. P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw–Hill Pub. Co. Ltd, NewDelhi, 30th Re-print (2007).
4. Dr.P.Kandasamy,Dr.K.Thilagavathy,Dr.K.Gunavathy,**"Transforms and Partial Differential Equation",** S.Chand & Company Ltd. Ram Nagar, New Delhi.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2									2		3	1		1
CO2	3	2									1		2	1		1
CO3	3	2									1		2	1		1
CO4	3	2									2		2			1
CO5	3	2									1		1		1	1
CO6	3	2									1		1		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BS31 BIOLOGY FOR ENGINEERS L-T-P C
3-0-0 3

Programme: **B.E./B.Tech. (Common to all Branches)** **Sem: III** **Category:** **BSC**

Prerequisites: Basic science

Aim: To understand basic and fundamental engineering knowledge from biology.

Course Outcomes:

The Students will be able to

CO1: Understand various biochemical interactions and the structure and function of various biological molecules

CO2: Explain basic concepts of thermodynamics and energy transactions.

CO3: Discuss different aspects of molecular computing

CO4: Demonstrate an understanding of Mendelian laws of inheritance.

CO5: Describe cellular architecture and utilize these concepts to design an engineering system.

CO6: Understand fundamental concepts in sensory physiology analogy with communication systems.

INTRODUCTION. **9**

Biological analogy in engineering science, Biological elements-Carbohydrate, protein, amino acids, lipids and nucleic acids structure and function. Primary, secondary, tertiary and quaternary structure of protein. Protein as enzymes, transporter, receptors and structural elements.

METABOLISM AND ENGINEERING **9**

Engineering aspects in thermodynamics of energy transactions, exothermic and endothermic versus endergonic and exergonic reactions. ATP as an energy source, glycolysis, Krebs cycle and photosynthesis. Energy yielding and energy consuming reactions. Enzymes classification, mechanism of enzyme action, enzyme kinetics and kinetic parameters

GENETICS AND TRANSFORMATION TECHNOLOGY **9**

Molecular basis of information transfer. DNA as a genetic material. Concept of genetic code. Mendal's laws, concept of segregation and independent assortment. Concept of allele, Gene mapping, Gene interaction, Epistasis, concepts of recessiveness and dominance and their relativeness to programming. Cell multiplication. Phenotype and genotype. Single gene disorders in humans and human genetics.

CLASSIFICATION AND SYSTEM ENGINEERING **9**

Structure, function and relativeness to engineering of prokaryotes and eukaryotes. Habitats- aquatic or terrestrial. Molecular taxonomy-three major kingdoms. Microbial species and strains. Identification and classification of microorganisms. Industrial application of microorganisms. Sterilization and media compositions. Growth kinetics.

SENSOR BIOLOGY AND COMMUNICATION SYSTEMS **9**

Sensory system, circulatory system and excretory system and their relativeness to communication engineering. Hormonal regulation. General defense mechanism in human. Major human disorder and diseases.

Total Periods: 45

Text Book

1. Arthur T. Johnson, CRC Press, New York2011
2. ThyagaRajan.S., Selvamurugan. N., Rajesh.M.P., Nazeer.R.A., Richard W. Thilagaraj, Barathi.S., and Jaganthan.M.K., "*Biology for Engineers"*, Tata McGraw-Hill, New Delhi, 2012

References

1. Rajiv Singal, Gaurav Agarwal, Ritu Bir, Biology for Engineers, CBS Publisher,2019
2. Charles Molnar and Jane Gair, Concepts of Biology-1st Canadian Edition, OpenStax Publication, 2013.
3. Raven Johnson, Biology, 11th Edition, Mc Graw Hill Publication, 2017

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2											1			1
CO2	2												1			1
CO3			1										1			1
CO4						2							1			1
CO5					1		2						1			1
CO6										2			1			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE31	**ELECTROMAGNETIC THEORY**	**L-T-P**	**C**
		3-1-0	**4**

Programme: B.E –Electrical and Electronics Engineering **Sem: III Category: PC**

Pre-requisites: Engineering Physics – I & II

AIM: To expose the students to the fundamentals of electromagnetic fields and their applications in Electrical Engineering

Course Outcomes:

The Students will be able to

CO1. Represent electromagnetic fields in different coordinate systems.

CO2. State and apply the principles of Coulomb's Law and Gauss's law to electric fields in the Cartesian, cylindrical and spherical coordinate systems.

CO3. Analyze and classify magnetic materials, and solve magneto static field problems using Biot-Savart law and Ampere's circuit law with the associated boundary conditions.

CO4. Identify Maxwell's equations and apply them in both their integral and differential forms to time-varying field problems.

CO5. Identify an electromagnetic wave and determine parameters (frequency, phase constant and velocity, associated intrinsic impedance) and power density.

CO6. Determine the attenuation constant, phase constant, and skin depth for waves in a lossy, lossless, free space medium, where the conductivity may range from low to high.

ELECTROSTATICS **12**

Introduction to various Co-ordinate Systems - Coulomb's law – Electric field intensity – electric fields due to point, line, surface and volume charge distributions – Electric flux density – Gauss's law and its applications – Electric potential – potential gradient – Divergence and divergence theorem.

ELECTRIC FIELDS IN MATERIAL SPACE **12**

Current and current density – Continuity of Current - Conductors and Dielectrics - Boundary conditions – capacitance – Capacitance of system of conductors – Energy stored in capacitor – Energy density - Poisson's and Laplace's equations.

MAGNETOSTATICS **12**

Lorentz force, magnetic field intensity (H) -Magnetic field intensity – Biot – Savart Law – Ampere's Law – Magnetic field due to straight conductors, circular loop, infinite sheet of current – Curl – Stoke's theorem – Magnetic flux – Magnetic flux density – The Scalar and Vector magnetic potentials – Force on a moving charge and current elements – Force and Torque on closed circuit.

MAGNETIC FORCES AND MATERIALS **12**

Introduction to magnetic materials – Magnetization and Permeability – Magnetic boundary conditions – Magnetic circuit – Potential energy and forces on Magnetic materials – Inductance and mutual inductance – Inductance of solenoids, toroids, and transmission lines.

ELECTROMAGNETIC FIELDS AND WAVE PROPAGATION **12**

Faraday's Law – Time varying magnetic field - Conduction current and Displacement current – Maxwell's equation in point and integral forms – Electromagnetics Wave Equations –Skin Depth - Wave propagation in free space, Dielectrics, conductors – Power and the Pointing Vector.

Total Periods 60

Text Books

1. Mathew N. O. Sadiku, 'Elements of Electromagnetics', Oxford University Press, 6thEdition, 2015.
2. WillianHayt, 'Engineering Electromagnetics', McGraw Hill, New York, 8threvised edition, 2011.

References

1. Joseph. A. Edminister, 'Theory and Problems of Electromagnetics', 2nd Edition, Schaum Series, Tata McGraw Hill, 1993.
2. AshutoshPramanik, 'Electromagnetism – Theory and Applications', Prentice-Hall of India Private Limited, New Delhi, 2014.
3. Gangadhar.K.A, P.M. Ramanathan, 'Field theory', Khanapumlishers, New Delhi, 15th edition, 2008.
4. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, 5th Edition, 1999.
5. NPTEL Course on 'Electromagnetic Theory' by Dr.K.Pradeep Kumar, IIT Kanpur.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	2	1				1	1	1	3	3	1	1
CO2	2	2	1	1	2	1				1	1	1	3	3	2	1
CO3	2	1	1	1	2	1				1	1	1	3	3	1	1
CO4	3	2	2	1	1	1				2	1	1	3	2	1	1
CO5	1	2	2	1	1	1				2	1	1	2	2	1	1
CO6	1	2	1	1	2	1				1	1	2	3	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE32	**DC MACHINES AND TRANSFORMER**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E –Electrical and Electronics Engineering **Sem: III Category: PC**

Pre-requisites: Engineering Physics

AIM: To expose the students to the basic principles of Electro-mechanical Energy Conversion in Electrical Apparatus and the operation of DC Machines and Transformers.

Course Outcomes:

The Students will be able to

CO1. Explain the concept of basic electromechanical energy conversion systems.

CO2. Sketch the construction and enlighten the working principle, characteristics of DC Generators.

CO3. Illustrate the principle, characteristics and speed control of DC Motors.

CO4. Express the constructional details and performance characteristics of 1-phase transformer.

CO5. Exemplify the constructional details and connections of 3-phase transformer.

CO6. Study the different testing methods of DC machines and transformer.

PRINCIPLE OF ELECTROMECHANICAL ENERGY CONVERSION 9

Introduction – Energy in magnetic system – Field Energy and Mechanical Force – Singly and Multiply Excited Magnetic field systems – Force/Torque in systems with permanent magnets – Energy Conversion via Electric Field.

DC GENERATOR 9

DC Generator – construction, principle of operation – emf equation– types, Characteristics, commutation - armature reaction.

DC MOTOR 9

DC motor – principle of operation – torque equation – types – electrical & mechanical characteristics – starting – speed control – various testing – braking.

SINGLE PHASE TRANSFORMER 9

Transformers – principle of operation – types – basic construction – equivalent circuit - regulation and efficiency – auto transformer.

THREE PHASE TRANSFORMER 9

Three-phase transformer connection - Scott connection – all day efficiency - Sumpner's test – parallel operation of transformers.

Total Periods 45

Text Books

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', 5th Edition, Tata McGraw Hill Publishing Company Ltd, 2017.
2. P.S. Bimbhra, 'Electrical Machinery', 7th Edition, Khanna Publishers, 2015.

References

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', 7th Edition, Tata McGraw Hill publishing Company Ltd, 2012.
2. J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2009.
3. B L Theraja, AK Theraja,'A Text book of Electrical Technology: Volume 2 AC and DC Machines', S.Chand; Twenty Third edition, 2006.
4. Stephen Chapman, 'Electric Machinery Fundamentals', 4th Edition, McGraw Hill Companies Inc. 2012.
5. NPTEL Course on 'Electrical Machines I' by Dr.D.Kastha, IIT Kharagpur.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1							2	1	3	3	2	1
CO2	3	2	1	1							1	1	3	3		1
CO3	3	1	1	1							1	1	3	3		1
CO4	3	2	2	1							1	1	3	2		1
CO5	3	2	2	1							2	1	2	2	2	1
CO6	3	2	1	1							1	2	3	3	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE33	**ELECTRONIC DEVICES AND CIRCUITS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E –Electrical and Electronics Engineering **Sem: III Category: PC**

Pre-requisites: Engineering Physics

AIM: To study the structure, operation, characteristics and applications of the basic analog electronics.

Course Outcomes:

The Students will be able to

CO1. Describe the construction and principle of operation of PN junction diode along with its application.

CO2. Analysis the characteristics of various configurations.

CO3. Identify the hybrid parameters of the transistor in various configuration methods.

CO4. Explain the construction and characteristics of JFET, MOSFET and its equivalent circuits.

CO5. Enumerate the functioning of amplifiers and oscillator circuits.

CO6. Interpret the wave shaping circuits and its applications.

PN DIODE AND ITS APPLICATIONS **9**

PN junction diode - VI characteristics – diode resistance, temperature effects – Drift and diffusion currents – Rectifiers: HWR, FWR, - Zener diode – VI characteristics, Zener as Regulators, LED, LCD characteristics and applications.

BJT AND ITS APPLICATIONS **9**

Junction transistor – Transistor construction – Input and output characteristics of CE, CB and CC configurations – Transistor hybrid model for CE configuration– Analytical expressions for transistor characteristics– Transistor switching times – cascade connection – Darlington connection - Opto-couplers.

FET AND ITS APPLICATIONS **9**

FET – VI characteristics, JFET – small signal model – high frequency equivalent circuit – CS and CD amplifiers –MOSFET - Characteristics – enhancement and depletion.

AMPLIFIERS AND OSCILLATORS **9**

Differential amplifiers: CM and DM –Advantages of negative feedback – voltage / current, series, shunt feedback –positive feedback – Condition for oscillations - Oscillators – Hartley, Colpitts, RC phase shift, Crystal.

PULSE CIRCUITS **9**

RC wave shaping circuits – Diode clampers and clippers – Multivibrator- Schmitt triggers – UJT based saw tooth oscillators.

Total Periods 45

Text Books

1. David A. Bell, ‘Electronic Devices & circuits’, Prentice Hall of India/Pearson Education, Fourth

edition, Ninth printing, 2007.
2. S.Salivahanan, N.Suresh Kumar, 'Electronic Devices and Circuits', Third edition, Tata McGraw Hill publishing Co.Ltd., 2012.

References

1. Albert Paul Malvino, 'Electronic Principles', 5th Edition, Tata McGraw Hill publishing Co.Ltd., 1997.
2. Robert Boylestad and Louis Nashelsky, 'Electronic Devices and Circuits', 9th Edition, Prentice-Hall of India Private Ltd, New Delhi, 2009/PHI.
3. Jacob Millman& Christos.C. Halkias, 'Electronic devices and circuits', Tata McGraw Hill publishing company ltd., Thirdedition, 2010.
4. R.S.Sedha, 'A text book of Applied Electronics', S.Chand& Company Ltd., 2004.
5. G.K. Mithal, 'Electronic devices and circuits', Khanna publishers, 1997.
6. NPTEL Course on 'Basic Electronics' by Prof. M.B.Patil, IIT Bombay.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1							3	2	3	1		2
CO2	3	3	2	1							3		3	1		2
CO3	3	3	1	1							3		3	1		2
CO4	3	3	2	1							3		3	2		2
CO5	3	3	1	1							3		3	1		2
CO6	3	3	1	1							3		3	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE34	**MEASUREMENT AND INSTRUMENTATION**	**L-T-P**	**C**
		3-0-2	**4**

Programme: B.E –Electrical and Electronics Engineering **Sem: III Category: PC**

Pre-requisites: Basic Electrical Engineering, Maths

AIM: To provide adequate knowledge in electrical instruments and measurements techniques.

Course Outcomes:

The Students will be able to

CO1. Represent about the functional elements, characteristics and errors of an instrument.
CO2. Evaluate the measured data and calibrate it for error rectification
CO3. Measure the electrical and electronic quantities by using measuring instruments.
CO4. Measure the unknown values of electrical components using bridge circuits
CO5. Discuss about various types of recorders and plotters.
CO6. Describe the classification of transducers according to its application

INTRODUCTION **8**

Functional elements of an instrument – measurement standards – characteristics – calibration of meters- Errors in measurement – Significance of IS Standards of instruments – Principle and types of analog, digital voltmeters and ammeters.

ELECTRICAL AND ELECTRONICS INSTRUMENTS **8**

Classification of measuring instruments- Essential requirements of an Instrument-Construction, working principle and Torque equation of Permanent Magnet Moving Coil instruments - Attraction type and Repulsion Type Moving iron instruments- Electro-dynamometer type wattmeter and Induction Type Energy meter – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

COMPARITIVE METHODS OF MEASUREMENT **8**

D.C & A.C potentiometers, Series and shunt type ohmmeter- D.C Bridges: Wheatstone Bridge, Kelvin's bridge, Kelvin's double bridge- A.C bridges: Maxwell bridge, Anderson bridge, Hays bridge, Schering bridge, Wein's bridge, Megger. Electrostatic and electromagnetic interference – Grounding techniques.

STORAGE AND DISPLAY DEVICES **8**

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD and dot matrix display – Data Loggers, Digital Storage Oscilloscope.

TRANSDUCERS AND DATA ACQUISITION SYSTEM **8**

Classification of transducers – Selection of transducers – Resistive, capacitive and inductive transducers – Piezoelectric, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Thermal imagers - Smart sensors.

Total Periods 40

LIST OF EXPERIMENTS

1. Study of LVDT and Strain Gauge.
2. AC bridges – Maxwell's Bridge and Schering's Bridge.
3. DC bridges – Wheatstone Bridge and Kelvin's Double Bridge.
4. Calibration of 3- ϕ Energy Meter by Phantom Loading.
5. Calibration of current transformer and potential transformer.
6. Measurement of iron loss.

Total Periods 20

Text Books

1. Sawhney A K, 'A Course in Electrical and Electronic Measurement and Instrumentation', Dhanpat Rai & Sons, New Delhi, 18th Edition, 2012.
2. Gupta J.B., 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2009.

References

1. Prithwiraj Purkait, Budhaditya Biswas, Chiranjib Koley 'Electrical and Electronics Measurements and Instrumentation', McGraw Hill Education India, First Edition, 2013.
2. Doeblin E., 'Measurement Systems: Application and Design', Tata Mc-Graw Hill Book Co., Fifth Edition, New Delhi, 2004.
3. Moorthy D.V.S, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2008.
4. H.S. Kalsi," Electronic Instrumentation" McGraw Hill Third Edition, 2010.
5. NPTEL Course on 'Industrial Instrumentation', by Prof. Alok Barua, IIT kharagpur

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3				1				1	1		3	1		1
CO2	3	3				2				1	1		3	2		1
CO3	3	2	1			1				1	1		3	2		1
CO4	3	2	3							1	1		3	2		2
CO5	3									1	1		3	1		2
CO6	3	1				2				1	2	1	3	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE37 DC MACHINES AND TRANSFORMER LABORATORY L-T-P C
0-0-2 1

Programme: B.E. Electrical and Electronics Engineering **Sem: III Category: PC**
Pre/Corequisites: Engineering Physics, DC machines and Transformer
AIM: To expose the students to the operation of D.C. machines and transformers and give them experimental skill.

Course Outcomes:

The Students will be able to

CO1. Perform the open circuit test and the load test on a given DC generator and draw the characteristic curves.
CO2. Perform the direct test on a given DC motor.
CO3. Design a speed controller for the dc shunt motor by field and armature control method also to draw its characteristic curves.
CO4. Predetermine the load test on a given DC machines and draw its performance curves.
CO5. Determine the Efficiency and Regulation on a given single phase transformer.
CO6. Predetermine the load test on a given single phase transformer and draw its performance curves.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of separately excited and self-excited DC generators.
2. Load characteristics of DC compound generator with differential and cumulative connection.
3. Load characteristics of DC shunt and compound motor.
4. Load characteristics of DC series motor.
5. Swinburne's test and speed control of DC shunt motor.
6. Hopkinson's test on DC motor – generator set.
7. Load test on single-phase transformer and three phase transformer connections.
8. Open circuit and short circuit tests on single phase transformer.
9. Sumpner's test on transformers.
10. Separation of no-load losses in single phase transformer.
11. Testing of Transformer oil and insulation.

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	1	2				3	1	1	1	2	3	1	1
CO2	3	2	3	2	2				1	1	1	1	2	3		1
CO3	3	3	3	2	1				3	1	1	1	2	3		2
CO4	3	3	3	2	1				3	1	1	2	2	3		2
CO5	2	3	2	1	1				3	1	1	2	2	3	1	1
CO6	3	3	2	1	2				3	1	1	2	2	3	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE38 ELECTRONIC DEVICES AND CIRCUITS LABORATORY L-T-P C
0-0-2 1

Programme: B.E- Electrical and Electronics Engineering **Sem: III Category: PC**

AIM: To study the characteristics and to determine the device parameters of various solid-state devices.

Pre-requisites: Electronic Devices and Circuits, Electric Circuit Analysis

Course Outcomes:

The Students will be able to

CO1: Construct the VI characteristics of various configurations of BJT.

CO2: Illustrate the VI characteristics of UJT and analyze its relation.

CO3: Describe the VI characteristics of Opto-coupler.

CO4: Design the rectifier circuit using PN.

CO5: Develop the Oscillator Circuits.

CO6: Design the amplifier circuits.

LIST OF EXPERIMENTS

1. Characteristics of P-N Junction diode.
2. Characteristics of Zener diode.
3. Characteristics of JFET/MOSFET.
4. Input and Output Characteristics of Transistor in CE configuration.
5. Input and Output Characteristics of Transistor in CBconfiguration
6. Single phase half wave and full wave rectifiers.
7. Characteristics of UJT
8. Common Emitter amplifier.
9. RC phase Shift Oscillator Circuits.
10. Characteristics of Opto-coupler.
11. PCB Designing.

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1				2	1	2	1	3	1		2
CO2	3	2	2	2	1				2	1	2	1	3	1		2
CO3	3	2	2	2	1				2	1	2	1	3			2
CO4	3	2	3	2	1				3	1	2	2	3		1	2
CO5	3	2	3	2	1				2	1	2	1	3			3
CO6	3	2	3	2	1				3	1	2	1	3			3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS37 COMMUNICATION SKILLS-I L-T-P C

(Common to all B.E/B.Tech Degree Programmes)

0-0-2 MC

Programme: B.E –Electrical and Electronics Engineering **Sem: III Category: HSMC**

AIM: To create an Environment to improve learner's communication skill using Professional English module.

Course Outcomes:

The Students will be able to

CO1. Impart basics of Language relating to Business Communication

CO2. Impart basics of Grammar relating to Business Communication

CO3. Imbibe the spirit of accurate and appropriate Basic Communication

CO4. Familiarize with the Professional Communication Module

CO5. Improve learners ability to understand Technical Communication

CO6. Train students to use language appropriately for public speaking, group discussions and interviews

A. Language & Grammar **2**

1 Use of Verb, Article, Adjectives, Adverbs, Preposition, Conjunction, Comparative Superlative,

2 Noun –Antecedent & Precedent

3 Spelling &Punctuation

4 Concord

5 Use of Active & Passive voice

6 Use of Conditional Sentence & Reported speech

B. Reading **4**

1. Reading technical reports for Gist
2. Reading Technical Article, Graphs, Charts, Adverts, Notices & Proposals for Structure and detail

C. Writing **3**

1. Writing E-mails for giving Instruction/ Summarizing/Persuading/Giving assurance/asking a comment
2. Writing an Introduction to Report/Proposal/Technical Description
3. Writing Instructions & Recommendations for User manuals/Equipments/devices/New Inventions

D. Listening **3**

1. Listening to Technical News for Gist
2. Listening to Technical Interviews for gathering information
3. Listening to a Presentation for inferring meaning

E. Speaking **6**

1 Self-Introduction

2 Have your say- Recent gadgets/Technical Innovations/ Scientific Inventions

Total Periods 18

Text Books

1. Technical Writing: Process and Product, Gerson, Pearson Education India, 2007, ISBN: 8131709280, 9788131709283
2. 2. Business Benchmark Pre-Intermediate to Intermediate: Student's Book BEC Preliminary Edition, Norman Whitby, PB + 2 Audio CDs,ISBN: 9780521759397.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1					2				3	2	2	1			1
CO2		1								3				1	1	1
CO3					1			2	1	3		1				2
CO4						3			1	3		2			1	1
CO5						3	1		1	1	2	2			1	2
CO6					3				1	2						1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SEMESTER – IV

191HS42	PROBABILITY AND STATISTICS	L-T-P	C
		2-1-0	3

Programme: B.E. / B.Tech. (CIVIL, CSE, EEE, MECH, BIO-TECH & BIO-MEDICAL) **Sem:** III **Category:** BSC

Pre-requisites: Engineering Mathematics

Aim: To analyze the engineering problems using the techniques and the mathematical skills acquired by studying ODE and PDE uses numerical methods.

Course Outcomes:

The students will be able to

CO1: Classify the discrete and continuous random variables.

CO2: Analyze the binomial, Poisson, geometric, uniform, exponential and normal distribution.

CO3: Understanding the two dimensional Random Variables.

CO4: Analyze the differences between means & standard deviations

CO5: Test the independence of attributes for small samples

CO6: Classify the tests for single variance and equality of variances

PROBABILITY AND RANDOM VARIABLES **12**

Probability spaces – Conditional probability – Bayes rule - Discrete and continuous random variables – Moments - Moment generating functions and their properties.

DISCRETE AND CONTINOUS PROBABILITY DISTRIBUTION **12**

Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and normal distributions – Function of Random Variable

TWO DIMENSIONAL RANDOM VARIBLES **12**

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem (for 2-D random variables)

STATISTICS **12**

Curve fitting by the method of least squares – fitting of Straight lines, Second degree parabolas and more general curves – Test of significance – Large sample test for single proportion, difference of proportions, single mean, difference of means and difference of standard deviations.

TESTING OF HYPOTHESIS **12**

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

Total Periods: 60

Text Book

1. B.S. Grewal, 'Higher Engineering Mathematics', Thirty Sixth Edition, Khanna Publishers, Delhi, 2005.
2. Grewal B.S. and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, (2004).

Reference

1. Greenberg. *M.D*. "Advanced Engineering Mathematics, Second Edition, Pearson Education Inc.

(First Indian reprint), 2002
2. Venkataraman. M.K., “Engineering Mathematics”, Volume I and II Revised enlarged Fourth Edition, The National Publishing Company, Chennai, 2004.
3. Kreyszig, E., Advanced Engineering Mathematics, 8th edition, John Wiley Sons, 2001.
4. Chapra S.C. and Canale R.P., “Numerical Methods for Engineers”, Tata Mc-Graw Hill, New Delhi, (2007).
5. Gerald C.F., and Wheatley P.O., “Applied Numerical Analysis”, Pearson Education Asia, New Delhi, (2006).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1		1								3	1			1
CO2	2	2		2									1			1
CO3	2	1		2								1	1			1
CO4	1	2		3								2	1			1
CO5	2	3											1			1
CO6	3	3			3				1			2	1			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191CS46	PYTHON PROGRAMMING	L T P C 3 0 2 4

Programme: BIOTECH / ECE / EEE **Sem:** IV **Category:** ESC

Pre-requisites: Programming for Problem Solving

Aim: To provide students with the programming knowledge and to develop python programs.

Course Outcomes:

The Students will be able to

CO1: Understand Introduction of python programming.
CO2: Develop functions in python.
CO3: Understand strings and lists in python programs.
CO4: Analyze OOPS Concept in python.
CO5: Demonstrate tubles, dictionaries in python.
CO6: Handle files and exceptions in python.

INTRODUCTION **8**

Python Overview - Comments - Identifiers - Keywords - Variables - Data types - Operators -Statement and Expressions - String Operations - Boolean Expressions - Control Statements -Iterations - Input from Keyboard.

FUNCTIONS IN PYTHON **8**

Built-in Functions - Composition of Functions - User defined functions - Parameters and Arguments - Function calls - The return statement - Python recursive function - Anonymous Functions.

STRINGS AND LISTS **8**

Strings - Compound Data Types - String slices - String Traversal - Escape Characters - String formatting operator, functions - Lists-Traversing a List - Built-in list operators, methods.

CLASSES AND OBJECTS **8**

Class, Objects in python - Built-in Class attributes - Inheritance - Method Overriding - Data Encapsulation - Data hiding.

DICTIONARIES AND FILES **8**

Tubles-Values - Operations - Functions - Dictionaries - Values - Update - Properties Operations - Files - Text Files - Exceptions - Exception with arguments - User defined Exceptions.

Total Periods : 40

Lab Component:

Write the programs for the following topics using python:

1. Operators
2. Control Statements
3. Built-In and User defined functions

4. String functions
5. List functions.
6. Classes and their attributes.
7. Inheritance and method overriding.
8. Data Encapsulation and hiding.
9. File Operations and Exception handling.

Total Periods : 20

Text Books:

1. E.Balagurusamy, ”Introduction to Computing And Problem Solving Using Python”, Mc-GrawHill Education (India) Private Ltd., 2016.

References:

1. MarkLutz, ”Programming Python”, Fourth Edition, 2010.
2. John V.Guttag, ”Introduction to Computation and Programming using Python”, Second Edition, 2016.
3. John Paul Mueller, ”Beginning Programming with python For DUMMLES”, 2014.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		3	1	2		2						1			1
CO2	3	3		1	2								1			1
CO3	3		2	3			3				3	3	1			1
CO4	2	3		2	2								1			1
CO5	3	2		3	1				3	3			1			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EC32	LINEAR INTEGRATED CIRCUITS			L-T-P	C
				3-0-0	3
Programme:	B.E. Electrical and Electronics Engineering	**Sem:**	**IV**	**Category:**	**PC**

Pre-requisites: Engineering Physics, Electric Circuits Analysis

AIM: To learn the basic concepts in the design of electronic circuits using linear integrated circuits and their applications in the processing of analog signals.

Course Outcomes: The students will be able to

CO1: Examine the operational amplifier stages and its AC, DC performance characteristics.
CO2: Analyze the applications of operational amplifier.
CO3: Elaborate the concepts of analog multiplier IC and PLL IC.
CO4: Classify and explain the types of digital-to-analog and analog-to-digital converters.
CO5: Apply special function ICs to design different types of waveform generators and explain the basics of IC regulators
CO6: Analyze the astable and monostable operation of timer IC 555.

CIRCUIT CONFIGURATION FOR LINEAR ICs **9**

Advantages of ICs over discrete components –General operational amplifier stages and internal circuit diagrams of IC 741– DC and AC performance characteristics – Slew rate – Open and Closed loop configurations.

APPLICATIONS OF OPERATIONAL AMPLIFIERS **9**

Scale Changer – Adder and Subtractor – Instrumentation amplifier – Phase Shift Circuits – Voltage Follower – V-to-I and I-to-V converters – Peak detector – Clipper and Clamper –Differentiator – Integrator – Comparators – Schmitt trigger –Low-pass, high-pass and band-pass filters.

ANALOG MULTIPLIER ICs AND PLL ICs **9**

Analog Multiplier ICs and its applications — Operation of the basic PLL, Closed loop analysis of PLL, Voltage Controlled Oscillator(VCO), Block diagram of PLL IC 565 and its applications for frequency synthesizing, frequency multiplication and division.

A/D AND D/A CONVERTERS **9**

Analog and Digital Data Conversions, D/A converter – specifications - Weighted resistor type, R-2R Ladder type, Voltage Mode R-2R Ladder and Current-Mode R-2R Ladder types - Sampling Process-High speed sample and hold circuit, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type - Dual Slope type - A/D Converter using Voltage-to-Time Conversion.

WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs **9**

Sine-wave generators, Multivibrators, Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555-GeneralDescription - Monostable and Astable operation of Timer IC 555 – LM317 adjustable voltage regulators.

TOTAL PERIODS 45

TEXT BOOK

1.RoyChoudhry.D, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd, 4th Edition, 2014.

REFERENCES

1. Salivahanan.S & Kanchana Bhaskaran.V.S., "Linear Integrated Circuits",3rd Edition, McGraw Hill, 2018.
2. Sonde.B.S., "System design using Integrated Circuits" , New Age Pub, 2nd Edition, 2001
3. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.
4. Ramakant. A. Gayakwad, "OP-AMP and Linear Ics", Prentice Hall / PE, 4th edition, 2001.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2								2	2	3		2
CO2	2	2	2									2	2	3	2	2
CO3	3	2	3	2	2	2			1			2	2	3	2	2
CO4	3	2	2		1	1			1			2	2	2		2
CO5	2	2	2	1	1	1			2			2	2	3	2	2
CO6	3	2	2	2	2	1			1			2	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE41	**AC MACHINES**	**L-T-P**	**C**
		3-1-0	**4**

Programme: B.E –Electrical and Electronics Engineering **Sem:** **IV** **Category:** **PC**

Pre-Requisites: DC Machines and Transfromer

AIM: To expose the students to the concepts of synchronous and asynchronous machines and analyze their performance.

Pre-requisite: Engineering Physics – I & II

Course Outcomes:

The Students will be able to

CO1. Recognize construction and performance of salient and non – salient type synchronous generators.

CO2. Exemplify the principle of operation and performance of synchronous motor.

CO3. Explain construction, principle of operation and performance of poly phase induction machines.

CO4. Impart Knowledge on starting and speed control of three-phase induction motors.

CO5. Illustrate the construction, principle of operation and performance of single phase induction motors.

CO6. Choose a suitable special motor for domestic applications.

SYNCHRONOUS GENERATOR **9**

Alternators – construction, principle and types – armature reaction – load characteristics – voltage regulation – two-reaction theory – parallel operation.

SYNCHRONOUS MOTOR **9**

Synchronous motors – Synchronous machines on infinite bus bars – phasor diagram – V and inverted- V curves – Hunting and its suppression – starting methods.

POLY PHASE INDUCTION MOTOR **9**

Poly-phase induction motors – construction, principle and types – no-load and load characteristics – no-load and blocked rotor test – equivalent circuit – circle diagram.

STARTING AND SPEED CONTROL METHODS **9**

Poly-phase induction motors – Starting and speed control methods – Braking methods.

SINGLE PHASE INDUCTION MOTORS **9**

Single-phase induction motors – construction, principle and types – double revolving field theory –equivalent circuit. Permanent magnet brushless motors – construction, principle and types – torque equation.

Total Periods **45**

Text Books

1. D.P. Kothari and I.J. Nagrath, ‘Electric Machines’, 5th Edition, Tata McGraw Hill Publishing Company Ltd, 2017.
2. P.S. Bimbhra, ‘Electrical Machinery’, 7th Edition, Khanna Publishers, 2015.

References

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', 7th Edition, Tata McGraw Hill publishing Company Ltd, 2012.
2. J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2009.
3. B L Theraja, AK Theraja,'A Text book of Electrical Technology: Volume 2 AC and DC Machines', S.Chand; Twenty Third edition, 2006.
4. Stephen Chapman, 'Electric Machinery Fundamentals', 4th Edition, McGraw Hill Companies Inc. 2012.
5. NPTEL Course on 'Electrical Machines II', by Tapas Kumar Bhattacharya, IIT Kharagpur.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1		1					1	1	3	3		1
CO2	2	2	1	1		1					1	1	3	3		1
CO3	2	1	1	1		1					1	1	3	3	1	1
CO4	3	2	2	1		1					1	1	3	2		1
CO5	3	2	2	1		1					1	1	2	2		1
CO6	3	2	1	1	2	1					1	2	3	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE42	**CONTROL SYSTEMS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E –Electrical and Electronics Engineering **Sem: IV Category: PC**

Pre-requisites: Physics, Mathematics and Measurement and Instrumentations

AIM: To provide sound knowledge in the basic concepts of linear control theory and design of control system.

Pre-requisite: Mathematics, Machines

Course Outcomes:

The Students will be able to

CO1. Develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.

CO2. Perform time response analysis for I and II order system with different test inputs.

CO3. Analyze various methods of frequency domain analysis.

CO4. Verify the stability of the system.

CO5. Design a suitable compensator for the given specifications.

CO6. Identify the solution for complex control problem by state variable analysis.

SYSTEMS AND REPRESENTATION **9**

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

TIME DOMAIN ANALYSIS **9**

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error.

FREQUENCY DOMAIN ANALYSIS **9**

Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.

STABILITY AND COMPENSATOR DESIGN **9**

Concept of Stability - Routh-Hurwitz Criteria - Root-Locus technique - Nyquist stability criterion - Design of Lag, lead compensator using bode plots.

STATE VARIABLE ANALYSIS **9**

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

Total Periods 45

Text Books

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017
2. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.

References

1. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014
2. M.Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
3. A. NagoorKani, Control Systems, RBA Publications, 2017.
4. NPTEL Course on “Control Engineering” by Prof. S. D. Agashe, IIT Bombay.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2			1				2	1	3	2		2
CO2	3	2	3	2							2		3	1	1	2
CO3	3	2	3	2							1		3	1	1	2
CO4	3	2	3	2			1				1	1	3	2	1	2
CO5	3	3	3	1							2		3		1	2
CO6	3	2	2	1							1		3	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE43	**TRANSMISSION AND DISTRIBUTION**	**L-T-P**	**C**
		3-1-0	**4**

Programme: B.E –Electrical and Electronics Engineering **Sem: IV Category: PC**

Pre-requisites: Engineering Mathematics, Engineering Physics, Electromagnetic Theory

AIM: To understand the importance and the functioning of transmission and distribution of the electric power in an electrical utility (or) a power system.

Course Outcomes:

The Students will be able to

CO1. Illustrate the generation transmission and distribution system.
CO2. Calculate transmission line parameters.
CO3. Analyze the performance of various transmission lines.
CO4. Examine the Power flow through a transmission line.
CO5. Analyses the voltage distribution in insulator strings and cables and methods to improve the same.
CO6. Evaluate various distributions in power system.

INTRODUCTION **12**

Structure of electric power system - different operating voltages of generation, transmission and distribution – advantage of higher operating voltage for AC transmission. Mechanical design of transmission line between towers – sag and tension calculations using approximate equations taking into account the effect of ice and wind.

TRANSMISSION LINE PARAMETERS **12**

Parameters of resistance, inductance and capacitance calculations - single and three-phase transmission lines - single and double circuits - solid, stranded and bundled conductors - symmetrical and unsymmetrical spacing – transposition of lines -concepts of GMR and GMD - skin and proximity effects - interference with neighbouring communication circuits.

MODELLING AND PERFORMANCE OF TRANSMISSION LINES **12**

Transmission line classification - short line, medium line and long line – equivalent circuits – Sending end voltage, current, voltage regulation and transmission efficiency –ABCD constants- real and reactive power flow in lines – power angle diagrams– surge-impedance loading, Ferranti effect-Surge impedance. Corona discharge characteristics- critical voltage and corona loss.

INSULATORS AND CABLES **12**

Classification of insulators for transmission and distribution purpose – voltage distribution in insulator string and grading - improvement of string efficiency.

Underground cables - constructional features of LT and HT cables – insulation resistance, capacitance, dielectric stress and grading – tan δ and power loss –thermal characteristics.

DISTRIBUTION SYSTEM **12**

Feeders, distributors and service mains. DC distributor – 2-wire and 3-wire, radial and ring main distribution. AC distribution – single phase (with concentrated and distributed loads) and three phase 3-wire and 4-wire distribution with balanced and unbalanced loads.

Total Periods 60

Text Books

1. B.R.Gupta, 'Power System Analysis and Design', S. Chand, New Delhi, 2003.
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd., New Delhi, 2002.

References

1. Luces M. Fualkenberry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 1996.
2. Hadi Saadat, 'Power System Analysis,' Tata McGraw Hill Publishing Company', 2003.
3. Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning',New Delhi.
4. 'Tamil Nadu Electricity Board Handbook', 2007.
5. S.L.Uppal and S.Rao 'Electrical Power Systems', Khanna Publishers, 2009.
6. NPTEL Course on 'Power System Generation, Transmission and Distribution', IIT Delhi.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1		1	1				2	3	2	1	3	1
CO2	3	2	2	1		1	1					2	2		3	1
CO3	3	2	1	1		1	1					2	2		3	1
CO4	3	2	3	1		1	2					3	2		3	1
CO5	3	2	3	1		1	1					2	2		3	1
CO6	3	2	3	1		1	2					3	2		3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE47 AC MACHINES LABORATORY L-T-P C
0-0-2 1

Programme: B.E. Electrical and Electronics Engineering **Sem: IV Category: PC**
Pre/Corequisites: DC machines and Transformer, AC Machines
AIM: To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

Course Outcomes:

The Students will be able to

CO1. Model and analyze the performance of synchronous generators and their application to power system.
CO2. Model and analyze the performance characteristics of induction motors and their application to industry.
CO3. Differentiate the no-load losses in induction motor
CO4. Construct the circle diagram and analyze the performance of induction motor.
CO5. Model and analyze the performance of synchronous motor under different excitation conditions.
CO6. Choose a suitable A.C. starter for industrial application.

LIST OF EXPERIMENTS

1. Load test on alternator
2. Load test on 1-phase induction motor
3. Load test on 3-phase squirrel cage induction motor
4. Load test on 3-phase slip ring induction motor
5. Regulation of alternator by EMF and MMF methods
6. Regulation of alternator by ZPF and ASA methods
7. Separation of no load losses in induction motor
8. No load and blocked rotor test on 3-phase squirrel cage induction motor
9. V and inverted V curves of synchronous motor
10. Parallel Operation of Alternator
11. No load and blocked rotor test on 1-phase squirrel cage induction motor
12. Regulation of three phase salient pole alternator by slip test
13. Study of A.C. motor starters

Total Periods 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	1				3	1	2		2	3	1	2
CO2	3	2	3	3	1				3	1	2		2	3	1	2
CO3	3	1	3	3	1				3	1	1		2	3		1
CO4	3	1	3	3	1				3	1	1		2	3		1
CO5	3	3	3	3	1				3	1	1		2	3		1
CO6	3	2	1	1	3				3	1	2	1	2	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE48 **CONTROL SYSTEMS LABORATORY** **L-T-P** **C**

0-0-2 **1**

Programme: B.E. Electrical and Electronics Engineering **Sem: IV** **Category: PC**

Pre/Requisites: Control System, Measurement and Instrumentations

AIM: To provide sound knowledge in the basic concepts of linear control theory and design of control system.

Course Outcomes:

The Students will be able to

CO1. Develop the transfer function model for DC and AC Servomotor.

CO2. Simulate Type - 0 and Type - 1 system with different test inputs.

CO3. Develop the transfer function of DC Generator and Motor.

CO4. Analyze the stability of linear system using MATLAB.

CO5. Simulate first and second order system using MATLAB.

CO6. Design the various controllers in control system.

LIST OF EXPERIMENTS

1. Determination of transfer functions of DC Generator.
2. Determination of transfer functions of DC Motor.
3. Determination of transfer functions of AC Servomotor.
4. Analog simulation of Type - 0 and Type – 1 system.
5. Stability analysis of linear systems.
6. DC and AC position control systems.
7. Stepper motor control system.
8. Digital simulation of first order systems.
9. Digital simulation of second order systems.
10. Study of PID Controller.
11. Closed loop control of temperature.

Total Periods 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	1		1		3	1	2		3	1		1
CO2	3	3		2	1		1		3	1	1	1	3			1
CO3	3	3	3	3	2		1		3	1	2		3	1	1	1
CO4	3	3	1	3	3		2		3	1	1		3			2
CO5	3	3	2	2	3		2		3	1	1	1	3			2
CO6	3	3	3	2	3		2		3	1	2	1	3	1	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS47 **COMMUNICATION SKILLS-II** **L-T-P** **C**

(Common to all B.E/B.Tech Degree Programmes)

2-0-2 **MC**

Programme: B.E –Electrical and Electronics Engineering **Sem: IV Category: HSMC**

AIM: To create an Environment to experiment Professional English communication module with Intermediate resources

Course Outcomes:

The Students will be able to

CO1. Be competent in Presentation skill
CO2. Develop their accuracy in Written Communication
CO3. Improve their ability to understand Technical Presentations.
CO4. Improve their ability to understand Conversations
CO5. Give the exposure with Internal workplace Communication
CO6. Give the exposure with External workplace Communication

A. Reading **4**

1. Reading Technical Articles, Reports, Proposals for gathering information
2. Reading Technical Journals, User manuals, annual reports for matching information

B. Writing **6**

1. Writing E-mail to inform/respond/Insist/Convince/comment
2. Writing Technical Report (Format, Types, Abstract)
3. Writing Project Introduction/Website/Product
4. Writing User Manuals/Guidelines
5. Writing Product Reviews
6. Writing Useful Expressions for Persuading, Summarizing, gathering information

C. Listening **2**

1. Listening to Telephonic conversation for filling the gaps
2. Listening to Group discussion to gather information
3. Listening to Interviews for writing short answers
4. Listening to Technical Presentation for evaluation

D. Speaking **6**

1. Mini-Presentation on Technical Themes (Samples):
   a) Cloud computing b) 4g c) Mission to Mars
   d) Water Resource e) Sixth Sense Technology
2. Group Discussion on Social and Technical issues

Total Periods **18**

Text Books

1. Technical Communication: Principles and Practice, 2/e,Meenakshi Raman; SangeetaSharma ISBN:

0198065299, 9780198065296

2. Business Benchmark Pre-Intermediate to Intermediate: Student's Book BEC Preliminary Edition, Norman Whitby, PB + 2 Audio CDs, ISBN: 9780521759397

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1										3	1		1			3
CO2	1									3		3	1			3
CO3									2	3	1		1			3
CO4	1				2				2	3		3	1			3
CO5								1	2	3			1	1	1	3
CO6					3			1	2	3			1			3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SEMESTER V

191EE51	POWER SYSTEM ANALYSIS	L-T-P	C
		3-1-0	4

Programme: B.E.- Electrical and Electronics Engineering **Sem: V** **Category: PC**

Pre-requisites: Engineering Mathematics, Electric Circuits Analysis, Transmission and Distribution

AIM: To gain comprehensive knowledge on power system analysis problems.

Course Outcomes:

At the end of the course, student will be able to

CO1. Develop mathematical model of a given power system.

CO2. Evaluate the power system network using simple bus building algorithms.

CO3. Perform power flow analysis using numerical techniques.

CO4. Analyze the behavior of the power system under symmetrical faulted condition.

CO5. Examine the behavior of the power system under unsymmetrical faulted condition in a power system.

CO6. Realize the stability status of power system under transient condition.

INTRODUCTION **12**

Power scenario in India - Modern power system (or) electric energy system - Analysis for system planning and operational studies – basic components of a power system - Primitive parameters - Single line diagram – per unit quantities, p.u. impedance diagram. Simple building algorithms for the formation of Y-Bus matrix and Z-Bus matrix.

POWER FLOW ANALYSIS **12**

Bus classification, Formulation of Power Flow problems - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method - Fast Decoupled Power Flow Solution - Comparison of the three methods.

SYMMETRICAL FAULT ANALYSIS **12**

Symmetrical short circuit on Synchronous Machine - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Fault level, Current limiting reactors – Short circuit capacity.

UNSYMMETRICAL FAULT ANALYSIS **12**

Symmetrical components - Sequence impedances, Sequence networks - Analysis of unsymmetrical fault at generator terminals - Bus impedance matrices of zero sequence, positive sequence and negative sequence - analyzing unsymmetrical fault occurring at any point in a power system.

POWER SYSTEM STABILITY **12**

Introduction to stability studies - Swing equation - Swing curve, Power-Angle equation - Equal area criterion - Critical clearing angle and time - Further applications of the equal-area criterion - Classical step-by-step solution of the swing curve

Total Periods 60

Text Books

1. Hadi Saadat, 'Power System Analysis', 3rd Edition (revised), Tata McGraw Hill Publishing Company, 2011.
2. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', 4th Edition, Tata McGraw-Hill Publishing Company, 2011.

References

1. Olle I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, Second Edition, 2003.
2. P. Kundur, 'Power System Stability and Control', 1st Edition, Tata McGraw Hill Publications, 2006.
3. K.Nagasarkar and M.S. Sukhija, 'Power System Analysis', 1st Edition, Oxford University Press, 2007.
4. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', 1st Edition, McGraw Hill International Book Company, July 2017.
5. E. Mariani, S.S. Murthy, "Control of Modern Integrated Power Systems", Springer, 1997.
6. Prof. A.K. Sinha, "NPTEL – Power System Analysis", Department of Electrical Engineering, IIT Kharagpur. Link: https://nptel.ac.in/courses/108105067/#.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	1	2	2			1			1	1	3	1
CO2	3	3	3	1		2	1						1	1	3	1
CO3	3	3	3	1	2	1				1		1	1	1	3	1
CO4	3	3	3	2	1	1		1	1	1		1	1	1	3	1
CO5	3	3	3	1	1	1	1	1	1	2		1	1	1	3	1
CO6	3	3	3	1	1	1	1		1	2		1	1	1	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE52	**POWER ELECTRONICS**			**L-T-P**	**C**
				3-0-0	**3**
Programme:	B.E. Electrical and Electronics Engineering	**Sem:**	**V**	**Category:**	**PC**
Pre-requisites:	Electronic Devices and Circuits				
AIM:	To understand the various applications of electronic devices for conversion, control and conditioning of the electrical power.				

Course Outcomes:

The Students will be able to

CO1. Acquire knowledge about characteristics of various power semiconductor devices.

CO2. Analyze the performance of single phase and three phase ac-to-dc circuits.

CO3. Design choppers and analyze about the various topologies in converter

CO4. Analyze the performance of single phase and three phaseinverter circuits.

CO5. Design AC voltage controller and cyclo-converter.

CO6. Develop skills in switching and control circuits of converters and choppers

POWER SEMICONDUCTOR DEVICES **9**

Introduction - Power Diodes - Power Transistors - Power MOSFETs - IGBTs - Thyristor family: SCRs, TRIAC, GTOs, MCT and IGCT - Static and Dynamic characteristics - Protection circuits - Methods of SCR commutation.

AC TO DC CONVERTERS **9**

Single phase half wave controlled rectifier with various loads- Effect of freewheeling diode- Single phase fully controlled and half controlled bridge converters with various loads- Performance Parameters of single phase controlled Converters-Three phase half wave converters- Three phase fully controlled and half controlled bridge converters- Effect of source impedance- Single phase and three phase dual converters

DC TO DC CONVERTERS **9**

Principle of step-up and step-down operation- Single quadrant DC chopper with R, RL and RLE load- Time ratio Control-Estimation of average load voltage and load current for continuous current Operation-Two quadrant and four quadrant DC choppers. Buck, Boost, Buck- Boost, converters – Switched Mode Power Supply (SMPS)– Resonant converters

DC TO AC CONVERTERS **9**

Types - Voltage source and current source inverters - Single phase bridge inverters - Three phase bridge inverters - Introduction to Multi level inverter-Control of AC output voltage - Harmonic reduction.

AC TO AC CONVERTERS & CONTROL CIRCUITS **9**

Principle of On-Off and phase controls-Single phase ac voltage controller with resistive and inductive loads- Three phase AC voltage controllers (No analysis)- Principle of operation of cyclo converter-Functional requirements of switching control circuits - Generation of control signals for single phase AC to DC converters - Cosine wave crossing control, ramp comparator approach. Generation of timing pulses for DC choppers

Total Periods 45

Text Books

1. Rashid M H, 'Power Electronics – Circuits, Devices and Applications', 4th Edition, Prentice Hall of India, New Delhi, 2013.
2. P.S.Bimbhra, 'Power Electronics', Khanna Publishers, New Delhi, 2012.

References

1.P.C. Sen, " Power Electronics", McGraw Hill Education (India) Pvt. Ltd.
2. Joseph Vithayathil, 'Power Electronics', Tata McGraw-Hill, New Delhi, 2010.
3. L.Umanand, 'Power Electronics: Essentials & Applications', Wiley India, New Delhi, 2009.
4.Ned Mohan, T.M.Undeland, W.P.Robbins, 'Power Electronics: Converters, applications and design', John Wiley and Sons, 3rd Edition, 2006.
5.NPTEL course on "Power Electronics" IIT Kharagpur by Prof.D.Prasad, Dr. D.Kastha et.al.,

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3	3	2			2			1		2	3	2		1
CO2	2	3	3	3	2		3			1		3	3	3	2	3
CO3	2	3	3	3	2		3			1		3	3	3	1	3
CO4	2	3	3	3	2		3			1		3	3	3	2	3
CO5	1	3	3	3	2		3			1		3	3	3	2	3
CO6		2	3	1			2			1		2	3	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE53	PROTECTION AND SWITCHGEAR	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem: V** **Category: PC**

Pre-requisites: Engineering Mathematics, Transmission and Distribution

AIM: To expose the students to the various faults in power system and learn the various methods of protection scheme.

Course Outcomes:

The student will be able to

CO1. Represent the importance of protection in a Power system network.

CO2. Identify suitable protection scheme for generation, transmission and distribution.

CO3. Select a suitable relay for an electrical network

CO4. Explain about microprocessor based numerical relaying concepts.

CO5. Highlight various arc quenching process in AC and DC circuit breakers.

CO6. Outline the operation of various types of Circuit breakers.

OPERATING PRINCIPLES AND RELAY CONSTRUCTIONS **9**

Introduction to Protection and Switchgear - Zones of protection and essential qualities of protection –- Electromagnetic relays – Over current and Earth fault relays– directional and non-directional relays, distance relays – differential relays - under frequency relays.

APPARATUS PROTECTION **9**

Apparatus protection –transformer- generator- motor- protection of bus bars- transmission lines – CTs and PT, Capacitive voltage Transformer (CVT), Wave trap, PLCC, Lightning Arresterand their applications in protection schemes.

NUMERICAL RELAYS **9**

Numerical relay – Data acquisition system – IC elements and circuits for interfaces – A/D converter, Analog multiplier, S/H circuit - Over current relay – Impedance relay – Directional relay – Reactance relay – Measurement of R and X.Synchronization Relays

THEORY OF CIRCUIT INTERRUPTION **9**

Physics of arc phenomena and arc interruption, Restriking voltage & Recovery voltage, rate of rise of recovery voltage, resistance switching, current chopping and interruption of capacitive current – DC circuit breaker.

CIRCUIT BREAKERS **9**

Types of Circuit Breakers – Air blast, Air break, oil, SF_6 and Vacuum circuit breakers – comparative merits of different circuit breakers – Testing of circuit breakers.

Total Periods 45

Text Books

1. Badri Ram, Vishwakarma, ‘Power System Protection and Switchgear’, 2nd Edition, Tata McGraw hill, 2011.

2. V.K.Mehtha,R.K.Mehtha, 'Principles of Power System', Tata McGraw hill. of India Pvt. Ltd., New Delhi, 2003.

References

1. Sunil S. Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, Thirteenth Edition 2008.
2. B. Ravindranath, and N. Chander, 'Power System Protection & Switchgear', Wiley Eastern Ltd., 2011.
3. C.L. Wadhwa, 'Electrical Power Systems', Newage International (P) Ltd., 2009.
4. M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, 'A Text Book on Power System Engineering', DhanpatRai& Co., 2009.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1			1						1	2	2	3	2
CO2	3	2	1			1						1	2	2	3	2
CO3	3	2	1									1	2	2	3	2
CO4	3	2	1									1	2	2	3	2
CO5	3	2	1									1	2	2	3	2
CO6	3	2	1			1						1	2	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE54	**DIGITAL LOGIC CIRCUITS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E –Electrical and Electronics Engineering **Sem: V Category: PC**

Pre-requisites: Engineering physics

AIM: To learn the basic methods for the design of digital circuits and provide the fundamental concepts used in the design of digital systems.

Pre-requisite: Analog Electronic Circuits

Course Outcomes:

The Students will be able to

CO1. Represent the common forms of number system in digital electronic circuits and conversion between them.

CO2. Design the different types of Combinational Circuits.

CO3. Develop the synchronous sequential circuits.

CO4. Design of Asynchronous sequential circuits.

CO5. Summarize the Special Characteristics of digital integrated circuits.

CO6. Design and analyze circuits with Programmable Logic Devices.

NUMBER SYSTEM & BOOLEAN ALGEBRA **9**

Review of number system; types and conversion, codes. Boolean algebra: De-Morgan's theorem, switching functions and simplification using K-maps & Quine McCluskey method.

COMBINATIONAL CIRCUITS **9**

Design of Logic gates. Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers. Function realization using gates & multiplexers.

SYNCHRONOUS SEQUENTIAL CIRCUITS **9**

Flip flops - SR, D, JK and T. Design of synchronous sequential circuits – Synchronous counters, Sequence generator and detector with the support of state diagram; state reduction; state assignment. Analysis of synchronous sequential circuits.

ASYNCHRONOUS SEQUENCTIAL CIRCUIT **9**

Design of fundamental mode and pulse mode circuits – primitive state / flow table – Minimization of primitive state table –state assignment – Excitation table – Excitation map- cycles – Races –Hazards: Static –Dynamic –Essential –Hazards elimination.

PROGRAMMABLE LOGIC DEVICES, MEMORY AND LOGIC FAMILIES **9**

Memories: ROM, PROM, PLA, PAL, and FPGA, digital logic families: TTL, ECL, and CMOS.

Total Periods 45

Text Books

1. M. Morris Mano, 'Digital Logic and Computer Design', Pearson Education, Inc., 2016.
2. John M.Yarbrough, 'Digital Logic, Application & Design', Cengage learning, 2006.

References

1. S. Salivahanan and S. Arivazhagan, 'Digital Circuits and Design', 4thEdition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.
2. Charles H.Roth. 'Fundamentals of Logic Design', Thomson Publication Company, 2015.
3. Donald P.Leach and Albert Paul Malvino, 'Digital Principles and Applications', 8th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2014.
4. R.P.Jain, 'Modern Digital Electronics', 4thEdition, Tata McGraw–Hill publishing company limited, New Delhi, 2009.
5. Thomas L. Floyd, 'Digital Fundamentals', Pearson Education, Inc., New Delhi, 2012.
6. Donald D.Givone, 'Digital Principles and Design', Tata McGraw-Hill Publishing company limited, New Delhi, 2012.
7. NPTEL Course on 'Digital Circuits' by Santanu Chattopadhyay IIT Karagpur.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1			1			1	2	1	3	2		3
CO2	3	3	3	2			1			1	2		3	1		2
CO3	3	2	3	1						1	1		3			1
CO4	3	3	3	2						1	1		3			1
CO5	3	1	1	1			1			1	2		3	2		2
CO6	3	3	3	2			1			1	3		3	1	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE55	DIGITAL SIGNAL PROCESSING	L-T-P	C
		3-0-2	4

Programme: B.E. Electrical and Electronics Engineering **Sem: V** **Category: PC**

Pre-requisites: Engineering Mathematics, control system

AIM: To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain.

Course Outcomes:

The Student will be able to

CO1. Understand the concept of digital signal processing.
CO2. Evaluate the DFT and FFT of discrete time sequence.
CO3. Design digital IIR Butterworth and Chebyshev filters.
CO4. Implement digital filters using various structures such as direct, cascade and parallel form.
CO5. Design digital FIR filters using the windowing technique.
CO6. Implement digital FIR filters using various structures such as Transversal, linear phase, and poly phase structures.
CO7. Experiment the applications of digital signal processors

INTRODUCTION **8**

Introduction to Digital signal processing – Basic block diagram Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.

DISCRETE TIME SYSTEM ANALYSIS **8**

Z-transform and its properties, inverse z-transforms; Solution of difference equation – Solution by z-transform, Inverse z- transform, application to discrete systems - Stability analysis, frequency response – Convolution – Fourier transform of discrete sequence.

DISCRETE FOURIER TRANSFORM & COMPUTATION **8**

DFT properties, magnitude and phase representation, IDFT, Computation of DFT using FFT algorithm – DIT & DIF – FFT using radix 2 – Butterfly structure.

DESIGN OF DIGITAL FILTERS **8**

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Rectangular window, Hanning window, Hamming window, Blackmam window – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation – Warping, prewarping – Frequency transformation.

DIGITAL SIGNAL PROCESSORS **8**

Introduction, Architecture: TMS 320C5x processor, TMS 320C54x processor, Features, Addressing Formats – Functional modes, Applications of DSP.

Total Periods 40

LIST OF EXPERIMENTS

USING TMS320C5X & ADSP

1. Study of various addressing modes of DSP using simple programming examples.
2. Sampling of input signal and display.
3. Implementation of FIR filters.
4. Calculation of FFT.
5. Audio signal processing.

USING MATLAB

1. Generation of signals.
2. Linear and circular convolution of two sequences.
3. Sampling and effect of aliasing.
4. Design of FIR filters.
5. Design of IIR filters.
6. Calculation of FFT of a signal.

Total Periods 20

Text Books

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', 4th Edition, Pearson Education, New Delhi, 2012.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', 4th Edition, Tata McGraw Hill, New Delhi, 2011.

References

1. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, 'Discrete – Time Signal Processing', Pearson Education, New Delhi, 2003.
2. B. Venkataramani, M. Bhaskar, 'Digital Signal Processors, Architecture, Programming and Applications', Tata McGraw Hill, New Delhi, 2003.
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, 'Digital Signal Processing', Tata McGraw Hill, New Delhi, 2003.
4. Texas TMS 320C54X user manual (website).
5. NPTEL Course: Discrete Time Signal Processing by Prof. Mrityunjoy Chakraborty | IIT Kharagpur.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2										3			
CO2	3	3	3										2			2
CO3	3	2	3		2								3			2
CO4	3	3	3		2								3	1	1	2
CO5	3	2	3										3			2
CO6	3	3	2										2			
CO7	3	2	2										2	1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE57	**INTEGRATED CIRCUITS LABORATORY**	**L-T-P**	**C**
		0- 0-2	**1**

Programme: B.E-Electrical and Electronics Engineering **Sem: V Category: PC**

Pre/Corequisites: Linear Integrated Circuits and Digital Logic Circuits

AIM: To introduce the concepts for realizing functional building blocks in ICs, fabrications & application of ICs.

Course Outcomes:

The Students will be able to

CO1. Realize functions using SOP, POS form for adder, subtractor and code converters.

CO2. Design and Realize the Timer IC 555 application

CO3. Design the adder, comparator, Integrator and Differentiator circuits.

CO4. Develop the shift registers and demonstrate the addressing way of data channel selection for multiplexer and demultiplexer.

CO5. Implement the 4-bit modulo counters as synchronous and asynchronous types using FF IC's and specific counter IC, ADC and DAC.

CO6. Demonstrate the circuit for communication application- PLL and VCO.

LIST OF EXPERIMENTS

1. Study of Basic Digital IC's.
   (Verification of truth table for AND, OR, XOR, NOT, NOR, NAND, JK FF, RS FF, D FF)
2. Implementation of Boolean Functions, Adder/ Subtraction circuits.
3. Code converters, Parity generator and parity checking, Excess 3, 2s Complement, Binary to grey code using suitable IC's.
4. Encoders and Decoders:
5. Multiplex/ De-multiplex :
   Study of 4:1; 8:1 multiplexer and Study of 1:4; 1:8 demultiplexer.
6. Counters: Design and implementation of 4-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
7. Timer IC application.
   Study of NE/SE 555 timer in Astable, Monostable operation.
8. Applications of Op-Amp:
   Slew rate verifications, inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
9. Study of Analog to Digital Converter and Digital to Analog Converter:
   Verification of A/D conversion using dedicated IC's.
10. Study of VCO and PLL ICs
    i. Voltage to frequency characteristics of NE/ SE 566 IC.
    ii. Frequency multiplication using NE/SE 565 PLL IC.
11. Schmitt Trigger and precision rectifier.
12. Developing simple electronic projects.

Total Periods 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3					2			1	3	2		1
CO2	3	3	3	3			2		2			3	3	1		1
CO3	3	3	3	3			2		2			3	3	2	1	1
CO4	3	3	3	3			2		2			1	3	2	1	1
CO5	3	3	2	3			2		2			1	3	2	1	1
CO6	3	3	2	3			1		2			1	3	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE58 POWER ELECTRONICS LABORATORY L-T-P C
0-0-2 1

Programme: B.E. Electrical and Electronics Engineering **Sem: V Category: PC**
Pre/Corequisites: Electronic Devices and Circuits and Power Electronics
AIM: To study the power electronics devices characteristics and its applications.

Course Outcomes:

The Students will be able to
CO1. Understand the Characteristics of SCR, MOSFET and IGBT
CO2. Analyze the transient characteristics of SCR and MOSFET
CO3. Design a circuit on AC to DC half and fully controlled converter
CO4. Design and analyze the performance of Step down and step up choppers
CO5. Analyze the performance of IGBT based single-phase and three-phase PWM inverter
CO6. Investigate the characteristics of cyclo-converter

LIST OF EXPERIMENTS

1. Characteristics of SCR
2. Characteristics of TRIAC
3. Characteristics of power MOSFET
4. Characteristics of power IGBT
5. Transient characteristics of MOSFET
6. Single phase half wave controlled converter
7. Single phase fully controlled converter
8. Step up &Step down DC choppers
9. Single phase AC voltage controller using thyristors
10. Single phase IGBT based PWM inverter
11. Three phase IGBT based inverter
12. Single phase cyclo-converter
13. Single phase full bridge inverter

Total Periods 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3			1			1		1	3	1	3	2
CO2	3	3	3	3			1			1		1	3	1	3	2
CO3	3	3	3	3	2		2			1		2	3	3	3	3
CO4	3	3	3	3	2		2			1		2	3	3	3	3
CO5	3	3	3	3	2		2			1		2	3	3	3	3
CO6	3	3	3	3	2		2			1		2	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS57 BUSINESS ENGLISH L-T-P C

(Common to all B.E/B.Tech Degree Programmes)

0-0-2 MC

Programme: B.E –Electrical and Electronics Engineering **Sem: V Category: HSMC**

AIM: To Improve learner's Communication Skills in English

Course Outcomes:

The Students will be able to

CO1. Familiarize in Language Skills, Soft Skills, Inter Personal Skills, Decision Making and Business Communication

CO2. Competent in Presentation skill

CO3. Imbibe the knowledge of effective classroom speaking and presentation

CO4. Provide opportunities to learners to practice their communicative skills to become proficient users of English

CO5. Write job applications

CO6. Acquire knowledge about the various principles of communication.

UNIT I **6**

Elements of effective presentation – Structure of presentation – Presentation tools – Voice Modulation – Audience analysis – Body language – Video samples

UNIT II **6**

Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity – Stress Management & Poise – Video Samples

UNIT III **6**

Covering letter – strategies to write, resume and it's various kinds.

Total Periods 18

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1										1			1		1
CO2					1					1					1	1
CO3					2					1				1		1
CO4					1					1						1
CO5										3				1		1
CO6					1					1	1			1		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SEMESTER VI

191EE61	DESIGN OF ELECTRICAL MACHINES	L-T-P	C
		3-1-0	4

Programme: B.E. Electrical and Electronics Engineering **Sem: VI** **Category: PC**

Pre-requisites: Engineering Mathematics, and Machines

AIM: To enable the students, gain fair knowledge on design of magnetic circuits and electrical machines

Course Outcomes:

The Students will be able to

CO1. Identify specific electrical and magnetic loadings for machines.

CO2. Illustrate the classification of electrical engineering materials and evaluate the rating of machines.

CO3. Construct the various design procedure involves in an armature and field systems of D.C. machines.

CO4. Illustrate the overall dimensions and operating characteristics of transformers and its cooling methods.

CO5. Analyze the stator, rotor of cage machine & wound rotor machine.

CO6. Design the armature and field systems of salient pole machine and turbo alternators.

INTRODUCTION **12**

Major considerations in Electrical Machine Design - Electrical Engineering Materials – design limitations and specifications-Space factor – Choice of Specific Electrical and Magnetic loadings – Thermal considerations - Heat flow – Temperature rise.

DC MACHINES **12**

Output Equations – Main Dimensions – choice of specific loadings- Magnetic circuit calculations – Gap contraction factor - Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.

TRANSFORMERS **12**

Output Equations – Main Dimensions - KVA output for single and three phase transformers – Window space factor – Overall dimensions – Operating characteristics – Regulation – No load current – Temperature rise in Transformers – Design of Tank with cooling tubes - Methods of cooling of Transformers.

INDUCTION MOTORS **12**

Output equation for Induction motor – Main dimensions – choice of specific loadings-Length of air gap-Rules for selecting rotor slots of squirrel cage machines – Stator design-Design of rotor bars & slots – Design of end rings – Design of wound rotor.

SYNCHRONOUS MACHINES **12**

Output equations – Run away speed-choice of loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field

winding – Design of turbo alternators – Rotor design.

Total Periods 60

Text books

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 2013.
2. Say.M.G, 'The Performance and Design of Alternating current Machines', Isaac Pitman & sons Ltd., 2005.

References

1. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.
2. A.Shanmugasundaram, G.Gangadharan, R.Palani, 'Electrical Machine Design Data Book', New Age Intenational Pvt. Ltd., Reprint 2015.
3. Balbir Singh, 'Electrical Machine Design', Vikas Publishing House, 1982.
4. M.Ramesh,M.Sheela Sankari, 'Design of Electrical Machines', Lakshmi Publications,2016

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2		3								1	3		2
CO2	3	3	2		1								2	3	1	2
CO3	3	3	3		1								1	3	3	2
CO4	3	3	3										2	3	2	3
CO5	3	3	3										3	3		2
CO6	3	3	3		2								1	3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE62	ELECTRICAL DRIVES AND CONTROL	L-T-P	C
		3-0-0	3

Programme: B.E.- Electrical and Electronics Engineering **Sem: VI Category: PC**

Pre-requisites: Power Electronics, Machines, Control System

AIM: To study and understand the operation of electric drives controlled from a power electronic converter and to introduce the design concepts of controllers.

Course Outcomes:

The students will be able to

CO1. Express the characteristics of electrical drives.
CO2. Analyze and design operation of converter fed DC drive.
CO3. Analyze and design operation of chopper fed DC drive.
CO4. Illustrate various speed control strategies for induction motor drive.
CO5. Describe open loop and closed loop control of synchronous motor drive.
CO6. Design of controller for controlling speed of an electrical drive.

DRIVE CHARACTERISTICS **9**

Equations governing motor load dynamics – steady state stability – Multi quadrant dynamics in the speed torque plane – Typical load torque characteristics –Selection of Motor power rating – Thermal model of motor for heating and cooling – Types of duty – Acceleration, deceleration, starting and stopping.

CONVERTER / CHOPPER FED DC MOTOR DRIVE **9**

Steady state analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive: Continuous and discontinuous conduction mode – Chopper fed D.C drive: Time ratio control and current limit control – Operation of four quadrant converter/chopper fed drive – Closed loop control.

INDUCTION MOTOR DRIVES **9**

Stator side control: Stator voltage control – Adjustable frequency drives: v/f control, constant slip-speed control and constant air-gap flux control – Basics of voltage/current fed inverters – Block diagram of closed loop drive.

Rotor side control: Rotor resistance control and slip power recovery scheme – Static control of rotor resistance using DC chopper – Block diagram of closed loop drive – Vector control.

SYNCHRONOUS MOTOR DRIVES **9**

Open loop volts/hertz control and self-control of synchronous motor: Marginal angle control and power factor control – Permanent magnet synchronous motor Block diagram of closed loop control.

DESIGN OF CONTROLLERS FOR DRIVES **9**

Transfer function for dc motor, load and converter – Closed loop control with current and speed feedback – Armature voltage control and field weakening mode control – Design of controllers: Current controller and speed controller – Converter selection and characteristics.

Total Periods 45

Text Book

1. Gopal K.Dubey, 'Fundamentals of Electrical Drives', 2nd Edition, Narosa Publishing House, 2012.
2. Bimal K.Bose. 'Modern Power Electronics and AC Drives', PHI Learning, 2005.

References

1. S.K.Pillai, 'A First course on Electrical Drives', 3rd Edition, New Age International, 2012.
2. Murphy J.M.D and Turnbull, 'Power Electronic Control of AC Motors', Pergamon Press, Oxford 1988.
3. Gopal K.Dubey, 'Power semiconductor controlled drives', Prentice Hall Inc., New Jersey, 1989.
4. R.Krishnan, 'Electric Motor & Drives: Modeling, Analysis and Control', 1st Edition, PHI, 2009.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										1	3	2	1
CO2	3	2	2			1	2					2	1	3	1	1
CO3	3	2	2			1	2					2	1	3	1	1
CO4	3	2	2			1	2					2	1	3	1	1
CO5	3	2	2			1	2					2	1	3	1	1
CO6	3	2	2			1	2					2	1	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE63	**MICROPROCESSORS AND MICROCONTROLLERS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E –Electrical and Electronics Engineering **Sem: VI Category: PE**

Pre-requisites: Engineering Physics

AIM: To learn the architecture, programming, interfacing and rudiments of system design of microprocessors and microcontrollers.

Course Outcomes:

The Students will be able to

CO1: Identify the basic elements and functions of contemporary microprocessors and microcontrollers

CO2: Design, develop and interface complete microprocessor or microcontroller based systems to peripheral devices and systems at the chip level.

CO3: Connect peripheral devices and circuits to microprocessors and microcontrollers.

CO4: Impart knowledge on the architecture and software aspects of microprocessor 8086.

CO5: Develop skills in simple applications development with programming using microprocessor

CO6: Examine standard architecture and peripheral subsystem of PIC 16F877 and 8051

CO7: Summarize the special features of PIC Microcontroller

8085 Microprocessor **9**

Hardware Architecture- pin outs - Signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupt structure -addressing modes – instruction set, programming and its applications.

Peripherals Interfacing **9**

Programmable Peripheral Interface (PPI 8255) –Programmable Interval Timer (PIT 8253) – 8259 Programmable Interrupt Controller – keyboard & display controller (8279) - Interfacing serial I /O (8251)- Direct Memory Access (8237) - ADC/DAC interfacing.

Applications of Microprocessor **9**

Basic interfacing concepts - Interfacing of Input and Output devices-Applications of microprocessor Temperature controller, Stepper motor controller, traffic light controller.

8051 Microcontroller **9**

8051 Architecture- Instruction set - Addressing modes - Assembly language programming- Special function Registers- Interrupt structure.

PIC Microcontroller **9**

Introduction to PIC Microcontrollers 16F877 -PIC development tools-CPU Architecture and Instruction set-Hardware architecture and pipelining-program memory consideration- Register file structure.

Total Periods 45

Text Books

1. Doughlas V.Hall, 'Microprocessors and Interfacing, Programming and Hardware', TMH, 2012.
2. R.S.Gaonkar, 'Microprocessor Architecture Programming and Application', 5th Edition, CBS Publishers, 2011.
3. Krishna Kant, 'Microprocessors and microcontrollers Architecture, Programming and System design 8085, 8086, 8051, 8096', PHI-Third Printing-2010.

References

1. John .B.Peatman , 'Design with PIC Microcontroller', Prentice Hall, 1997
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, 'The 8051 Microcontroller and Embedded Systems: Using Assembly and C', Second Edition, Pearson education, 2011.
3. KrishnaKant, 'Microprocessor & Microcontrollers', Eastern Company Edition, Prentice Hall Of India, Delhi, 2010.
4. NPTEL swayam course "Microprocessors And Microcontrollers" By Prof. Santanu Chattopadhyay IIT Kharagpur.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2					1					1	3	2	2	3
CO2	3	2	2		2		1					1	3	2	2	3
CO3	3	2	2		2		1					1	3	2	2	3
CO4	3	2			2		1					1	3	2	2	3
CO5	3	2	2		2		1					1	3	2	2	3
CO6	3	2			2		1					1	3	2	2	3
CO7	3	2			2		1					1	3	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE67 INDUSTRIAL DRIVES AND CONTROL LABORATORY L-T-P C
0-0-2 1

Programme: B.E. Electrical and Electronics Engineering **Sem: VI Category: PC**
Pre/Corequisites: Power Electronics, Electrical Drives and Control
AIM: To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

Course Outcomes:

The Students will be able to

CO1. Design the fully controlled converter with R & RL load using MOSFET.
CO2. Design the open loop & closed loop control of converter fed dc motor drive.
CO3. Design the open loop & closed loop control of chopper fed dc motor drive.
CO4. Simulate the VSI fed AC drives.
CO5. Simulate the Open loop and Closed loop converter/ chopper fed DC motor drive.
CO6. Design a controller for Stepper motor.

LIST OF EXPERIMENTS

1. Simulation of single phase fully controlled converter with R & RL load.
2. Simulation of three phase fully controlled converter with R & RL load.
3. Simulation of open loop control of converter fed dc motor drive.
4. Simulation of closed loop control of converter fed dc motor drive.
5. Simulation of open loop control of chopper fed dc motor drive.
6. Simulation of closed loop control of chopper fed dc motor drive.
7. Simulation of VSI fed 3φ induction motor drive.
8. Simulation of VSI fed 3φ synchronous motor drive.
9. Microcontroller based Speed control of chopper fed DC motor.
10. Speed control of converter fed DC drive using microcontroller.
11. Speed control of Stepper motor.

Total Periods 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	3				2			1	2	3	2	1
CO2	3	3	2	3	3				2			1	2	3	2	1
CO3	3	3	2	3	3				2			2	2	3	1	1
CO4	3	2	2	3	3				2			2	1	3		1
CO5	3	2	2	3	3				2			2	2	3		1
CO6	3	3	2	3	3				2			2	2	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE68	**MICROPROCESSOR AND MICROCONTROLLER LABORATORY**	**L-T-P**	**C**
		0-0-2	**1**

Programme: B.E. Electrical And Electronics Engineering **Sem: VI** **Category: PC**

Pre/Corequisites: Engineering Physics, Microprocessor and Microcontroller

AIM: To Learn The Architecture, Programming, Interfacing and Rudiments of System Design of Microprocessors and Microcontrollers.

Course Outcomes:

The Student will be able to

CO1: Understand and apply The Fundamentals of Assembly Level Programming of Microprocessors and Microcontroller.

CO2: Familiarize with the assembly level programming in different processors.

CO3: Interface Various Peripherals Using Microprocessors and Microcontrollers.

CO4: Troubleshoot Interactions between Software and Hardware.

CO5: Design a Simple Application Using Advanced Microprocessors.

CO6: Develop Skills in Simple Applications Development with Programming Using Microprocessor

LIST OF EXPERIMENTS

1. Basic Arithmetic and Logic Operations Using 8085 And 8086
2. Programs for Sorting and Searching Using 8085 And 8086
3. Interfacing and Programming of Interrupt Controller
4. Interfacing ADC and DAC with 8085.
5. Interfacing and Programming of Traffic Light Controller and Digital Clock Using Timer.
6. Interfacing, Programming of Stepper Motor & DC Motor Speed Control.
7. Microcontroller 8051 Arithmetic and logic operation Programs using ports through IDE Using KEIL Software
8. Read the Key and Display the Key via Ports Using PIC Microcontroller
9. LED and LCD Interface Using PIC Microcontroller.
10. Simple Application programs Using Arduino Board.

Total Periods 45

Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	1	2	2	2				1	1			3	2	2	1
CO2	3	1	2	2	2				1	1			3	2	2	1
CO3		1	2	2	2				1	1			3	2	2	1
CO4	3	1		2	2				1	1			3	2	2	1
CO5	3	1		2	2				1	1			3	2	2	1
CO6	3	1		2	2				1	1			3	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE69 **MINI PROJECT** **L-T-P** **C**

0-0-2 **1**

Programme: B.E. Electrical And Electronics Engineering **Sem: VI** **Category: PROJ**

AIM: To prove the personal abilities and the skill to develop, produce and present an extended piece of work.

Course Outcomes:

The Student will be able to

CO1: Identify and describe the problem and scope of project clearly.

CO2: Collect, analyze and present data into meaningful information using relevant tools

CO3: Select, plan and execute a proper methodology in problem solving.

CO4: Work independently and ethically

CO5: Present the results in written and oral format effectively

CO6: Identify basic entrepreneurship skills in project management.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	2				1	1			3	2	2	1
CO2	3	1	2	2	2				1	1			3	2	2	1
CO3		1	2	2	2				1	1			3	2	2	1
CO4	3	1		2	2				1	1			3	2	2	1
CO5	3	1		2	2				1	1			3	2	2	1
CO6	3	1		2	2				1	1			3	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191HS67 CAREER ENGLISH L-T-P C

(Common to all B.E/B.Tech Degree Programmes)

0-0-2 MC

Programme: B.E –Electrical and Electronics Engineering **Sem: VI Category: HSMC**

AIM: To practice English for Enhancing Employability skills

Course Outcomes:

The Students will be able to

CO1. Enlarge their aptitude and reasoning skills.

CO2. Deal with the barriers that affect communication in a professional set up.

CO3. Understand various stages of communication and the role of audience and purpose.

CO4. Practice English for Enhancing Employability skills.

CO5. Develop their job prospects through oral communication.

CO6. Enhance the performance of learners at placement interviews and group discussions and other recruitment procedures.

UNIT I **6**

Verbal analogy, verbal reasoning, error spotting, sentence completion

UNIT II **6**

Why is GD part of selection process? – Structure of GD – Moderator – Strategies in GD – Team work – Body Language – Mock GD – Video samples

UNIT III **6**

Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews – Video samples

1. Resume / Report Preparation
2. Presentation Skills: Students make presentations on given topics. (8)
3. Group Discussion: Students participate in group discussions. (6)
4. Interview Skills: Students participate in Mock Interviews (8)

Total Periods 18

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1			1									1		
CO2					1					1	1					1
CO3					1						2			1		
CO4										3				1		
CO5					2					1					1	
CO6	1	1			1									1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SEMESTER VII

191EE71 POWER SYSTEM OPERATION AND CONTROL L-T-P C
3-1-0 4

Programme: B.E. Electrical and Electronics Engineering **Sem: VII Category: PC**

Prerequisites: Engineering Mathematics, Transmission and Distribution, Power System Analysis

AIM: To understand the day to day operation of power system and the control actions to be implemented on the system to meet the minute-to-minute variation of system load demand.

Course Outcomes:

The Students will be Able to

CO1. Illustrate the various system load characteristics and importance of load forecasting.
CO2. Estimate Maximum demand, Demand Factor, Load factor and load curve of Generation station.
CO3. Analyze the load frequency control of a Single and Two Area system.
CO4. Express the concepts of Automatic Voltage Regulator.
CO5. Evaluate static and dynamic systems and their modeling of typical excitation system.
CO6. Solve Unit Commitment and Economic Dispatch problems using computational techniques.
CO7. Explicate the system hardware configuration of SCADA and EMS functions.

FORECASTING STUDY 9

System load – variation - load characteristics - load curves and load-duration curve (daily, weekly and annual) - load factor - diversity factor. Importance of load forecasting and simple techniques of forecasting. An overview of power system operation and control and the role of computers in the implementation. (Qualitative treatment with block diagram).

REAL POWER - FREQUENCY CONTROL 9

Basics of speed governing mechanism and modeling - speed-load characteristics – load sharing between two synchronous machines in parallel. Control area concept LFC control of a single area system. Static and dynamic analysis of uncontrolled and controlled cases. Integration of economic dispatch control with LFC. Two-area system – modeling - static analysis of uncontrolled case - tie line with frequency bias control of two-area system - state variable model.

REACTIVE POWER–VOLTAGE CONTROL 9

Basics of reactive power control. Excitation systems – modeling. Static and dynamic analysis - stability compensation - generation and absorption of reactive power. Relation between voltage, power and reactive power at a node - method of voltage control - tap-changing transformer. System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

UNIT COMMITMENT AND ECONOMIC DISPATCH 9

Statement of economic dispatch problem – cost of generation – incremental cost curve co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. (No derivation of loss coefficients). Statement of Unit Commitment problem – constraints; spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints. Solution methods - Priority-list methods - forward dynamic programming approach. Numerical problems only in priority-list method using full-load average production cost.

COMPUTER CONTROL OF POWER SYSTEMS 9

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Network topology - state estimation - security analysis and control. Various operating

states (Normal, alert, emergency, in-extremis and restorative) - Contingency Analysis.

Total Periods 45

Text book

1. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', 2nd Edition, John Wiley & Sons, 3rd Edition ,2013.
2. Chakrabarti & Halder, "Power System Analysis: Operation and Control", 3rd Edition, Hall of India, 2010.

Reference

1. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Fourth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.
2. Hadi Saadat, "Power System Analysis", 3rd Edition 2007.
3. P. Kundur, 'Power System Stability and Control' MC Craw Hill Publisher, USA, 10th edition ,2010.
4. Olle I. Elgerd, 'Electric Energy Systems theory - An Introduction' Tata McGraw Hill Publishing Company Ltd. New Delhi, 34th Reprint,2010.
5. T.J.E. Miller, 'Reactive Power Control in Electric power systems', John Wiley and sons, 1982.
6. https://nptel.ac.in/courses/108101040/ NPTEL Online Courses.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1							2	1	3	3	2	1
CO2	3	2	1	1							1	1	3	3		1
CO3	3	1	1	1							1	1	3	3		1
CO4	3	2	2	1							1	1	3	2		1
CO5	3	2	2	1							2	1	2	2	2	1
CO6	3	2	1	1							1	2	3	3	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE72	HIGH VOLTAGE ENGINEERING	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** VII **Category:** PC

Pre-requisites: Engineering Mathematics, Engineering Physics, Electromagnetic Theory, Transmission and distribution

AIM: To expose the students to various types of over voltage transients in power system and its effect on power system.

- Generation of over voltages in laboratory.
- Testing of power apparatus and system.

Course Outcomes:

The Students will be able to

CO1. Analyze the various origins of over voltages and its effect on power system.

CO2. Make out the various breakdown phenomena in gases, liquid and solid dielectrics.

CO3. Elucidate the concepts used for the generation of high voltages and currents.

CO4. Expound the concepts used for the measurement of high voltages and currents also design corresponding circuits.

CO5. Exemplify high voltage testing techniques of power apparatus in power systems.

CO6. Discern the concepts of insulation co-ordination.

OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS **9**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary overvoltages, – Reflection and Refraction of Travelling waves- EMI and EMC protection against over voltages.

DIELECTRIC BREAKDOWN **9**

Gaseous breakdown in uniform and non-uniform fields – Penning effect, Corona discharges – Vacuum breakdown –Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics. Applications of insulating materials in electrical equipments.

GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS **9**

Generation of high AC, DC, impulse and switching voltages; Generation of high impulse currents. Tripping and control of impulse generators.

MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS **9**

Measurement of high direct current voltages – Measurement of high alternating voltages – Measurement of high impulse voltages – Measurement of high direct currents – Measurement of high alternating and Impulse currents - Digital techniques in high voltage measurement.

HIGH VOLTAGE TESTING & INSULATION COORDINATION **9**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.

Total Periods 45

Text Books

1. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newness Second Edition Elsevier , New Delhi, 2005.
2. S.Naidu and V. Kamaraju, 'High Voltage Engineering', 5th Edition, Tata McGraw Hill, Fifth Edition, 2013.

References

1. Subir Ray, 'An Introduction to High Voltage Engineering', 2nd Edition, PHI Learning Private Limited, New Delhi, Second Edition, 2013.
2. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.
4. Nptel Course on "Advances in UHV Transmission and Distribution", by Prof. Subba Reddy B, IISc Bangalore, https://nptel.ac.in/courses/108108099/.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1										3	2	3	1
CO2	2	3	1										3	1	2	1
CO3	2	3	1										3	1	1	
CO4	2	3											3	2	2	1
CO5	2	3			3								3	1	3	1
CO6	1	2	1										3	1	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE73	WIRING, ESTIMATION AND COSTING	L-T-P	C
		3-0-0	3

Programme: B.E.- Electrical and Electronics Engineering **Sem: VII** **Category: PC**

Pre-requisites: Fundamentals of Electrical Engineering

AIM: To impart knowledge on Electrical supply systems and its protection equipments, Different wiring methods and Estimation for electrical wiring.

Course Outcomes:

The Students will be able to

CO1. Address Electrical supply systems and its protection equipments
CO2. Differentiate various wiring systems
CO3. Design a simple wiring system for domestic application
CO4. Identify the elements for performing estimation and costing
CO5. Estimate the load requirements and type of supply requirement
CO6. Evaluate the material and labour requirement
CO7. Explain about pre-commissioning tests

INTRODUCTION **9**

Electrical supply system-Three-phase four wire distribution system-Types of domestic loads-Protection against Electric shock- Earthing- Domestic Wiring Protection equipments: Fuse-Miniature Circuit Breaker – Residual Current Circuit Breaker or Earth Leakage Circuit Breaker-General requirements of Electrical Installations.

TYPES AND INSTALLATION OF WIRING SYSTEMS **9**

Types of wires- Factors influencing the choice of wiring system, Types of wiring system, Conduit Wiring System, Accessories, Advantages and Disadvantages of Conduit Wiring Systems, IE rules, 1956: rules 50, 56, 57, 58, 60,61 – Internal wiring systems – Looping-in system – Ring system – tree system - Position of switches, cut outs, sub-distribution boards.

ELECTRICAL INSTALLATION FOR POWER CIRCUITS **9**

Important consideration regarding motor installation wiring-Schematic diagram and Wiring diagram of Light and Fan circuits-Wiring diagram of a single tube light controlled by a switch-Alarm circuits without relays-Alarm circuits with relays-Determination of size of Conduit, Distribution board, Main switch and Starter- Determination of rating of fuses and cables.

DOMESTIC ELECTRICAL INSTALLATION AND ESTIMATES **9**

Estimation of load requirements-Estimation of connected load, Maximum demand, and type of supply required for a domestic building and related problem- Determination of size of distribution boards – Different types of commonly available distribution boards-Estimation of Accessories required, wiring materials and labour requirement for a domestic building and related problem-Pre-commissioning tests for domestic wiring Installation: Visual Inspection

ELEMENTS OF ESTIMATION AND COSTING **9**

Introduction –Electrical schedule of rates- catalogues, survey and source selection- overhead charges-contingencies- Purchase order. Purpose of Estimating and Costing-Qualities of a good Estimator-Essential Elements of Estimating and Costing-Tender-Guidelines for Inviting Tenders-Quotation-Other Important Factors of Estimating and Costing.

Total Periods 45

Text Book

1. Uppal S.L, 'Electrical Wiring - Estimating and Costing', Khanna Publishers, 6th Edition, 2011.
2. J.B. Gupta, 'A Course in Electrical Installation Estimating and Costing', S. K. Kataria & Sons, 9th Edition, 2013.

References

1. Giridharan M.K., 'Electrical Systems Design', I.K. International Publishing House, New Delhi, 2nd edition, 2011.5
2. Raina K.B., Bhattacharya S.K., 'Electrical Design Estimating and Costing', New Age International Pvt. Ltd., Publishers, 2010.
3. https://nptel.ac.in/courses/108/106/108106025/

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2			2						3	2	1	3	2
CO2	3	2	2			2						2	2	2	3	2
CO3	3	2	2			2	2	2				2	1	1	3	2
CO4	3	2	2			2	2	2				2	2	2	3	1
CO5	3	2	2			2	2					2	2	1	3	1
CO6	3	2	2			1						2	1	1	3	1
CO7	3	2	2			1						1	2	1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE74	UTILIZATION OF ELECTRICAL ENERGY	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** VII **Category:** PC

Pre-requisites: Engineering Mathematics, Electromagnetic field theory, Machines, Transmission and Distribution, Solid State Drives

AIM: To expose students to the main aspects of electric energy, utilization and conservation.

Course Outcomes:

The Students will be able to

CO1. Represent the Economics of electrical energy and capacitors for improving power factor.
CO2. To understand the energy conservation methods and energy auditing.
CO3. Analyze the illumination calculation and also evaluate about various types of lamps.
CO4. Illustrate the construction for various methods of electric heating.
CO5. Knowledge about the different methods of electric welding.
CO6. Identify the requirements for traction system and the recent trends in electrical traction.

COST AND CONSERVATION OF ELECTRICAL ENERGY **9**

Cost of electrical energy – tariff and types – Economics of power factor improvement and its techniques – power quality – Importance of electrical energy conservation – methods – energy efficient equipment - Introduction to energy auditing - IE rules and regulations for energy audit.

ILLUMINATION **9**

Importance of lighting – properties of good lighting scheme – laws of illumination – photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, and sports ground - energy efficiency lamps.

ELECTRIC HEATING **9**

Role of electric heating for industrial applications - modes of heat transfer - methods of electric heating – resistance heating - types - electric ovens – properties of resistance heating elements - domestic water heaters and other heating appliances - induction heating – dielectric heating - electric arc furnace- types.

ELECTRIC WELDING **9**

Introduction to electric welding – welding methods - resistance welding and types – electric arc welding and types-Advantages of using coated electrodes, comparison between AC and DC arc welding - welding generator, welding transformer and the characteristics.

ELECTRIC TRACTION **9**

Merits of electric traction – requirements of electric traction system – supply systems – types of services – urban, sub-urban, and main lines and their speed-time curves - mechanism of train movement – traction motors and control – braking – recent trends in electric traction.

Total Periods 45

Text Books

1. C.L. Wadhwa, ‘Generation, Distribution and Utilization of Electrical Energy’, (Third Edition) New Age International Pvt. Ltd, 2012.

2. B.R.Gupta, 'Generation of Electrical Energy', Eurasia Publishing House (p) Ltd, New Delhi, 6th edition, 2008.
3. E. Openshaw Taylor, 'Utilization of Electrical Energy in SI Units', Orient Longman Pvt. Ltd, 2006.

References

1. H. Partab, 'Art and Science of Utilization of Electrical Energy', Dhanpat Rai and Co, New Delhi, 2004.
2. J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K.Kataria and sons, 2002.
3. Utilization of Electrical Power including Electric drives and Electric traction, N.V.Suryanarayana, New Age International (P) Limited.
4. Utilization of Electric Energy, VVL Rao, University Press.
5. Utilization of Electric Power and Electric Traction G.C. Garg Khanna Publishers 9th Edition, 2014.
6. https://nptel.ac.in/courses/108105060/

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2			3	2						3	1	3	2
CO2	3	3	2			2	2					1	1		3	3
CO3	3	3	3			2	2					2	2	1	3	1
CO4	3	3	3			2	2					2	2	2	3	2
CO5	3	3	3			2	2					1	2	1	3	3
CO6	3	3	3			2	2					1	3	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE77	POWER SYSTEM SIMULATION LABORATORY	L-T-P	C
		0-0-3	1

Programme: B.E. Electrical And Electronics Engineering **Sem: VII Category: PC**

Pre-requisites: Power System Operation and Control, Transmission and Distribution, Power System Analysis

AIM: To develop skills in simulation softwares and conducting experiments related to power system studies.

Course Outcomes:

At the end of the course, student will be able to

CO1. Develop the building algorithm for formation of bus admittance and impedance matrices.
CO2. Analyze the computation parameters of transmission lines in power systems.
CO3. Evaluate the algorithm and flowchart to solve load flow analysis problems using G- S, N-R, FDLF Method using MATLAB and ETAP program.
CO4. Model the Automatic Voltage Regulator in power system.
CO5. Form the load frequency model of two area systems.
CO6. Estimate the Economic dispatch and unit commitment solution using MATLAB program.

LIST OF EXPERIMENTS:

1. Formation of Bus Admittance matrices and Impedance matrices solution of networks.
2. Computation of Parameters of Transmission Lines – Single Circuit & Double Circuit.
3. Load Flow Analysis - I: Solution of Load Flow And Related Problems Using Gauss-Seidel Method.
4. Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton Raphson method.
5. Load Flow Analysis - III: Fast-Decoupled Method.
6. Simulation of Automatic Voltage Regulator using MATLAB.
7. Load factor, Peak factor Utilization factor & Plant capacity factor calculation.
8. Load- Frequency Dynamics of Two area power systems.
9. Transient and Small Signal Stability analysis- Single Machine Infinite Bus Systems.
10. Economic dispatch and Unit Commitment Problem in power systems (with and without losses).
11. Steady State Stability Analysis using MATLAB Program.
12. Power System Fault Analysis.
13. Study of various contingency states in power system network.

Total Periods 45

References

1. Laboratory Manual
2. Olle I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Limited, New Delhi, 2008.
3. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', 4th Edition, Tata McGraw-Hill Publishing Company, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	1	1	1	1	1		1	1	1	3	1
CO2	3	3	3	3	2	1	1	1	1	1		1	1	1	3	1
CO3	3	3	3	3	1	1	1	1	2	2		1	1		3	1
CO4	3	3	3	3	2	1	1	1	2	2			1		3	2
CO5	3	3	3	3	2	1	1	1	2	1			1		3	1
CO6	3	3	3	3	2	2	1	1	1	2		1	1	1	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE78 COMPREHENSION & DESIGN LABORATORY L-T-P C
0-0-4 2

Programme: B.E. Electrical and Electronics Engineering **Sem: VII Category: PC**

AIM: To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

Course Outcomes:

The student will able to

CO1. Improve the technical and non-technical Knowledge
CO2. Enrich their soft skills
CO3. Experience online technical examinations for relevant electrical and soft skill courses
CO4. Analyze, design and solve tutorial problems on electrical and electronic circuits
CO5. Enhance their communication skill, leadership and team work.
CO6. Review, prepare and present technological developments

List of Experiments

1. Design of simple amplifier using BJT.
2. Design of Multivibrator using IC555.
3. Design of Counters using ICs.
4. Design of PID controller for Liquid level system using MATLAB.
5. Design of speed controller for stepper motor using Arduino.
6. DSP based speed control of SRM motor.

Total Periods 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	1	3		3			3	2	2	2	2	2	2
CO2					2	2		3	2	2	3	2				1
CO3	2	3	2	1	2		1			1	2	2	1	1	1	1
CO4	2	3	2	1	1		2			1	2	2	1	1	1	1
CO5						2		3	3	3	3	2				
CO6	2	3	2	1	2		3			3	2	2	3	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EE79 **PROJECT-I** **L-T-P** **C**

0-0-4 **2**

Programme: B.E. Electrical And Electronics Engineering **Sem: VII** **Category: PROJ**

AIM: To prove the personal abilities and the skill to develop, produce and present an extended piece of work.

Course Outcomes:

The Student will be able to

CO1: Identify and describe the problem and scope of project clearly.

CO2: Collect, analyze and present data into meaningful information using relevant tools

CO3: Select, plan and execute a proper methodology in problem solving.

CO4: Work independently and ethically

CO5: Present the results in written and oral format effectively

CO6: Identify basic entrepreneurship skills in project management.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	2				1	1			3	2	2	1
CO2	3	1	2	2	2				1	1			3	2	2	1
CO3		1	2	2	2				1	1			3	2	2	1
CO4	3	1		2	2				1	1			3	2	2	1
CO5	3	1		2	2				1	1			3	2	2	1
CO6	3	1		2	2				1	1			3	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SEMESTER VIII

191EE89	**PROJECT-II**	**L-T-P**	**C**
		0-0-12	**6**

Programme: B.E. Electrical And Electronics Engineering **Sem: VIII Category: PROJ**

AIM: To prove the personal abilities and the skill to develop, produce and present an extended piece of work.

Course Outcomes:

The Student will be able to

CO1: Identify and describe the problem and scope of project clearly.

CO2: Collect, analyze and present data into meaningful information using relevant tools

CO3: Select, plan and execute a proper methodology in problem solving.

CO4: Work independently and ethically

CO5: Present the results in written and oral format effectively

CO6: Identify basic entrepreneurship skills in project management.

Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	1	2	2	2				1	1			3	2	2	1
CO2	3	1	2	2	2				1	1			3	2	2	1
CO3		1	2	2	2				1	1			3	2	2	1
CO4	3	1		2	2				1	1			3	2	2	1
CO5	3	1		2	2				1	1			3	2	2	1
CO6	3	1		2	2				1	1			3	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

PROGRAM ELECTIVE

		L-T-P	C
191BM51	**BIOMEDICAL INSTRUMENTATION**	**3-0-0**	**3**

Programme: **B.E.,(BME,EEE)** **Sem:** **Category:** **PE**

Pre-requisites: Measurement and Instrumentation

Aim: To study the different measurement techniques for non-physiological parameters

Course Outcomes: The Students will be able to

CO1. Differentiate different biopotential electrodes and their equivalent circuits
CO2. Illustrate Measurements and recording of biopotential using different electrode placement
CO3. Design of signal conditioning for various physiological signals
CO4. Explain various technique for non-electrical physiological measurements
CO5. Demonstrate different biochemical measurement and sensors
CO6. Describe functional blocks of various biochemical analyzer

BIOPOTENTIAL ELECTRODES **9**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - motion artifacts, measurement with two electrodes.

BIOPOTENTIAL MEASUREMENTS **9**

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven ‘s triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG**.**

SIGNAL CONDITIONING CIRCUITS **9**

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering.

MEASUREMENT OF NON-ELECTRICAL PARAMETERS **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

BIOCHEMICAL MEASUREMENT AND BIOSENSORS **9**

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Bio Sensors – Principles – amperometric and voltmetric techniques.

Total Periods: 45

Text Books:

1. Leslie Cromwell, Biomedical Instrumentation and measurement‖, 2nd edition, Prentice hall of India, New Delhi, 2015.

References:

1. John G. Webster, ―Medical Instrumentation Application and Design‖, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, ―Introduction to Biomedical Equipment Technology‖, Pearson Education, 2004.
3. Myer Kutz, ―Standard Handbook of Biomedical Engineering and Design‖, McGraw Hill Publisher, 2003.
4. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, 3rd edition, Tata McGraw-Hill New Delhi, 2014.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1			1							3			1
CO2	2	2	2	1	1	2	1						3			1
CO3	2	3	3	2	2	1							3			1
CO4	3	1	1	1		1	2						3			1
CO5	2	2	2	2	2	2							3			1
CO6	2	2	2			1							3			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191CSEI	**INTERNET OF EVERYTHINGS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Engineering Physics, Electronic Devices and Circuits

AIM: To provide an overview of the concepts and challenges of the IoE economy and to discuss the Internet and its evolution to the interconnection of people, processes, data, and things that forms the Internet of Everything.

Course Outcomes:

Course Outcomes: The Students will be able to

CO1. Learn how the IoE turns information into action, creating unprecedented economic opportunity.
CO2. Understand how the IoE brings together operational technology and information technology systems.
CO3. Discover how business processes for evaluating and solving problems are being transformed.
CO4. Learn the security concerns that must be considered when implementing IoE solutions.
CO5. Practice what you learn using Cisco Packet Tracer, a network configuration simulation tool.
CO6. Connect to the global Cisco Networking Academy community.

WHAT IS THE IoE **9**

Internet and its evolution to the Internet of Everything. IoE benefits to individuals and organizations Concept of a network foundation connecting billions of things and trillions of gigabytes of data to enhance decision-making processes and interactions.

PILLARS OF THE IoE **9**

Interconnection of people, process, data, and things that forms the Internet of Everything.

CONNECTING THE UNCONNECTED **9**

IoT application in the home and industry, Protocol suite and its necessity for communication across a network, IoE and its affects to the evolution of data storage and access, Example of a Home IoE implementation environment.

TRANSITIONING TO THE IoE **9**

Internet of Everything (IoE) drivers for the convergence between an organization's operational technology (OT) and information technology (IT) systems, M2M, M2P, and P2P interactions in an IoE, Business processes for evaluating a problem that can be solved with IoE, Necessary architectural structure to implement an IoE solution, Security concerns that must be considered when implementing IoE solutions.

BRINGING IT ALL TOGETHER **9**

"What if" scenarios that can help a business understand the benefits and impediments to implementing a new solution, Physical topology and logical topology of an IoE Healthcare solution model , M2M, M2P and P2P interactions of an IoE Healthcare solution model, Concept of prototyping and why this is critical in the nascent IoE market.

Total Periods 45

TEXT BOOK(S)

1. Adrian McEwen and Hakim Cassimally, "Internet of Things", Wiley, 2013
2. Arshdeep Bhaga" Internet of Things, A hands on approach" VPT, first edition, 2014

REFERENCE(S)

1. Luigi Atzori, Antonio Lera, Giacomo Morabito, "The Internet of Things: A Survey", Journal on Networks, Elsevier Publications, October, 2010.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things –Key applications and Protocols", Wiley, 2012.
3. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective" - CRC Press, 2012.
4. Dieter Uckelmann, Mark Harrison, "Architecting the Internet of Things", Springer, 2011.
5. https:// cisco.netacad.net

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2			3						3		2	3			3
CO2	3	3	2		2						2	3	2			3
CO3	2			3						2		2	3	2	2	3
CO4		3			3								1	2	3	3
CO5	2	2								2		2	2			3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191CS56	OBJECT ORIENTED PROGRAMMING USING C++		L-T-P	C
			3-0-0	3
Programme:	B.E. Electrical and Electronics Engineering	**Sem:**	**Category:**	**PE**

Pre-requisites: Programming for Problem Solving

Aim To introduce the concepts Object Oriented Programming

Course Outcomes:

The Students will be able to.

CO1. Differentiate between structures oriented programming and object oriented programming.
CO2. Highlight the use object oriented programming language like C++ and associated libraries to develop object oriented programs.
CO3. Understand and apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism to solve various computing problems using C++ language.
CO4. Apply concepts of operator-overloading, constructors and destructors.
CO5. Apply exception handling and use built –in classes.
CO6. Design problem solutions using Object Oriented Techniques.

OBJECT ORIENTED PROGRAMMING FUNDAMENTALS **9**

Procedure Oriented Programming vs. Object Oriented Programming (OOP). Object oriented programming concepts – Classes, reusability, encapsulation, inheritance, polymorphism, dynamic binding, and message passing. C++ Programming features – constructors – static members – constant members – member functions – pointers – references – Role of this pointer – Storage classes – function as arguments.

OBJECTS AND CLASSES **9**

Structures and classes: Implementation of class in C++, C++ Objects as physical object, C++ object as data types constructor. Object as function arguments, default copy constructor, returning object from function, Arrays of object, string, The standard C++ String class. String Handling – Nested classes.

INHERITANCE AND POLYMORPHISM **9**

Inheritance – Types, Polymorphism – compile time and run time polymorphisms – function overloading – operators overloading – dynamic memory allocation Importance of virtual function, function call binding, virtual functions, implementing late binding, need for virtual functions, abstract base classes and pure virtual functions, virtual destructors.

FILES AND POINTERS **9**

Components of a file, different operation of the file, communication in files, creation of file streams, stream classes, header files, updating of file, opening and closing a file, file pointers and their manipulations, functions manipulation using file pointers, detecting end-of file. Pointer: Addresses and pointers. The address of operator and pointer and arrays. Pointer and Faction pointer and C-types string. Memory management: New and Delete, pointers to objects, debugging pointers.

TEMPLATES AND EXCEPTIONS **9**

Function templates, Class templates Exceptions. Standard Template Library: Introduction algorithms, sequence containers, iterators, specialized iterators, associative containers, strong user-defined object, function objects.

Total Periods 45

Text Books:

1. Bjarne Stroustrup, 'The C++ Programming Language', 3/e, Pearson Education, 2007.
2. B. Trivedi, 'Programming with ANSI C++', Oxford University Press, 2012.
3. K.R Venugopal and Rajkumar Buyya, 'Mastering C++', Tata McGraw Hill, 2/e, 2013.

References:

1. Robert Lafore, 'Object Oriented Programming in C++', Techmedia Publication, 4/e, 2002.
2. E. Balagurusamy, 'Object oriented Programming with C++', Tata McGraw-Hill, 6/e, 2013.
3. Herbert shield, 'The complete reference C++', McGraw Hill Publication, 9th edition, 2014.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										3		1	2
CO2	3	2	2		1								3			2
CO3	3		2	2	1								3			2
CO4	2	2	1	3									3	1	1	2
CO5	1	2	1	3									3	1	1	2
CO6	3	3	2	3	2	2							3	1	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEA	COMMUNICATION ENGINEERING		L-T-P	C
			3-0-0	3
Programme:	B.E. – Electrical and Electronics Engineering	**Sem:**	**Category:**	**PE**
Pre-requisites:	Engineering Physics			
AIM:	To introduce the concepts of communication systems engineering using wire and wireless medium.			

Course Outcomes:

The Students will be able to

CO1. Classify various analog modulation techniques
CO2. Express the different digital modulation technique
CO3. Illustrate different source coding techniques
CO4. Relate TDMA, CDMA & FDMA
CO5. Summarize data transmission over fiber optic media
CO6. Describe the general satellite system & optical communication systems.

ANALOG COMMUNICATION **9**

Introduction to communication systems – basic block diagram. Principles of amplitude modulation, AM Voltage & power distribution, Balanced Modulator, AM transmitters: High level and Low level transmitter, Diode Detector, AM receiver: TRF & Super heterodyne receiver.

Angle modulation - FM and PM waveforms, phase deviation and modulation index, frequency deviation and percent modulation, Bandwidth requirements for Angle modulated waves, FET reactance modulator, FM transmitters: PLL & Armstrong Method, Balanced slope detector, FM receiver.

DIGITAL COMMUNICATION **9**

Introduction, Shannon limit for information capacity, ASK, FSK bit rate and baud, FSK transmitter & receiver, BPSK transmitter & receiver, QPSK transmitter & receiver, QAM transmitter & receiver, DPSK transmitter & receiver, MSK transmitter & receiver.

DIGITAL TRANSMISSION **9**

Introduction, Pulse modulation, PCM – PCM sampling, Sampling rate, Signal to Quantization Noise Rate, DM transmitter and receiver, merits & demerits, ADM transmitter and receiver, DPCM transmitter and receiver, pulse transmission. Comparison of source coding methods.

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES **9**

Introduction, Generation of Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, processing gain FH spread spectrum, multiple access techniques –TDMA-FDMA-CDMA-SDMA.

SATELLITE AND OPTICALCOMMUNICATION **9**

Satellite System Link Model -Kepler's Law, Orbit Types, Multiple access techniques. Optical Communication Systems-Elements of Optical Fiber Transmission link, Types, Losses, Sources and Detectors.

Total Periods 45

Text Books

1. Wayne Tomasi, 'Advanced Electronic Communication Systems Fundamentals through advanced', 6th Edition, Pearson Education, 2014.

References

1. H.Taub, D L Schilling, G Saha, 'Principles of Communication', 4th Edition, McGraw-Hill Publication, 2015.
2. Simon Haykin, 'Communication Systems', 5th Edition, John Wiley & Sons. 2009.
3. Dennis Roddy, 'Satellite Communications', McGraw-Hill Publication, 4th Edition 2008.
4. Gerd Keiser, 'Optical Fiber Communication', McGraw Hill, 5th Edition, 2013.
5. Rappaport. T.S., 'Wireless communications', 2nd Edition, Pearson Education, 2010.
6. NPTEL Course: Principles of Digital Communication by Prof. Abhishek Dixit | IIT Delhi

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3					1						3	2	1	1
CO2	3	3	3										1	3	1	1
CO3	3	3	3										3	1	1	1
CO4	2	1					1						2			1
CO5	3	1					1						3	2	2	1
CO6	3	1					1						3	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEB	DISTRIBUTED GENERATION SYSTEMS AND MICROGRID	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Utilization of Electrical Energy, Power System Analysis, Power system operation and control

AIM: To understand the planning and operational issues related to Distributed Generation.

Course Outcomes:

The Students will be able to

CO1. Represent the current scenario in Distributed Generation and renewable sources in Distributed Generation.
CO2. Plan the optimal placement of DG sources in distribution systems.
CO3. Interconnect the grid with distributed generation.
CO4. Realize problems associated with integration of distributed generation.
CO5. Illustrate the various issues and challenges of DG in power system
CO6. Analyze the micro grid with connecting of multiple DGs.

INTRODUCTION **9**

Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

GRID INTEGRATION OF DISTRIBUTED GENERATION **9**

Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

IMPACT OF DISTRIBUTED GENERATION **9**

Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

ISSUES AND CHALLENGES OF DISTRIBUTED GENERATION **9**

Economic and control aspects of DGs –Market facts, issues and challenges - Limitations of DGs. Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis

MICRO GRID **9**

Introduction to micro-grids – Types of micro-grids – autonomous and non-autonomous grids – Sizing of micro-grids- modeling & analysis- Micro-grids with multiple DGs – Micro- grids with power electronic interfacing units. Transients in micro-grids - Protection of micro-grids – Case studies.

Total Periods **45**

Text Books

1. Soni, Gupta, Bhatnagar and Chakrabarti, 'A text book on Power Systems Engg.', Dhanapat Rai and Sons, New Delhi, 2009.
2. Wadhwa, C.L., 'Generation, Distribution and Utilisation of Electrical Energy', Wiley Eastern Ltd, N.D.2011.

References

1. Deshpande M.V., 'Elements of Electrical Power systems Design', New Delhi, TMH , 1990.
2. https://nptel.ac.in/courses/108107143/

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1		1				1						3		2	3
CO2	2	2	2				2						2	1	2	1
CO3	2	2	2				2						2	2	2	2
CO4	2	3	3				2						2	2	3	1
CO5	1		2		2		2						1	2	3	2
CO6	1		2				2						2	1	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEC	ELECTRICAL SAFETY		L-T-P	C
			3-0-0	3
Programme:	B.E. Electrical and Electronics Engineering	**Sem:**	**Category:**	**PE**

Pre-requisites: Fundamentals of Electrical Engineering

AIM: To provide a comprehensive exposure to electrical hazards, various grounding techniques, safety procedures and various electrical maintenance techniques.

Course Outcomes:

The Students would be able to

CO1. Describe different types of electrical hazards.

CO2. Expand skills in identifying the presence of electrical hazards, implementing measures to minimize risks

CO3. Develop skills in investigative techniques for determining the cause of electrical accidents, fire and explosions.

CO4. Select appropriate safety method for low, medium and high voltage equipment.

CO5. Analyze and apply various grounding and bonding techniques

CO6. Assess and provide solutions to a practical case study

INTRODUCTION AND HAZARDS OF ELECTRICITY **9**

Introduction – Primary and secondary hazards- arc, blast, shocks-causes and effects-summary of causes- protection and precaution – injury and Death protective strategies –IE Rules 1956 – Basic rules for new installations: power system, Domestic and Industry (Qualitative treatment Only)

ELECTRICAL SAFETY EQUIPMENT **9**

General Inspection and testing procedure for electrical safety equipment - Electrical safety equipment for external protection; flash and thermal protection – Head and eye protection – Insulation protection Electrical safety equipment for internal protection over voltage, short circuit, Earth fault, Leakage current, High/Low frequency – Single line diagram of industrial power system with safety control-Electrician's safety kit and materials.

SAFETY METHOD **9**

The six step safety methods- pre job briefings – hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment , procedure for low, medium and high voltage systems- the one minute safety audit.

GROUNDING AND BONDING TECHNIQUES **9**

General requirements for grounding and bonding- definitions- grounding of electrical equipment-bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment- system grounding- purpose of system grounding- grounding electrode system-grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

VOLTAGE SAFETY AND MEDICAL SAFETY MANAGEMENT 9

Safety equipment's and safety procedures for low voltage and high voltage system – Electrical safety around electronic circuits- Electrical safety for medical equipment like over current safety, Isolation, EMI and harmonics – Battery maintenance procedure – Stationary battery safety- Accident prevention – Accident investigation – First aid – Rescue techniques – Electrical safety program structure and development – Safety meetings – Safety audits.

Total Periods 45

Text Books

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, 'Electrical Safety Handbook', McGraw-Hill Publishing Company Ltd., 3rd Editon,1994.
2. Dennis Neitzel and Al Winfield," Electrical Safety Handbook", McGraw-Hill Education, 4th Edition, 2012.
3. Maxwell Adams.J, 'Electrical Safety- a guide to the causes and prevention of electric hazards', The Institution of Electric Engineers, IET 1994.

References

1. Ray A. Jones, Jane G. Jones, 'Electrical Safety in the Workplace', Jones & Bartlett Learning, 2000.
2. Mohamed A EI – Sharkawi, " Electrical Safety Practice and standards", CRC Press, New York, 2013.
3. Martha J Boss and Gayle Nicoli , "Electrical Safety Systems, sustainability and stewardship", CRC Press, New York, 2014.
4. https://nptel.ac.in/courses/108/107/108107157/

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2		2	3	1					1	2	1	3	1
CO2	2	3	2		2	3	1					2	2	2	3	2
CO3	2	3	2		2	3	1					2	2	2	3	2
CO4	2	3	2		2	2	1					2	2	1	2	1
CO5	2	3	2		2	2	1					2	2	3	3	1
CO6	2	3	2		2	2	1					3	2	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEED	**EMBEDDED SYSTEM**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E –Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Microprocessor and Microcontroller

AIM: To study embedded computers, networks, security, RTOS and their features with a design example

Pre-requisite:

Course Outcomes:

The Students will be able to

CO1. Understand and analyze Embedded systems.
CO2. Operate various Embedded Development Strategies
CO3. Study about the bus Communication in processors.
CO4. Understand basics of Real time operating system
CO5. Acquire knowledge on various processor scheduling algorithms.
CO6. Suggest an embedded system for a given application.

INTRODUCTION TO EMBEDDED SYSTEMS **9**

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- Embedded Program – Compiling, Linking and loading –downloading and debugging – Emulators and simulators processor – External peripherals – Types of memory – Memory testing – Flash Memory.

EMBEDDED SYSTEM DESIGN PROCESS **9**

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modeling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

EMBEDDED NETWORKING AND SECURITY **9**

I/O Device Ports & Buses– Serial/Parallel Bus communication protocols- Ethernet –USB and CAN Bus – RS232 standard – RS422 – RS 485 – CAN Bus –Serial Peripheral Interface – Inter Integrated Circuits- Wi-Fi, 802.11, Bluetooth-IPSec, firewalls, network security.

RTOS BASED EMBEDDED SYSTEM DESIGN **9**

Introduction to basic concepts of RTOS- - Structure of a Real Time System – Task, process & threads, interrupt routines in RTOS, Task Assignment and Scheduling- Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling.

EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT **9**

Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera

Total Periods **45**

Text Books

1. Peckol, Embedded system Design, John Wiley and Sons,2010
2. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson, 2013

3. Shibu. K.V, Introduction to Embedded Systems, 2e, Mcgraw Hill, 2017.

References

1. Raj Kamal, Embedded System-Architecture, Programming, Design, Mc Graw Hill, 2013.
2. Tammy Noergaard, Embedded Systems Architecture, Elsevier, 2006.
3. Rajib Mall Real-Time systems Theory and Practice Pearson Education, 2007.
4. NPTEL online course Link –
5. https://nptel.ac.in/courses/108102045/, https://nptel.ac.in/courses/108105057/

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	3	2	1					1	3	2	1	2
CO2	3	3	2	1	2	2	1						3	2	1	2
CO3	3	2	2	1	2	2	1						3		2	1
CO4	3	2	3	2	1	1	1					1	3	2		2
CO5	3	3	2	1	1	2	2						3	2	1	2
CO6	3	2	3	1	2	2	1						3	1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEE	FIBER OPTICS AND LASER INSTRUMENTS	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Measurement and Instrumentation

AIM: To understand and apply optical fiber and laser technology in industrial and medical field.

Course Outcomes:

The Students will be able to

CO1. Recognize and classify the structures of Optical fiber and types.
CO2. Discuss the channel impairments like losses and dispersion.
CO3. Analyze various coupling losses.
CO4. Classify the Optical sources and detectors and to discuss their principle.
CO5. Familiar with Design considerations of fiber optic systems.
CO6. Perform characteristics of optical fiber, sources and detectors, design as well as conduct experiments in software and hardware and analyze the results to provide valid conclusions.

OPTICAL FIBERS AND THEIR PROPERTIES **9**

Basic optical laws and definitions– Principles of light propagation through a fiber– Different types of fiber and their properties – Modes of propagation –Attenuation - Signal distortion in optical waveguides – Pulse broadening in graded index waveguides – Absorption losses – Scattering losses – Dispersion –Connectors & Splicers.

OPTICAL SOURCES AND OPTICAL DETECTOR **9**

Optical sources – LED structures – types of LED – planar – dome – surface emitting – Light source materials – Quantum efficiency and LED power –Modulation of an LED. Optical detectors – Principles of photo detection – PIN photodiode – Avalanche photodiode and its characteristics

INDUSTRIAL APPLICATIONS OF OPTICAL FIBERS **9**

Fiber optic sensors – Fiber optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes –Measurement of pressure – temperature – current – voltage – liquid level and strain.

LASER FUNDAMENTALS AND ITS APPLICATIONS **9**

Laser rate equation – 3 & 4 level lasers – Properties of laser – Laser modes –Resonator configuration – Q switching – Mode locking – Cavity damping – Types of lasers – gas – solid – liquid and semiconductor lasers – Laser for measurement of length – Atmospheric effects and pollutants – Material processing – Laser heating – Melting – Trimming – Welding – Material removal and vaporization – Calculation of power requirement of laser for material processing

HOLOGRAPHY AND MEDICAL **9**

Holography – Basic principles – Methods of holographic interferometry and applications – Holography for NDT – Medical application of lasers – Laser and tissue interaction – Laser instruments for surgery – Removal of tumors of vocal chords – Brain surgery – Plastic surgery –

Gynecology – Oncology.

Total Periods 45

Text Books

1. Senior.J.M, 'Optical Fiber Communication – Principles and Practice', Prentice Hall of India, 2nd edition, 2014.
2. Keiser, 'Optical Fiber Communication Systems', 4th Edition, McGraw Hill Ltd., 2010.

References

1. John F. Ready, 'Industrial Applications of Lasers', Academic Press, 2004.
2. Khare R.P, 'Fiber optics and optoelectronics', Oxford, 2006.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		3										3		1	2
CO2	2	2	3										3			2
CO3	2	3	3	2									3	1	2	2
CO4	2	3	3	1									3		1	2
CO5	2	3	3	3	2	1	1						3	1	2	2
CO6	2	2	3	2			1						3		3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEF	FLEXIBLE AC TRANSMISSION SYSTEMS		L-T-P	C
			3-0-0	3
Programme:	B.E. Electrical and Electronics Engineering	**Sem:**	**Category:**	**PE**
Pre-requisites:	Power Electronics, High voltage Engineering			
AIM:	To provide a knowledge of application of power electronics in the efficient design and operation of power systems.			

Course Outcomes:

The Students will be able to

CO1. Express the basic concepts of flexible AC transmission systems and fundamental idea about the FACTS controllers.

CO2. Realize the influence of SVC on system voltage.

CO3. Recognize the different modes of operation and modeling of TCSC.

CO4. Experiment the SVC & TCSC applications.

CO5. Demonstrate the operation of Static Synchronous Compensator (STATCOM) modes of operation and modeling of UPFC for power flow studies.

CO6. Illustrate Controller interactions & its type. Realize the co-ordination of multiple controllers.

INTRODUCTION **9**

Introduction of basic power transmission networks - Reactive power control in electrical power transmission lines -Uncompensated transmission line - series compensation – Basic concepts of static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified power flow controller (UPFC).

STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS **9**

Configuration of SVC - Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modelling of SVC for power flow and transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability.

THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS **9**

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for load flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping-SSR Mitigation.

VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS **9**

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow –Modeling of SSSC in load flow and transient stability studies. Applications: SSR Mitigation-UPFC and IPFC – comparision.

CO-ORDINATION OF FACTS CONTROLLERS **9**

FACTS Controller interactions – SVC – SVC interaction, TCSC - TCSC interaction, Co-ordination of multiple controllers using linear control techniques – Control coordination.

Total Periods 45

Text Books

1. R.Mohan Mathur, Rajiv K.Varma, 'Thyristor – Based Facts Controllers for Electrical Transmission Systems', IEEE press and John Wiley & Sons, Inc, 2011.
2. Narain G. Hingorani, 'Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems', Standard Publishers Distributors, Delhi, 2011.

References

1. K.R.Padiyar, 'FACTS Controllers in Power Transmission and Distribution', New Age International (P) Limited, Publishers, New Delhi, 2016.
2. A.T.John, 'Flexible A.C. Transmission Systems', Institution of Electrical and Electronic Engineers (IEEE), 1999.
3. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez, César Angeles-Camacho, 'FACTS: Modeling and Simulation in Power Networks', Wiley 2004.
4. NPTEL Course: Power System Engineering by Prof. Debapriya Das | IIT Kharagpur

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2				2					1	3		3	1
CO2	2	3	2	1			2					2	1	1	2	1
CO3	2	2	3				2					1	1	2	3	2
CO4	3	2	2		1		1					1	2	2	3	2
CO5	3	2	2				2					2	2	2	3	2
CO6	3	2	3	2	1		2					1	1	1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEG	GREEN ENERGY RESOURCES & SYSTEM	L-T-P	C
		3-0-0	3

Programme: B.E –Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Utilization of Electrical Energy

AIM: To instruct the importance of renewable energy and its utilization for the thermal and electrical energy needs and also the environmental aspects of these resources.

Pre-requisite:

Course Outcomes:

The Students will be able to

CO1. Appraise the conventional energy resources and current energy need.
CO2. Explain the process of solar radiation measurements and their basic theories.
CO3. Elaborate the various applications of photovoltaic cells.
CO4. Explain the classification, characteristics and applications of wind energy conversion system.
CO5. Outline the concept of energy generation from ocean energy.
CO6. Summarize the various energy sources and the process of energy conversion system.

Introduction **9**

Current energy requirements, growth in future energy requirements, Review of conventional energy resources- Coal, gas and oil reserves and resources, Tar sands and Oil Shale, Nuclear energy Option.

Solar Energy **9**

Solar radiation: measurements and prediction. Solar thermal collectors - flat plate collectors, concentrating collectors. Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping, power generation schemes.

Wind Energy **9**

Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, and applications.

Ocean Energy **9**

Ocean energy resources - ocean energy routes - Principles of ocean thermal energy conversion systems- ocean thermal power plants- Principles of ocean wave energy conversion and tidal energy conversion.

Other Sources **9**

Hydropower, Nuclear fission and fusion-Geothermal energy: Origin, types of geothermal energy sites, site selection, geothermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

Total Periods **45**

Text Books

1. G.D. Rai, 'Non Conventional Energy Sources', Khanna Publishers, New Delhi, 2006.
2. D P Kothari, K C Singal and Rakesh Ranjan, 'Renewable Energy Sources and Emerging Technologies' 2nd Edition, 2012.

References

1. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000.
2. C. S. Solanki, "Solar Photovoltaics: Fundamental Applications and Technologies, Prentice Hall of India, 2009.
3. L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.
4. D. A. Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press.
5. S.P. Sukhatme, 'Solar Energy', Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.
6. NPTEL Course "Technologies for Clean and Renewable Energy Production", IIT Roorkee by Prof.P.Mondal.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1			1		2	3	1				2				1
CO2	1	2	2			1	2						1		2	1
CO3	2	3	3	1	1		1						1		2	3
CO4	1	2	3	1	1								1	2	2	3
CO5	1	2	1	1									1		1	
CO6	1	1		1			2						1	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEH HIGH VOLTAGE DIRECT CURRENT TRANSMISSION L-T-P C
3-0-0 3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: High Voltage Engineering

AIM: To understand and analyze power system operation, stability, control and protection.

Course Outcomes:

The Students will be able to

CO1. Explain the concept, planning of DC power transmission and comparison with AC Power transmission.

CO2. Analyze the HVDC converters.

CO3. Design the controller for HVDC system.

CO4. Analyze the harmonics and design suitable filters.

CO5. Elaborate the model and analysis the DC system under steady state.

CO6. Perform power flow analysis for AC and DC systems

INTRODUCTION 9

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

ANALYSIS OF HVDC CONVERTERS 9

Line commutated converter – Analysis of Graetz circuit with and without overlap – Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

REACTIVE POWER AND HARMONICS CONTROL 9

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.

POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – case study.

Total Periods 45

Text Books

1. Padiyar, K. R., ‘HVDC power transmission system’, New Age International (P) Ltd., New Delhi, Second Edition, 2010
2. Edward Wilson Kimbark, ‘Direct Current Transmission’, Vol. I, Wiley interscience, New

York, London, Sydney, 1971.
3. Rakosh Das Begamudre, Extra High Voltage AC Transmission Engineering, New Age International (P) Ltd., New Delhi, 1990.

References

1. Kundur P., 'Power System Stability and Control', McGraw-Hill, 1993.
2. Colin Adamson and Hingorani N G, 'High Voltage Direct Current Power Transmission', Garraway Limited, London, 1960.
3. Arrillaga, J., 'High Voltage Direct Current Transmission', Peter Pregrinus, London, 1998.
4. S. Kamakshaiah, V. Kamaraju, 'HVDC Transmission', Tata McGraw Hill Education Private Limited, 2011.
5. https://nptel.ac.in/courses/108104013/

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3	1	3	
CO2	2	3	2	1									3	2	3	
CO3	1	2	2	2	2								3	3	3	2
CO4	1	2	1	1									3	2	3	2
CO5	3	2	1	1									3	1	3	
CO6	3	2	3	1									3	1	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEI	**ILLUMINATION ENGINEERING**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Power Electronics, High voltage Engineering

AIM:

Course Outcomes:

The Students will be able to

CO1. Get the detailed information about modern lamps and their accessories

CO2.Get detailed insight of indoor and outdoor illumination system components.

CO3.Concepts of controls and design aspects

CO4.Know the requirements of energy efficient lighting

CO5.Analyze the lighting Economics Audit Management

CO6.Introduce the modern trends in the lighting

FUNDAMENTALS OF ILLUMINATION **9**

Importance of Lighting in Human Life - Optical systems of human eye - Dependence of human activities on light-performance characteristics of human visual system-External factors of vision-visual acuity-contrast, sensitivity- Time illuminance, colour-visual perception- optical radiation hazards-Good and bad effects of lighting and perfect level of illumination- Artificial lighting as substitute to natural light, Ability to control natural light

LIGHTING CODES & ENERGY EFFICIENT LIGHTING SYSTEM **9**

Electrical Control of Light Sources: Ballast, igniters and dimmers for different types of lamps-Types of Luminaries-factors to be considered for designing luminaries- Types of lighting fixtures.- Design procedure of reflecting and refracting type of luminaries- physical protection of lighting fixtures-Installation type -luminaries standard (IEC-598-Part I)

LIGHTING DESIGN AND CALCULATION **9**

Zonal cavity method for general lighting design-determination for zonal cavities and different shaped ceilings using COU (coefficient of utilization)- Factors to be considered for design of indoor illumination scheme - Indoor illumination design for following installations- Residential (Numerical),Educational institute-Industrial lighting-Special purpose lighting schemes- Decorative lighting, -Theatre lighting,-Aquarium- swimming pool lighting.

LIGHTING ECONOMICS, AUDIT & MANAGEMENT **9**

Cost estimation of lighting systems- Economic analysis-pay back method- lifecycle cost Fundamentals of lighting surveys and audits- measuring tools & instruments-Types of surveys and audit- Design and use of software of lighting survey and analysis-Energy management in illumination-Energy efficient illuminating system components- energy, Power Quality-Demand side management (DSM).Maintenance of lighting system-indoor and outdoor, maintenance schedule, Equipment and materials used for maintenance job, General guidelines on disposal of burnt outlamps.

MODERN TRENDS IN ILLUMINATION **9**

LED luminary designs-Intelligent LED fixtures-Natural light conduiting- Organic lighting system-LASERS-characteristics-features and applications- Nonlighting lamps- Optical fiber- construction as a light guide- features and applications

Total Periods 45

Text Books

1. H. S. Mamak, Book on Lighting, Publisher International lighting Academy
2. Joseph B. Murdoch, Illumination Engineering from Edisons Lamp to Lasers Publisher -York, PA: Visions Communications

References

1. M. A. Cayless, A. M. Marsden, Lamps and Lighting, Publisher-Butterworth-Heinemann(ISBN978-0-415-50308-2)
2. Energy Management in Illumination Systems – Kao Chen,CRC Press.
3. Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002.
4. NPTEL Course Prof. N.K.Kishore 'Illumination Engineering',IITKaragpur.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1										3	1	3	
CO2	2	3	2	1									3	2	3	
CO3	1	2	2	2	2								3	3	3	2
CO4	1	2	1	1									3	2	3	2
CO5	3	2	1	1									3	1	3	
CO6	3	2	3	1									3	1	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEJ	INDUSTRIAL ELECTRONICS	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites Electronic Devices and Circuits

AIM: To introduce the application of electronic devices for conversion, control and conditioning of electric power.

Course Outcomes:

The Students will be able to

CO1. Give an overview of different types of power semi-conductor devices and their switching characteristics.
CO2. Understand the operation, characteristics and performance parameters of controlled rectifiers.
CO3. Study the characteristics of DC and AC drives
CO4. Explain the different modulation techniques of pulse width modulated inverters and to understand the harmonic reduction methods.
CO5. Know the practical application for power electronics converters in conditioning the power supply.
CO6. Study the Electronic timers, Digital counters and dielectric heating.

POWER DEVICES **9**

Power diode – Power transistor – Power MOSFET – SCR – TRIAC – GTO – IGBT – MCT–Protection of power devices.

CONVERTERS **9**

Introduction to half wave, full wave and bridge rectifiers – Single phase and three phase – Halfcontrolled and fully controlled converters – Dual converters – Introduction to cyclo converters andac controllers.

INVERTER AND CHOPPER **9**

Voltage, current and load commutation – Voltage Source Inverter (VSI) – Series and Parallel inverter – Bridge inverters – Single and three phase – Voltage control using PWM – Current Source Inverter (CSI) – Choppers – Step up and step down choppers – Chopper classification– Class A, B, C, D, E – AC choppers

DC AND AC DRIVES **9**

Steady state characteristic of dc motors – Control of DC motor using converters and choppers– Regenerative and dynamic braking – Closed loop control scheme – Speed-torque characteristic ofinduction motor – Static stator voltage control – V/f control – Static rotor resistance control – Slippower recovery scheme – Self-control of synchronous motor-

OTHER APPLICATIONS **9**

Electronic timers – Digital counters – Voltage regulators – Online and offline ups – Switched modepower supply – Principle and application of induction and dielectric heating. -Application of photoelectric control, industrial photoelectric device, electroniccircuit for photoelectric switch, optoelectronics devices, application of optocoupler.

Total Periods **45**

TEXT BOOK(S)

1. G. K. Mithal, “Industrial Electronics”, Khanna Publishers, Delhi, 2000.

REFERENCE(S)

1. M. H. Rashid, “Power Electronics Circuits, Devices and Application”, PHI, 3rd edition, 2004.
2. G. M. Chute and R. D. Chute, “Electronics in Industry”, McGraw Hill Ltd, Tokyo, 1995.
3. F. D. Petruzulla, “Industrial Electronics”, McGraw Hill, Singapore, 1996.
4.M.S. Berde ,Thyristor Engineering, (Khanna publisher, New Delhi).
5.Thomas E. Kissell, Industrial electronics, (PHI-New Jersy).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3	2	1	
CO2	2	3	2	1									3	2	2	2
CO3	1	2	2										3	3	1	1
CO4	1	2	1										3	3	1	
CO5	3	2	1	1	1								3	3	2	2
CO6	3	2	3										3	1	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEK	INTELLIGENT CONTROL SYSTEM	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Prerequisites: Control System

AIM: The objective of this course is to provide a thorough introduction to the field of soft computing techniques to modeling, optimization, and control.

Course Outcomes:

The student will be able to

CO1. Enumerate the architecture of intelligent control systems.
CO2. Illustrate the concept of artificial neuron and their learning factors.
CO3. Discuss the concept of genetic algorithm and it's optimization techniques.
CO4. Summarize the concept of fuzzy logic system.
CO5. Highlight the case studies of real time problems.
CO6. Elaborate the stability analysis of fuzzy control systems.
CO7. Demonstrate the case study using MATLAB toolbox.

INTRODUCTION **9**

Approaches to intelligent control- Architecture for intelligent control- Symbolic reasoning system, rule-based systems, and the AI approach- Knowledge representation- Expert systems and applications.

ARTIFICIAL NEURAL NETWORKS **9**

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller – case study.

GENETIC ALGORITHM **9**

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving electrical optimization problems.

FUZZY LOGIC SYSTEM **9**

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Block diagram of FLC – Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

APPLICATIONS **9**

GA application to power electronics optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using MATLAB

fuzzy-logic toolbox – Case study. Stability analysis of fuzzy control systems.

Total Periods 45

Text books

1. Padhy.N.P., 'Artificial Intelligence and Intelligent System', Oxford University Press, 2005.
2. S.N.Sivanandam & S.N.Deepa, 'Principles of Soft Computing', 2nd Edition, John Wiley & Sons, 2011.

References

1. Jacek.M.Zurada, 'Introduction to Artificial Neural Systems', Jaico Publishing House, 1999.
2. Zimmerman H.J, 'Fuzzy set theory-and its Applications', Kluwer Academic Publishers, Reprint 2014.
3. Driankov, Hellendroon, 'Introduction to Fuzzy Control', Narosa Publishers.
4. Kosko, B, 'Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence', PrenticeHall, NewDelhi, 2009.
5. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, New Delhi, 2008.
6. KOSKO. B. 'Neural Networks and Fuzzy Systems', Prentice-Hall of India Pvt. Ltd., 2009.
7. NPTEL Course: Introduction To Soft Computing by Prof. Debasis Samanta | IIT Kharagpur.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										3			2
CO2		2	2										3	1	1	2
CO3	3	2	2	1	2								3	2	1	2
CO4		2	2		1								3			2
CO5		2	2	1	2								3	2	2	2
CO6	3		3	1									3	1	1	2
CO7	3	2	2	3	2								3	3	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEL	NANO-DIELECTRICS	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Engineering Physics

AIM: To obtain a knowledge on nano materials, composites and various processing techniques.

Course Outcomes:

The Students will be able to

CO1. Describe about nano materials

CO2. Classify the various ceramic nano composites.

CO3. Interpret the application of nano materials

CO4. Illustrate the polymer composite processing techniques.

CO5. Summarize different biological nano composite materials and its synthesis process.

CO6. Perform Modeling of various nano composite materials.

INTRODUCTION TO NANO MATERIALS **9**

Introduction to nanomaterials- Definition of nanocomposite, nanofillers, classification of nanofillers, carbon and noncarbon based nanofillers - Properties of nanomaterials- role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells, conductivity and enhanced catalytic activity in the macroscopic state.

BULK METAL AND CERAMICS NANOCOMPOSITES AND ITS APPLICATIONS **9**

Ceramic/Metal Nanocomposites - Metal Matrix Nanocomposites - Bulk Ceramic Nanocomposites - Thin-Film Nanocomposites: Multilayer and Granular Films - Carbon Nanotube-Based Nanocomposites - Functional Low-Dimensional Nanocomposites - Particle-Dispersed Magnetic Nanocomposites - Magnetic Multilayer Nanocomposites - Inorganic Nanocomposites for Electrical Applications - Applications of Nanocomposite Wires and Nanocomposite Particles.

POLYMER-BASED AND POLYMER-FILLED NANOCOMPOSITES **9**

Nanoscale Fillers - Nanofiber or Nanotube Fillers - Carbon Nanotubes - Nanotube Processing - Equi-axed Nanoparticle Fillers - Inorganic FillerPolymer Interfaces - Processing of Polymer Nanocomposites - Nanotube/Polymer Composites - Layered FillerPolymer Composite Processing - Polyamide Matrices - Polymer Composite Processing - Direct Mixing - Solution Mixing - In-Situ Polymerization - In-Situ Particle Processing – Ceramic / Polymer Composites - In-Situ Particle Processing Metal/Polymer Nanocomposites - Properties of Composites.

NATURAL NANOBIOCOMPOSITES **9**

Natural Nanocomposite Materials - Biologically Synthesized Nanoparticles - Biologically Synthesized Nanostructures -Biologically Derived Synthetic Nanocomposites - Protein-Based Nanostructure Formation - DNA-Templated Nanostructure Formation - Protein Assembly - Biologically Inspired Nanocomposites - Lyotropic Liquid-Crystal Templating -Liquid-Crystal Templating of Thin Films - Block-Copolymer Templating - Colloidal Templating.

MODELING OF NANOCOMPOSITES **9**

Introduction The Need For Modeling - Current Conceptual Frameworks - Multiscale Modeling - Multiphysics Aspects.

Total Periods 45

Text Books

1. P.M. Ajayan, L.S. Schadler, P.V.Braun, 'Nanocomposite Science and Technology', WILEY-VCH Verlag GmbH Co. KGaA, Weinheim, 2003.
2. Yiu-Wing Mai and Zhong-Zhen Yu, 'Polymer nanocomposites', First published, Wood head Publishing Limited and CRC Press LLC, USA, 2006.

References

1. Gary Wiederrecht, 'Handbook of Nanofabrication', Elsevier, 2010.
2. Nick Kanello Poulos, 'Nanoporous materials: Advance techniques for characterization, Modeling and Processing', CRC press, 2011.
3. Claudia Altavilla and Enrico Ciliberto, 'Inorganic Nanoparticles: Synthesis, Application and Perspectives', CRC Press, 2011.
4. CR Rowe, 'Handbook of Thermoelectrics', CRC, Ed.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			1
CO2	3		3										2			1
CO3	3	1											3	1	1	1
CO4	3	2	3										3			2
CO5	3	1											3	1	1	1
CO6	3	2	2	1	1								3	1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEM	PLC AND DISTRIBUTED CONTROL SYSTEM	L-T-P	C
		3-0-0	3

Programme: B.E.- Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Measurement and Instrumentation, Control Systems

AIM: To gain knowledge on concepts towards controller design using PLC and human machine interface system.

Course Outcomes:

The student will be able to

CO1. Explain the history and stage by stage development of PLC.
CO2. Develop a program using PLC programming language.
CO3. Represent the concept of human machine interface.
CO4. Demonstrate the concept of SCADA system and communication standard.
CO5. Represent the DCS architecture, control unit and its interface.
CO6. Elaborate the interfacing issues in distributed control system.

INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLERS **9**

Definition and History of PLC - Manufacturing and assembly Processes - PLC Advantages and Disadvantages – Overall PLC System Architecture – PLC CPU, Input and Output Modules. Input, and output, On/Off devices- Input and output analog devices.

PROGRAMMING OF PLC **9**

Programming Languages: Ladder Diagram, Function Block Diagram, Instruction List, Structured Text and Sequential Function Charts – Ladder Diagram: Basic relay Instructions, Timer and Counter Instructions, Arithmetic and Comparison Functions – Creating Ladder Diagrams using Process Control Descriptions.

HUMAN-MACHINE INTERFACES **9**

Human-Machine Interactions: Models for Human-Machine Interactions, Systems of Human-Machine Interactions – User Machine interfaces: User-Machine interface system, User-Machine interface Hardware – Industrial Application Example: Human Machine interfaces in Robotic systems.

SCADA **9**

SCADA Systems: Hardware – Software – Open Systems and Communication Standards - Fundamentals of SCADA- Communications, Remote Terminal Unit, PLCs as RTUs – Communication Architectures and Philosophies – SCADA Protocols: HDLC and MODBUS.

DISTRIBUTED CONTROL SYSTEMS (DCS) **9**

Introduction - Emergence of DCS Architecture – Comparison of Architectures - Local Control Unit: Architecture - Process Interfacing Issues - operator interface – engineering interfaces.

Total Periods 45

Text Book

1. Rajesh Mehra, Vikrant VIJ, ‘PLCs and SCADA Theory and Practice’, University Science Press, Lakshmi Publication, 2016.

2. Michael P Lukas, 'Distributed Control systems', Van Nostrand Reinhold Company, New York, 1995

References

1. Frank D. Petruzella, 'Programmable Logic Controllers', Tata Mc Graw-Hill, New Delhi, 2011.
2. Peng Zhang, 'Advanced Industrial Control Technology', Elsevier, 2010.
3. David Bailey, Edwin Right, 'Practical SCADA for Industry', Newnes (Elsevier), Mumbai, 2003.
4. John W. Webb and Ronald A. Reis, 'Programmable logic controllers: Principles and Applications', Prentice Hall India, New Delhi, 2009

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2									1	3			
CO2	2	2	2	3	3	1						1	3	1	1	2
CO3	3	2	2	3	1	1						1	3			2
CO4	2	2	2	3	3	1						1	3			2
CO5	2	2	2	3	3	1						1	3		1	2
CO6	3		3	3								1	3	1	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEN	**POWER PLANT ENGINEERING**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Fundamentals of Electrical Engineering

AIM: Expose the students to basics of various power plants so that they will have the comprehensive idea of power system operation.

Course Outcomes:

The Students will be able to

CO1. Illustrate the layout of steam power plant with coal handling and cooling systems.

CO2. Construct about the nuclear power plant and nuclear reactors.

CO3. Illustrate the layout of gas and diesel power plant.

CO4. Analyze various renewable energy systems.

CO5. Construct the hydro electric power plant and various types of turbines.

CO6. Analyze the economic and environmental impact of power plants.

THERMAL POWER PLANTS **9**

Rankine cycle – improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment-super heater- regenerator dearearators-cooling tower.

NUCLEAR POWER PLANTS **9**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors-Safety measures for Nuclear Power plants.

DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS **9**

Otto, Diesel, Dual & Brayton Cycle – Analysis & Optimisation-Components of Diesel and Gas Turbine power plants-Combined Cycle Power Plants-Integrated Gasifier based Combined Cycle systems.

POWER FROM RENEWABLE ENERGY **9**

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic, Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS **9**

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits- Capital & Operating Cost of different power plants-Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

Total Periods **45**

Text Books

1. P.K. Nag, 'Power Plant Engineering', Tata McGraw Hill, 4th Edition, 2014.
2. Arora and Domkundwar, 'A Course in Power Plant Engineering', 6th Edition, Dhanapat Rai and

Co.Pvt.Ltd., New Delhi, 2013.

References

1. R.K.Rajput, 'A Text Book of Power System Engineering', 1st Edition, Lakshmi Publication, 2006.
2. Bernhardt G.A.Skrotzki and William A. Vopat, 'Power station Engineering and Economy', Tata McGraw Hill Publishing Company Ltd., New Delhi, 20th reprint 2002.
3. G.D. Rai, 'An introduction to power plant technology', Khanna Publishers, Delhi, 2015.
4. M.M. El-Wakil, 'Power Plant Technology', McGraw Hill 1984.
5. https://swayam.gov.in/nd1_noc20_me10/preview.
6. https://www.classcentral.com/course/swayam-steam-power-engineering-14304.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3				2						3	1		
CO2	3	2	3				2						3	1	1	
CO3	3	2	3			2	2						3	1	1	
CO4	3	2	2	1		2	2						2	1	3	3
CO5	3	2	2				2						3	1	1	
CO6	3	2	3	1			2					1	3	1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEO	POWER QUALITY	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Power system analysis, Power system operation and Control

AIM: To study the various issues affecting power quality, their production, monitoring and suppression.

Course Outcomes:

The Students will be able to

CO1. Impart Knowledge on various power quality issues in power systems and methods of suppression.
CO2. Calculate and analyse the sources of sags and interruptions in power system.
CO3. Know the severity of sag and mitigation of voltage sags in transmission line.
CO4. Analyse the sources of over voltages and mitigation methods of voltage swells in transmission line.
CO5. Demonstrate the computer analysis tools for transients using PSCAD and EMTP softwares.
CO6. Select the suitable type of filters for reducing the harmonics in transmission line.

INTRODUCTION TO POWER QUALITY **9**

Terms and definitions: overloading - under voltage - over voltage. Concepts of transients – short duration variations such as interruption - long duration variation such as sustained interruption. Power quality issues in power systems. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve - Power quality studies for green energy systems.

VOLTAGE SAGS AND INTERRUPTIONS **9**

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. Voltage sags due to induction motor starting - Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

OVERVOLTAGES **9**

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

HARMONICS **9**

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion - voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

POWER QUALITY MONITORING **9**

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer -

flicker meters – disturbance analyzer. Investigation on PQ improvement in PV grid connected system.

Total Periods 45

Text Books

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality', 3rd Edition, McGraw Hill, 2012.
2. G.T. Heydt, 'Electric Power Quality', 2nd Edition. West Lafayette, IN, Stars in Circle Publications, 1994.

References

1. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', New York: IEEE Press, 2000.
2. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', New York: Wiley, 2000.
3. https://nptel.ac.in/courses/108/106/108106025/

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2					3					2	2		3	
CO2	2	2		1			1					2	1	1	3	2
CO3	3	2					1					2	1	1	2	1
CO4	2	2	1	1			1					2	2		3	
CO5	2	2	1	2			1					2	3		3	1
CO6	2	2										2	3	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEP	**ROBOTICS AND AUTOMATION**		**L-T-P**	**C**
			3-0-0	**3**
Programme:	B.E. Electrical and Electronics Engineering	**Sem:**	**Category:**	**PE**

Pre-requisites: Measurement and Instrumentation, Control system

AIM: To learn the fundamentals of robotics and its safety issues

Course Outcomes:

The Students will be able to

CO1. Represent the state of art technology and products in automation

CO2. Highlight the functions of the basic components of a Robot

CO3. Design Robot Kinematics and develop its program.

CO4. Elaborate the concepts and techniques in robot manipulation kinematics.

CO5. Highlight Robot safety issues and economics.

CO6. Instruct the use of various types of End of Effectors, Sensors and its Automation.

FUNDAMENTALS OF ROBOT **9**

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification-Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

SENSORS AND MACHINE VISION **9**

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications

ROBOT KINEMATICS AND ROBOT PROGRAMMING **9**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

IMPLEMENTATION AND ROBOT ECONOMICS **9**

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots

Total Periods 45

Text books

1. Klafter R.D., Chmielewski T.A and Negin M., 'Robotic Engineering - An Integrated Approach', Prentice Hall, 2003.
2. Groover M.P., 'Industrial Robotics-Technology Programming and Applications', McGraw Hill, 2001.

References

1. Craig J.J., 'Introduction to Robotics Mechanics and Control', Pearson Education, 2017.
2. Deb S.R., 'Robotics Technology and Flexible Automation' Tata Mc Graw Hill Book Co., 2010.
3. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., 'Robotics Control, Sensing, Vision and Intelligence', McGraw Hill Book Co., 2008.
4. Janakiraman P.A., 'Robotics and Image Processing', Tata Mc Graw Hill, 1995.
5. Rajput R.K., 'Robotics and Industrial Automation', S.Chand and Company, 2008.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	1	2				1	2	3			2
CO2	3	2	2	2	3	1	2				1	2	3		2	
CO3	3	2	2	2	3	1	2				1	2	3	1	2	2
CO4	3	2	2	2	3	1	2				1	2	3		1	2
CO5	3		2	2		1						2	3	1	1	2
CO6	3	2	2	2	3	1	2				1	2	3		1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEEQ	SMART GRID TECHNOLOGIES	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Smart Grid, Power Electronics, Renewable Energy Sources, Power system Operation and Control.

AIM:

1. To understand the concepts and design of Smart grid.
2. To understand the various communication and measurement technologies in smart grid.
3. To understand the analysis and stability of smart grid.
4. To learn the renewable energy resources and storages integrated with smart grid.

Course Outcomes:

The Students will be able to

CO1. Discriminate power grid with smart grid.

CO2. Realize smart grid market drivers, stakeholders, functions and measures.

CO3. Recognize the various measurement and communication techniques.

CO4. Identify the challenges and weakness of the load flow methods.

CO5. Analyze the Power Electronics devices in smart grid

CO6. Categorize the integration issues of renewable energy resources with smart grid.

SMART GRID ARCHITECTURAL DESIGNS **9**

Introduction – Comparison of Power grid with Smart grid – power system enhancement – communication and standards - General View of the Smart Grid Market Drivers - Stakeholder Roles and Function - Measures - Representative Architecture - Functions of Smart Grid Components-Wholesale energy market in smart grid-smart vehicles in smart grid.

SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY **9**

Communication and Measurement - Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS) - Advanced metering infrastructure- GIS and Google Mapping Tools.

PERFORMANCE ANALYSIS TOOLS FOR SMART GRID DESIGN **9**

Introduction to Load Flow Studies - Challenges to Load Flow in Smart Grid and Weaknesses of the Present Load Flow Methods - Load Flow State of the Art: Classical, Extended Formulations, and Algorithms –Load flow for smart grid design-Contingencies studies for smart grid.

POWER ELECTRONICS IN SMART GRID **9**

Introduction-Fault current limiting-Shunt Compensation: D-Statcom - Shunt compensator with energy storage - Series compensation - Power Quality Conditioners for Smart Grid – Anti islanding and smart grid protection.

RENEWABLE ENERGY AND STORAGE **9**

Renewable Energy Resources-Sustainable Energy Options for the Smart Grid-Penetration and Variability Issues Associated with Sustainable Energy Technology-Demand Response Issues-Electric Vehicles and Plug-in Hybrids-PHEV Technology-Environmental Implications-Storage Technologies-Grid integration issues of renewable energy sources.

Total Periods 45

Text Books

1. James Momoh, 'Smart Grid: Fundamentals of design and analysis', John Wiley & sons Inc, IEEE press 2015.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid:Technology and Applications', John Wiley & sons inc, 2012.

References

1. Fereidoon P. Sioshansi, 'Smart Grid: Integrating Renewable, Distributed & Efficient Energy', Academic Press, 2012.
2. Clark W.Gellings, 'The smart grid: Enabling energy efficiency and demand response', Fairmont Press Inc, 2009.
3. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
4. Ali Keyhani, "Design of Smart Power Grid Renewable Energy Systems", John Wiley & Sons, New Jersey, 2011 5. NouredineHadjsaid,
5. https://nptel.ac.in/courses/108107113/ NPTEL Online Course.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1									1	2	1	3	
CO2	3	2	1	1									3	3	3	1
CO3	3	2	1										3	1	3	1
CO4	3	2	2	1									3		3	1
CO5	3	2	1	1									3	3	3	2
CO6	3	2	1	1									2	1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEER	**SMPS AND UPS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: Power Electronics

AIM: To provide conceptual knowledge in modern power electronic converters and its applications in electric power utility.

Course Outcomes:

The Students will be able to

CO1. Analyze the state space model for DC-DC converters.

CO2. Acquire knowledge on switched mode power converters.

CO3. Understand the importance of Resonant Converters.

CO4. Analyze the PWM techniques for DC-AC converters.

CO5. Acquire knowledge on modern power electronic converters and its applications in electric power utility.

CO6. Acquire knowledge on filters and UPS.

DC-DC CONVERTERS **9**

Principles of step down and step up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters.

SWITCHING MODE POWER CONVERTERS **9**

Analysis and state space modeling of flyback, Forward, Luo, Half bridge and full bridge converters- control circuits and PWM techniques.

RESONANT CONVERTERS **9**

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS, clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.

DC-AC CONVERTERS **9**

Single phase and three phase inverters, control using various (sine PWM, SVPWM and advanced modulation) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts – Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

POWER CONDITIONERS, UPS & FILTERS **9**

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.

Total Periods 45

Text Books

1. Simon Ang, Alejandro Oliva, Power-Switching Converters, Third Edition, CRC Press, 2010.
2. KjeldThorborg, Power Electronics –In theory and Practice, Overseas Press, First Indian Edition 2005.

References

1. Philip T Krein, Elements of Power Electronics, Oxford University Press
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design-Third Edition- John Wiley and Sons- 2006
3. M.H. Rashid – Power Electronics circuits, devices and applications- third edition Prentice Hall of India New Delhi, 2007.
4. Erickson, Robert W, Fundamentals of Power Electronics, Springer, second edition, 2010.
5. M.H. Rashid – Power Electronics handbook, Elsevier Publication, 2001.
6. Prof.L.Umanand, Prof.V.Ramanarayanan 'Switched Mode Power Conversion' IISc Bangalore.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										1	2	3	
CO2	3	2	2	1									3	3	2	1
CO3	3	2	2										2	1	1	1
CO4	3	2	2	1									2	3	3	2
CO5	3	2	2	1									3	2	1	2
CO6	3	2	1	1									1	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEES	SPECIAL ELECTRICAL MACHINES	L-T-P	C
		3-0-0	3

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Prerequisites: Machines, Electrical Drives and Control

AIM: To explore the theory and applications of special electrical machines and its controllers

Course Outcomes:

The Students will be able to

CO1. Elaborate the construction and principle of operation of stepper motors.

CO2. Outline the driver system of stepper motors

CO3. Impart the knowledge on switched reluctance motors.

CO4. Enumerate the construction, principle of operation, control and performance of permanent magnet brushless D.C. motors

CO5. Analyze the structure, operation and control of permanent magnet synchronous motors

CO6. Explain the characteristics of Hysteresis, Servo and Linear Motors.

STEPPER MOTORS **9**

Types – Constructional features – principle of operation – variable reluctance motor – single and Multi-stack configurations – Permanent Magnet Stepper motor – Hybrid stepper motor. Modes of Excitation – theory of torque predictions – Drive circuits –control of stepper motor with rduino.

SWITCHED RELUCTANCE MOTORS **9**

Constructional features – rotary and linear SRM- principle of operation –Torque production – Power Converters and controllers for SR Motor – method of Rotor position Sensing – Sensor less operation – characteristics and closed loop operation- Applications.

PERMANENT MAGNET BRUSHLESS DC MOTORS **9**

Fundamentals of permanent magnets- Types –Principle of operation — Magnetic circuit analysis – EMF and torque equations –Torque speed characteristics – Power converter circuit– Motor characteristics – control of BLDC with rduino – Applications.

PERMANENT MAGNET SYNCHRONOUS MOTORS **9**

Construction-Principle of operation, EMF and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self control, Vector control, and microprocessor based control – Applications.

OTHER SPECIAL MACHINES **9**

Constructional features –Principle of operation and characteristics of Hysteresis motor – servo motor; control with rduino – Linear motor – Applications.

Total Periods 45

Text Books

1. Krishnan R, ‘Permanent Magnet synchronous and Brushless DC Motor Drives’, CRC Press, Taylor and Francis group, New York,2017.
2. Kenjo T, ‘Stepping Motors and their Microprocessor Controls’, Clarendon Press London, 2003.

References

1. Matthew Scarpino, 'Motors for makers: A Guide to Steppers, Servos & Other Electrical Machines, Que publication, Indiana 2015.
2. Kenjo, T and Naganori, S, 'Permanent Magnet and brushless DC motors', Clarendon Press, Oxford, New Delhi, 1989.
3. Floyd E Saner, 'Servomotor Applications', Pittman, London, 1993.
4. Rajini V,Nagarajan V S,"Electric Motor Drives" Pearson publication,Chennai,2019.
5. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.
6. Prof.Srinivasa murthy, 'Special Electromechanical Systems' IIT delhi.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										2	3		1
CO2	3	2	2	1									1	3		2
CO3	3	2	2										2	3	1	2
CO4	3	2	2										3	3	2	1
CO5	3	2	2	1									3	3		2
CO6	3	2	1										2	3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EEET	TRANSFORMER ENGINEERING	L-T-P	C
		3-0-0	3

Programme: B.E –Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites: DC machines and Transformer, High Voltage Engineering

AIM: To give an in depth study of selected topics about transformers

Pre-requisite: Transformer principal of operation and types

Course Outcomes:

The Students will be able to

CO1. Understand the types of windings and materials used in transformer.

CO2. Explain the functions of tap changer.

CO3. Understand structural design procedure of transformers

CO4. Apply various standards for testing of transformers

CO5. Plan for commissioning of transformers.

CO6. Choose condition monitoring technique to assess the condition of transformer.

UNIT I TRANSFORMER CONSTRUCTION 9

Core construction, Transformer windings, Dispositions of windings, Impulse strength, Thermal considerations, Tappings and tap changers, Winding forces and performance under short-circuit, Tanks and ancillary equipment, Processing and dry out.

UNIT II STRUCTURAL DESIGN 9

Importance of Structural Design, Different Types of Loads and Tests, Classification of Transformer Tanks, Tank Design, Methods of Analysis, Overpressure Phenomenon in Transformers, Seismic Analysis, Transformer Noise: Characteristics and Reduction, Transport Vibrations and Shocks.

UNIT III STANDARDS AND TESTING OF POWER TRANSFORMERS 9

Impulse Testing, Partial Discharge Testing, Testing of Reactors, Insulation resistance test, Polarization index, DAR, Vector group, Magnetizing current, magnetic core balance, Open circuit and Short-Circuit Testing of Power Transformers, First Revision of IS: 2026, Other Related Standards, New Standards, Standard Specification of a Power Transformer, Indian Standards Related to Power Transformers, IEC Publications.

UNIT IV COMMISSIONING AND PROTECTION 9

Dispatch, Inspection upon Arrival at Site, Handling, Installation, Commissioning, Maintenance, Dos for Power Transformer, Don'ts for Power Transformers, Dos and Don'ts for HV Condenser Bushings, Protection against External Faults SEF, Protection against Internal Faults Differential and REF, Buchholz relay, OTI, WTI, PRV, MOG

UNIT V CONDITION MONITORING OF TRANSFORMERS 9

Introduction, Aging Electrical Power Infrastructure, Diagnosis Method, Transformer Oil-Paper Insulation System, Remaining Life Analysis, Chemical Techniques, Dissolved gas analysis(DGA) Electrical Techniques.

Total Periods 45

Text Books

1. Transformers 2nd Edition, BHEL, McGraw Hill Publishers, 2008.
2. Martin J.Heathcote, The J&P Transformer Book, Thirteen Edition, Newnes, An imprint of Elsevier,

2007
3. S.V. Kulkarni and S.A. Khaparde, Transformer Engineering: Design, Technology and Diagnostics, 2nd Edition, CRC Press, 2013.
4. S. Chakravorti, D. Dey, B. Chatterjee, Recent Trends in the Condition Monitoring of Transformers, London:Springer, pp. 61-69, 2013

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1										3	1	3	1
CO2	2	3	1										2	1	3	1
CO3	2	3	3	3									3		2	1
CO4	2	3											2		2	1
CO5	2	3			3								1		3	1
CO6	1	2	1	2									3		3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

OPEN ELECTIVES

191OE4A	**BATTERY TECHNOLOGY**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E –Electrical and Electronics Engineering **Sem:** **Category:** **OE**

Pre-requisites: Engineering Physics, Engineering Chemistry

AIM: To impart fundamental knowledge on electrochemical energy storage systems considering the operation and design of various battery technologies. To enable the students to understand the requirement of batteries for automotive application combined with environment policy considerations.

Pre-requisite:

Course Outcomes:

The Students will be able to

CO1. Recognize the basic physical concepts of thermodynamics and kinetics involved in electrochemical reactions.

CO2. Select the appropriate battery system with respect to application.

CO3. Analyse the characterization methods of batteries and interpret concepts describing battery performance.

CO4. Describe the recent developments battery systems.

CO5. Understand the requirements of battery systems for automotive applications and understand the modelling of battery systems.

CO6. Discuss the Life Cycle Analysis according to cost and environmental aspects; material and energy consumption, reuse, recycling.

INTRODUCTION TO ELECTROCHEMICAL ENERGY STORAGE **9**

Introduction to battery technologies- Electromotive force- Reversible cells- Relation between electrical energy and energy content of a cell-Free energy changes and electromotive force in cell- Current challenges in Energy storage Technologies.

MAJOR BATTERY CHEMISTRIES DEVELOPMENT AND TESTING **9**

Battery performance evaluation- Primary battery - Service time- Voltage data- Service life – ohmic load curve- Effect of operating temperature on service life. Secondary batteries- Discharge curves- Terminal voltages- Plateau voltage –Lead acid Batteries – Construction and application.

RECENT TECHNOLOGIES: **9**

Recent development of electrode materials in lithium ion batteries- Recent development of solid electrolytes and their application to solid state batteries-Polymer solid electrolytes for lithium ion conduction– Thin Film solid state Batteries: Fundamentals, Constriction and application – Super Capacitors: Fundamental, Construction and application.

BATTERIES FOR AUTOMOTIVES – FUTURE PROSPECTS **9**

Degrees of vehicle electrification - Battery size vs. application -USABC and DOE targets for vehicular energy storage systems - Analysis and Simulation of batteries - Equivalent circuit and life modeling – Environmental concerns in battery production – Recycling of batteries

BATTERY MANAGEMENT SYSTEM **9**

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging

Total Periods 45

Text Books

1. T.Minami, M.Tatsumisago,M.Wakihara,C. Iwakura,S. Kohijiya, Solid state ionics for batteries, Springer Publication, 2009
2. Sandeep Dhameja, Electric Vehicle Battery Systems, Newnes publication, 2001.

Reference Book

1. Bard, Allen J., and Larry R. Faulkner. Electrochemical Methods: Fundamentals and Applications. 2nd ed., Wiley– VCH, Verlag, GmbH, 2000.
2. Masataka Wakihara and Osamu Yamamoto, Lithium ion Batteries Fundamental and Performance,Wiley–VCH, Verlag GmbH, 1999.
3. Robert A.Huggins, Advanced Batteries – Materials science aspects,Springer, 2009.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1		1	2									1			1
CO2	1	2	2	1									1			2
CO3	1	2	2	1									1			2
CO4	1		1	1									2			1
CO5	1	2	2	1									2			2
CO6	2	2	2	1									2	1	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191OE4B	DOMESTIC AND INDUSTRIAL ELECTRICAL INSTALLATIONS	L-T-P	C
		3-0-0	3

Programme: B.E.- Electrical and Electronics Engineering **Sem:** **Category:** **OE**

Pre-requisites: Measurement and Instrumentation, Wiring, Estimation and costing

AIM: To impart knowledge on Electrical supply systems and its protection equipments, Different wiring methods and Estimation for electrical wiring.

Course Outcomes:

The Students will be able to

CO1. Explain the basic Electrical Distribution systems.
CO2. Design lighting system for domestic, commercial and industrial applications.
CO3. Assess the material requirements for a wiring work.
CO4. Categorize different types of wiring practice.
CO5. Perform electrical inspection and accident analysis.
CO6. Adapt Do's and Don'ts in wiring and lighting systems.

INTRODUCTION **9**

Load - Contracted demand, Maximum demand, Power factor – Power Supply - Single Phase, Three phase supply, Three phase wiring. Protective, MCB, MCCB's, RCCB, ELCB – Earthing for safety – Types of earthing in electrical installations– Fuse for Electrical Safety.

TYPES AND INSTALLATION OF WIRING SYSTEMS **9**

Types of wiring - Accessories used in Domestic wiring practice - wire ratings, FRLS type wires and PVC pipes. Types of Distribution Boards-Planning Electrical Wiring for Buildings - Checking Electrical wiring in Flats. Electrical Distribution Design in Multi-Storied Residential Flats and Commercial Buildings-Lightning Arrestors for Buildings.

ELECTRICAL INSTALLATION IN INDUSTRY **9**

Planning Electrical installations - Types of cable - ratings and types - Installations of electrical cables. Sub-station Layout and Design - Electrical installations in Hotels, Hospital wiring - Earthing in Power and Distribution - Lightning Arrestors for Industrial applications - Selecting Standby Gensets- Electrical wiring of garment making industry.

DO'S AND DON'TS WIRING **9**

Guidelines for Electrical Contractors - General specifications for electrical installation work, Electrical Maintenance, treatment for electric shock, Electricity Legislation. Points to be inspected, while carryout an Electrical Inspection – Cinema buildings and fire safety.

LIGHTING ACCESSORIES AND LAMP CIRCUITS **9**

Home lighting -Different types of switches and holders -Types of lighting schemes and design of lighting system for home, office and industrial work place - Energy Efficient lightings. Lamp circuits- Simple Circuits-Series and parallel circuits. Do's and Don'ts in lighting. Selection of lamps and luminars for lighting purpose, Simple fault findings in lighting

Total Periods 45

Text Book

1. B.RajaRao, 'Electricity for Architects, Project Consultants and Builders', B.RajaRao Technical Books Publishers, Chennai.
2. J.B. Gupta, 'A Course in Electrical Installation Estimating and Costing', S. K. Kataria& Sons, 9th Edition, 2013.

References

1. V.S.Rao, 'Operation & Maintenance of Electrical Equipment - Volume I & II', 2008 Edition, Media Promoters & Publishers Pvt. Ltd., Mumbai.
2. https://nptel.ac.in/courses/108/107/108107112/

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										1	3		1	1
CO2	3	2	2	2	2							2	3	1	1	2
CO3	3	2	2		2							2	3		1	2
CO4	3	2	2		2							2	3		1	2
CO5	2	2	3			2						2	2		1	2
CO6	3	2	3	2		2						3	3		1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191OE4C	ENERGY AUDITING AND CONSERVATION	L-T-P	C
		3-0-0	3

Programme: B.E –Electrical and Electronics Engineering **Sem:** **Category:** **OE**

Pre-requisites: Utilization of Electrical Energy

AIM: To learn the energy audit, conservation, efficiency and management.

Course Outcomes:

The Students will be able to

CO1. An ability to know the requirement of energy auditing.
CO2. Summaries the complex problems in the field of energy losses.
CO3. Elaborate the usage of modern computer/software tools to model and audit problems.
CO4. An ability to independently carry out energy related work to solve practical problems.
CO5. Explaining the capability of analyzing and solving complex energy audit and conservation problems.
CO6. Acquire knowledge to audit their own premises for energy awareness purpose.

Introduction **9**

Energy Scenario – Role of Energy Managers in Industries – Energy monitoring, auditing & targeting – Economics of various Energy Conservation schemes. Total Energy Systems

Energy Audit **9**

Energy Audit in various Energy Conservation Measures in Steam –Losses in Boiler. Energy Conservation in Steam Systems –Case studies.

Energy Conservation **9**

Energy Conservation in Centrifugal pumps, Fans &Blowers, Air compressor – energy consumption & energy saving potentials – Design consideration

Energy Efficiency **9**

Refrigeration & Air conditioning – Heat load estimation –Energy conservation in cooling towers & spray ponds – Case studies Electrical Energy –Energy Efficiency in Lighting – Case studies.

Energy Management **9**

Organizational background desired for energy management motivation, detailed process of M&T-Thermostats, Boiler controls- proportional, differential and integral control, optimizers; compensators.

Total Periods **45**

Text Books

1. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.
2. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.

References

1. Larry C Whitetal, Industrial Energy Management & Utilization.
2. Power System Engineering 2nd Ed. D P Kothari, I J Nagrath, Tata McGraw-Hill Co 2008.
3. NPTEL Swayam course "Energy Resources, Economics and Environment" – By Prof. Rangan Banerjee | IIT Bombay

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1			1		2	3	1				2				1
CO2	1	2	2			1	2						1		2	1
CO3	2	3	3	1	1		1						1		2	3
CO4	1	2	3	1	1								1	2	2	3
CO5	1	2	1	1									1		1	
CO6	1	1		1			2						1	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191OE4D	ELECTRIC VEHICLE		L-T-P	C
			3-0-0	3
Programme:	B.E. Electrical and Electronics Engineering	**Sem:**	**Category:**	**OE**

Pre-requisites: Electrical Drives and Control

AIM: This course introduces the fundamental concepts, principles and analysis of hybrid and electric vehicles

Course Outcomes:

The Students will be able to

CO1. Understand the various aspects of hybrid and electric vehicles.
CO2. Plan the selection of electrical machines for hybrid and electric vehicles.
CO3. Select various energy storage technologies for hybrid and electric vehicles.
CO4. Implement energy management techniques for hybrid and electric vehicles.
CO5. Analyze the energy management strategy for various vehicular systems.
CO6. Highlight the applications of various vehicular systems.

INTRODUCTION TO HYBRID AND ELECTRIC VEHICLES **9**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance, Capabilities, Automation system computer facilities.

ELECTRICAL MACHINES FOR ELECTRIC VEHICLES **9**

Introduction to electric components used in hybrid and electric vehicles- Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, and Switched Reluctance Motor drives- drive system efficiency.

ENERGY STORAGE TECHNOLOGIES **9**

Energy storage technologies in hybrid vehicles-flywheel, hydraulic, fuel cell and hybrid fuel cell energy storage system-ultra capacitors- comparison- battery charging control.

ENERGY MANAGEMENT STRATEGIES **9**

Introduction to energy management strategies used in hybrid and electric vehicle, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy strategies.

APPLICATIONS OF ELECTRIC VEHICLES **9**

Electrical power system in air craft, sea and undersea vehicles, space vehicles-hybrid vehicle control strategies-supporting subsystem.

Total Periods 45

Text Books

1. Chris Mi, M. Abul Masrur, David Wenzhong Gao, 'Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives', Wiley, 2011.

2. Ali Emadi, Mehrdad Ehsani, John M. Miller, 'Vehicular Electric Power Systems: Land, Sea, Air, and Space Vehicles', CRC Press, 2010.

References

1. Ion Boldea and S.A Nasar, 'Electric drives', CRC Press, 2005.
2. Sandeep Dhameja, 'Electric Vehicle Battery Systems', Newnes, 2002.
3. Iqbal Husain, 'Electric and Hybrid Vehicles: Design Fundamentals', CRC Press, 2nd Edition, 2010.
4. NPTEL Course Prof.Amit Jain 'Electric Vehicles part-1',IIT Delhi.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3			2					1	3		3	
CO2	3	1	2	2			2					1	3	1	3	
CO3	2	2	3	2								1	3	1	2	
CO4	2	2	2	3			2					1	2	1	3	1
CO5	2	2	1	2			2					1	1		3	1
CO6	2	2	1	2			2					1	3	2	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191OE4E	RENEWABLE AND SUSTAINABLE ENERGY	L-T-P	C
		3-0-0	3

Programme: B.E –Electrical and Electronics Engineering **Sem:** **Category:** **OE**

Pre-requisites: Utilization of Electrical Energy

AIM: To instruct the importance of renewable energy and its utilization for the thermal and electrical energy needs and also the environmental aspects of these resources.

Pre-requisite:

Course Outcomes:

The Students will be able to

CO1. Appraise the current energy need and energy conversion technologies.
CO2. Explain the process of solar radiation and technology challenges of solar energy industry.
CO3. Elaborate the wind resource basics, technology challenges of wind energy industry.
CO4. Summarize the various energy sources and the process of energy conversion system.
CO5. Outline the concept of energy efficiency in buildings.
CO6. Examine the various types of energy storage system and its sustainability.

Introduction **9**

Current Global Energy Use - Energy Consumption - Current energy requirements, growth in future energy requirements - Lifetime of Fossil Fuels -Sustainability and Energy Use - Energy Conversion Technologies

Solar Energy and Wind Energy **9**

Solar radiation: measurements and prediction - Technology Challenges – Sustainability - Solar Energy Industry & Economics - Solar Example Problems - Wind Resource Basics – Technologies – Challenges – Sustainability - Wind Energy Industry

Other Sources **9**

Hydropower - Nuclear fission and fusion - Geothermal energy: Origin, types of geothermal energy sites, site selection, geothermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

Renewable Energy and Energy Efficiency in Buildings **9**

Heat Pumps - Classification of GHP Loops - Heat Pump Efficiency & Examples - Building Integrated Solar - Building Integrated Wind Energy - Building Efficiency & Demand Response

Energy Storage System **9**

Basics- Parameters-Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Types-Lead Acid Battery-Lithium ion battery- Lead Acid Battery-Lithium ion Battery-Sustainability

Total Periods 45

Text Books

1. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Oxford University Press; Third edition, 2012.
2. D P Kothari, K C Singal and Rakesh Ranjan, ‘Renewable Energy Sources and Emerging Technologies’

2nd Edition, 2012.

References

1. S. Sumathi , L. Ashok Kumar, P. Surekha , Solar PV and Wind Energy Conversion Systems (Green Energy and Technology), Springer Nature; 2015.
2. Jeffrey Brownson, Solar Energy Conversion Systems, Elsevier, 2013.
3. L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.
4. G.D. Rai, 'Non Conventional Energy Sources', Khanna Publishers, New Delhi, 2006.
5. Alfred Rufer, Energy Storage: Systems and Components, CRC Press; 1 edition, 2017.
6. NPTEL Course "Technologies for Clean and Renewable Energy Production", IIT Roorkee by Prof.P.Mondal.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1			2			3						1			1
CO2	1	2	2	1			2						1	2	2	2
CO3	1	2	2				2						1	2	2	2
CO4	1			1			3						2			1
CO5	1	2	2				2						2			2
CO6	2	2	2	1			3						2	1	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191OE4F	**SMART MATERIALS FOR ENGINEERS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: B.E. Electrical and Electronics Engineering **Sem:** **Category:** **PE**

Pre-requisites:

AIM:

Course Outcomes:

The Students will be able to

CO1. Understand the basic mechanisms of Smart Materials
CO2. Select the Smart Materials for Magneto-Thermo-Mechanical Applications
CO3. Investigate the parameters used in strain measurements
CO4. Analyse the Smart Materials based micro sensors and micro actuators
CO5. Review the newly discovered smart materials

INTRODUCTION OF ADVANCES IN MATERIALS **9**

Ancient Materials - Conventional Materials - Advanced Materials- Smart/Emerging Materials - Smart Phone/iPhone- Pendrive/External Hard Disk – Spectacles.

SHAPE MEMORY ALLOYS (SMA) **9**

History of SMA - Microscopic and Macroscopic Perspectives of Martensite/Austenite Transformations – Superelasticity – One-way and Two-way Shape Memory Effect –Aerospace, Medical and Transport Applications - Problems

RHEOLOGICAL FLUIDS **9**

Electro Rheological Fluid (ERF) and Magneto Rheological Fluid (MRF) – ERF Based Mount – MRF Based Mount – Damping Concept Selection – Vibration of Simple Structures – Methods for Laminated and Discrete Type Smart Structures- Problems.

SENSOR AND ACTUATOR MATERIALS TECHNOLOGY **9**

Sensing and Actuation Principles Piezoelectricity – Piezoelectric Coefficients–Specifications and Terminologies – Piezoelectric Strain Measurement - Villari Effect – Matteuci Effect – Nagoka- Honda Effect – Joule Effect – Wiedemann Effect - Structural Health Monitoring- Microvalves – Linear Actuators- Problems.

ADVANCES IN SMART MATERIALS **9**

Ferromagnetic SMA - Field Induced Strain in FSMA - Magnetostrictive Materials -Smart Polymer Composite Materials -Self-Assembled Nanostructures -Energy Harvesting Materials - Intelligent Materials –Problems.

Total Periods **45**

Text Books

1. M.V. Gandhi and B.S. Thompson, Smart Materials and Structures, Chapman & Hall UK, 1992
2. V.K. Wadhawan, Smart Structures, Oxford University Press, UK, 2007
3. Mel Schwartz, Smart Materials, CRC Press New York, 2009
4. Christian Lexcellent, Shape Memory Alloys Handbook, John Wiley & Sons, USA, 2013

5. V.K. Varadhan, K.J.Vinoy and S. Gopalakrishanan, Smart Materials and MEMS, John Wiley & Sons, UK, 2006

References

1. William D. Callister, Materials Science and Engineering: An Introduction, Wiley, 2004
2. M. Kohl, Shape Memory Microactuators, Springer, New York, 2004
3. Dimitris C. Lagoudas, Shape Memory Alloys, Springer, New York, 2008
4. Micky Rakotondrabe, Smart Materials- Based Actuators at Micro/Nano-Scale, Springer Science + Business Media, New York, 2013
5. Jan Fischer-Wolfarth and Gereon Meyer, Advanced Microsystems for Automotive Applications, Springer International Publishing, Switzerland, 2013

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1			2			3						1			1
CO2	1	2	2	1			2						1			2
CO3	1	2	2	1			2						1			2
CO4	1	1		1			3						2			1
CO5	1	2	2				2						2			2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

MANAGEMENT ELECTIVES

191BAEA ENGINEERING ECONOMICS AND ACCOUNTING **L-T-P C**
3-0-0 3

Programme: B.E. / B.Tech **Sem: -- Category: HS**

Aim: To enable the students and provide an analytical idea about economics and accounting practices.

Course Outcomes: The students will be able to

CO1. Evaluate the economic theories, cost concepts and major economic problems
CO2. Gain the knowledge about Demand, Supply and its types.
CO3. Describe the concept of theory of production
CO4. Determine the recent pricing methods in market and prepare internal rate of return, payback period, net present value for project selection
CO5. Understand accounting systems and analyze financial statements using ratio analysis.
CO6. Provide an analytical idea about financial feasibility.

UNIT I – INTRODUCTION TO ECONOMICS& DEMAND **9**

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function - Demand elasticity - Demand forecasting.

UNIT II – SUPPLY, PORDUCTION AND COST CONCEPTS **9**

Supply - Determinants of supply - Supply function - Supply elasticity. **Production function** - Introduction - Production Process & Function - One Variable and Two Variable Inputs - Isoquants - Returns to scale. **Cost Concepts** - Cost function – Types of Cost - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT III – PRICING AND CAPITAL BUDGETING **9**

Pricing - Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice. **Capital Budgeting -** Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

UNIT IV – FINANCIAL ACCOUNTING **9**

Financial Accounting - Trail Balance, Balance sheet and related concepts: Trading Account, Profit & Loss Statement and related concepts - Analysis & Interpretation of financial statements - Financial Ratio Analysis.

UNIT V – COST ACCOUNTING **9**

Cost Accounting - Types of costing - traditional costing approach - activity based costing - full cost pricing - marginal cost pricing - going rate pricing - bid pricing - feasibility reports - technical, economic and financial feasibility.

Total Periods: 45

Text Books:

1. McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics, Cengage Learning, 13th Edition, 2013.
2. Prasanna Chandra. 'Fundamentals of Financial Management', Tata McGraw Hill Publishing Ltd., 8th Edition, 2011.

References:

1. Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007.
2. Sasmitha Mishra, 'Engineering Economics and costing', PHI Learning, 2nd Edition, 2010.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		1				3					3		3			
CO2	1										3	2				3
CO3				2							3					
CO4											3					
CO5		2									3					2
CO6		2									3	1				2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BAEB **ENTREPRENEURSHIP** **L-T-P C**
3-0-0 3

Programme: B.E. / B.Tech **Sem:** -- **Category:** **HS**

Aim: To develop and strengthen entrepreneurial quality and motivation in students and impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.

Course Outcomes: The students will be able to

CO1. Gain knowledge about the idéologies of entrepreneur.
CO2. Demonstrate a solid fundamental knowledge of entrepreneur and their successful characteristics within the broad field of entrepreneurism.
CO3. Learn to how prepare the feasible business plan and project reports for initiating businesses.
CO4. Trace out the ways to get financing for starting up the business and taxation issues.
CO5. Describe the ways of sickness in business and its turnout initiatives by the Government policies.
CO6. Develop and strengthen entrepreneurial quality and motivation in students and impart basic entrepreneurial skills

ENTREPRENEURSHIP **9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth. Entrepreneur Vs. Entrepreneurship, Entrepreneur Vs. Manager.

MOTIVATION **9**

Attributes and Characteristics of a successful Entrepreneur, Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives. -women Entrepreneurs.

BUSINESS PLAN PREPARATION **9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

FINANCING AND ACCOUNTING **9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

SUPPORT TO ENTREPRENEURS **9**

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

Total Periods: 45

Text Books:

1. Hisrich, Entrepreneurship, Edition 9, Tata McGraw Hill, New Delhi, 2014
2. S. S. Khanka, Entrepreneurial Development, S.Chand and Co. Ltd., New Delhi, (Revised Edition) 2013.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2					3			3		3	3				1
CO2	2					3			2		2	2				
CO3	2	3	3	3							1					2
CO4								1				1				1
CO5											2					1
CO6	1								3	1	2	1				

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BAEC ESSENTIALS OF MANAGEMENT L-T-P C

3-0-0 3

Programme: B.E. / B.Tech **Sem: -- Category: HS**

Aim: To study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

Course Outcomes: The students will be able to

CO1. Demonstrate knowledge of managerial functions, types of organizations, managers, and managerial roles and skills
CO2. Discuss and apply the planning, organizing and control processes.
CO3. Analyze organizational structure, and organizational control and culture.
CO4. Adapt motivation and leadership qualities and effective communicate through both oral and written presentations.
CO5. Conduct research and analyze information by using both human and technological resources.
CO6. Study the control management system and process.

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

Total Periods: 45

Text Books:

1. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata McGraw Hill, 12th edition, 2014.
2. James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert Jr., 'Management ', Prentice-Hall of India, 6th edition, 2012.

References:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert 'Management', 6th Edition, Pearson Education, 2004.
2. Robert Kreitner & Mamata Mohapatra, 'Management', Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, 'Fundamentals of Management', 7th Edition, Pearson Education, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2								3		3	1				1
CO2									3		3		2			1
CO3						2		2								2
CO4									1	3						1
CO5		3		3	3						2					1
CO6	1				1						3		2			3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BAED PROFESSIONAL ETHICS IN ENGINEERING **L-T-P C**
3-0-0 3

Programme: B.E. / B.Tech **Sem: -- Category: HS**

Aim: To enable the students to create an awareness on Engineering Ethics and Human Values.

Course Outcomes: The students will be able to

CO1. Gain the knowledge of human values in professional society.
CO2. Identify the core values that shape the ethical behavior of an engineer.
CO3. Enhance familiarity with codes of conduct, and responsibilities of engineers in professional society to ensure balanced outlook
CO4. Become aware of ethical concerns and conflicts.
CO5. Increase the ability to recognize and resolve ethical dilemmas.
CO6. Instill moral and social ethics and loyalty and to appreciate the rights of others.

HUMAN VALUES **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

ENGINEERING ETHICS **9**

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

GLOBAL ISSUES **9**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

Total Periods: 45

Text Books:

1. Mike Martin and Roland Schinzinger, 'Ethics in Engineering', McGraw Hill, New York, 2012.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, 'Engineering Ethics – Concepts and Cases', 6th Edition, Ray James, Elian Englehardt Wadsworth publishing co, 2013.

References:

1. Charles D Fleddermann, 'Engineering Ethics', Prentice Hall, New Mexico, 2012.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2013.

3. Edmund G Seebauer and Robert L Barry, 'Fundamentals of Ethics for Scientists and Engineers', Oxford University Press, 2013.
4. David Erman & Michele Shauf, 'Computers, Ethics and Society, Oxford University Press, 2012.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2					3			3		3	3				1
CO2	2					3			2		2	2	1			2
CO3	2	3	3	3							1					2
CO4								1				1	1			1
CO5											2					1
CO6	1								3	1	2	1				1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BAEE INTELLECTUAL PROPERTY RIGHTS L-T-P C

3-0-0 3

Programme: B.E. / B.Tech **Sem:** -- **Category:** **HS**

Aim: To provide an idea about IPR, registration and its enforcement.

Course Outcomes: The students will be able to

CO1. Gain the knowledge of Intellectual property rights in professional society.
CO2. Identify the process that shapes the registration of various categories of Intellectual Property Rights.
CO3. Enhance familiarity with agreements, and legislations of act relating to IPR.
CO4. Become aware of digital products and respective legislations.
CO5. Increase the ability of individuals to recognize and enforcing the legislations.
CO6. Provide an idea about IPR, registration and its enforcement.

INTRODUCTION **9**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

REGISTRATION OF IPRs **9**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

AGREEMENTS AND LEGISLATIONS **9**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

DIGITAL PRODUCTS AND LAW **9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

ENFORCEMENT OF IPRs **9**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

Total Periods: 45

Text Books:

1. S.V. Satarkar, 'Intellectual Property Rights and Copy Rights', ESS Publications, New Delhi, 2002.
2. Vinod V. Sople, 'Managing Intellectual Property', PHI Learning Pvt. Ltd, 4th Edition, 2014.

References:

1. Deborah E. Bouchoux, 'Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets', Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, 'Intellectual Property Rights: Unleashing the Knowledge Economy', McGraw Hill Education, 2011.
3. Derek Bosworth and Elizabeth Webster, 'The Management of Intellectual Property', Edward Elgar Publishing Ltd., 2013.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2					3		3			3	2				1
CO2					1	2					2					1
CO3						2		2				2				1
CO4	1				2	2				1						1
CO5											3					1
CO6						2		1	2		2					1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BAEF	WOMEN STUDIES AND WOMEN EMPOWERMENT	L-T-P	C
		3-0-0	3

Programme: B.E. / B.Tech **Sem:** -- **Category:** HS

Aim: To study the legal provisions for women and women's access to justice and also familiarize the students with the notion of gender and its operation in society.

Course Outcomes: The students will be able to

CO1. Gain knowledge in laws related to women's, rights protection.
CO2. Assist the students to look at stereotypical representation of women in the media and equip them to critique them.
CO3. Familiarize students with the specific cultural contexts of women in India.
CO4. Study the legal provisions for women and women's access to justice.
CO5. Familiarize with the notion of gender and its operation in society.
CO6. Be aware about work place related issues and discriminatory wages.

WOMEN'S STUDIES: AN INTRODUCTION **9**

Women's Studies -Definition, Scope and Controversies. Basic concepts of Women's Studies- Women's Studies perspectives- Gender: Perspectives-Gender sensitive approach- Gender and sex- Biological determinism- stereotyping- Socialization- Patriarchy- Devaluation- Marginalization- Silencing- Male Gaze- Power politics- Gynocriticism- Gender mainstreaming- Gender and work- Invisibility-Glass ceiling. Women's Studies in India.

LEGISLATION AND GENDER JUSTICE **9**

Women's rights as human rights, UN Conventions, Convention on the Elimination of all forms of Discrimination against Women (CEDAW), Millennium Development Goals (MDGs) - Women's Rights in the Indian Constitution, Fundamental Rights, Directive Principles- Protective legislation for women in the Indian constitution- Anti dowry, SITA, PNDT, and Prevention Sexual Harassment at Workplace (Visaka case), Domestic violence (Prevention) Act- Women's Rights to property, Uniform Civil Code, Property rights according to religions background Muslim, Christian.

FEMINIST THEORIES **9**

Early feminist thinkers- J.S Mill, Mary Wollstonecraft - Women's Movements before and during the world war.- Recent trends in feminist thinking- Masculinities, Eco-feminism, queer theory, transgender politics, Cyber feminism, Post-colonial - Different Schools of feminist through in the Indian contest- National and regional feminist thoughts.

GENDER AND MASS MEDIA **9**

Definition of gender, difference between sex and gender- Feminist terminology, stereotyping, patriarchy, silencing, margin alisation - Male Gaze, Feminist film criticism, thematic and semiotic analysis- Various forms of mass media. Print media, radio, visual, new media- internet, feminism and cyber space, texting, SMS and cell phone usage - Influence of media in society, patriarchy - in operation, use of feminist methods for - critiquing media representation, practice sessions.

WOMEN AND SOCIETY IN INDIA **9**

Women's position from Vedic times to the present, women participation in India's independence movement - Social construction of gender and gender roles – Socialisation - Women in family- Women in family- feminization of poverty, violence against women, empowerment measures - Women and environment- eco-feminist movements, women and globalization- women's labour, discriminatory wages, changing working conditions and work place related issues.

Total Periods: 45

Text Books:

1. Roberta Rosenberg, “Women’s Studies: An Interdisciplinary Anthology”, Peter Lang, 2001.
2. Jean Fox O'Barr, “Feminism in Action: Building Institutions and Community through Women's Studies”, University of North Carolina Press, 1994.

References:

1. Jill Duerr Berrick, “Faces of Poverty: Portraits of Women and Children on Welfare”, Oxford University Press, 1997.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1					3		3				2				1
CO2		1				3				3						1
CO3						3						2				1
CO4						3						2				1
CO5						3			2			2				1
CO6						3			2			2				1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

MANDATORY COURSES

191MC01	DESIGN THINKING	L-T-P	C
		2-0-0	0
Programme:	B.E., / B. Tech	**Category:**	MC

Aim: To impart knowledge on design thinking process for understanding complex designs and to provide design skills to analyze design thinking issues and apply the tools and techniques of design.

Course Outcomes: Students will be able to

CO1. Demonstrate knowledge of design thinking process
CO2. Recall design thinking techniques to design relevant products/services
CO3. Apply human centered design (HCD) methodology for product or service design.
CO4. Use ideation techniques for developing innovative products or services
CO5. Analyse the causes for the problems in the design of products or services
CO6. Perform the steps to gain practical knowledge of prototyping, testing and validation.

UNIT-I OVERVIEW OF DESIGN THINKING PROCESS 6

Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking, Problem solving, understanding design thinking and its process model, Design thinking tools. Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyze, Solve and Test.

UNIT-II EMPATHIZE 6

Design thinking phases, How to emphatize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user personas, customer journey mapping, How might we questions

UNIT-III SOLVE / IDEATE 6

Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications

UNIT-IV ANALYZE / DEFINE 6

Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling.

UNIT-V TEST (PROTOTYPING AND VALIDATION) 6

Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.

Total Periods 30

References

1. Dr. Bala Ramadurai, "Karmic Design Thinking", First Edition TRIZ Innovation India, 2020.
2. Karl T. Ulrich, “Design Creation of Artifacts in Society”, Trustees of the University of Pennsylvania Publisher, USA, 2011

3. Alma R. Hoffmann, “Sketching as Design Thinking”, Taylor & Francis, UK, 2019
4. Michael Lewrick, Patrick Link and Larry Leifer, “The Design Thinking Playbook”, Wiley, USA, 2018.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1					1				1	2				3
CO2		1		1							2	1				3
CO3	1			1							2	1				3
CO4	1	2		1							2	1				3
CO5	1	2		2							2	1				3
CO6	1						1				1	1				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191MC02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L-T-P	C
		2-0-0	0

Programme: B.E., / B. Tech **Category:** MC

Aim: To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

Course Outcomes: Students will be able to

CO1. Identify the concept of Traditional knowledge and its importance
CO2. Explain the need and importance of protecting traditional knowledge.
CO3. Illustrate the various enactments related to the protection of traditional knowledge.
CO4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
CO5. Identify the importance of conservation and sustainable development of environment
CO6. Explain the importance of Traditional knowledge in Agriculture and Medicine.

UNIT-I INTRODUCTION TO TRADITIONAL KNOWLEDGE 6

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

UNIT-II PROTECTION OF TRADITIONAL KNOWLEDGE 6

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT-III LEGAL FRAME WORK AND TRADITIONAL KNOWLEDGE 6

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act);
The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.

UNIT-IV TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY 6

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT-V TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS 6

Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Total Periods 30

References

1. Amit Jha, “Traditional Knowledge System in India”, 2009.
2. Basanta Kumar Mohanta, Vipin Kumar Singh, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan 2012.
3. Amit Jha, “Traditional Knowledge System in India”, Atlantic publishers, 2002
4. Kapil Kapoor, Michel Danino, "Knowledge Traditions anSd Practices of India"

E-Resources:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1										1		1				1
CO2										1		1				1
CO3										1		1				1
CO4										1		1				1
CO5										1		1				1
CO6										1		1				1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191MC03	**INDIAN CONSTITUTION**	**L-T-P**	**C**
		2-0-0	**0**
Programme:	B.E., / B. Tech	**Category:**	**MC**

Aim: To understand the importance of Indian constitution, Administration, Concept and Development of Human Rights, election commission.

Course Outcomes: Students will be able to

CO1. Know the sources, features and principles of Indian Constitution.
CO2. Learn about Union Government and its administration.
CO3. Learn about State government and its administration.
CO4. Get acquainted with Local administration and Panchayat Raj
CO5. Be aware of basic concepts and developments of Human Rights.
CO6. Gain knowledge on roles and functioning of Election Commission.

UNIT-I INTRODUCTION TO INDIAN CONSTITUTION 6

Constitution' meaning of the term, Indian Constitution- Sources and constitutional history, Features- Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II UNION GOVERNMENT AND STATE GOVERNMENT 6

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;

State Government and its Administration

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT-III LOCAL ADMINISTRATION AND PACHAYAT RAJ 6

Local Administration District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation,

Panchayat 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.

UNIT-IV CONCEPT AND DEVELOPMENT OF HUMAN RIGHTS 6

Meaning Scope and Development of Human Rights, United Nations and Human Rights – UNHCR, UDHR 1948, ICCPR 1996 and ICESCR 1966, Human Rights in India: Protection of Human Rights Act, 1993 - (NHRC and SHRC), First, Second and Third Generation Human Rights, Judicial Activism and Human Rights.

UNIT-V ELECTION COMMISSION 6

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

Total Periods 30

References

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4E, 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government and Politics Hans
7. J. Raj Indian Government and Politics
8. M.V. Pylee, Indian Constitution
9. Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd. New Delhi
10. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-Resources:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1						2				2		3				1
CO2						2				3		3				1
CO3						2				3		3				1
CO4						2				3		3				1
CO5						2				4		3				1
CO6						2				3		3				1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191MC04 UNIVERSAL HUMAN VALUES L-T-P C
2-0-0 0

Programme: B.E., / B. Tech **Category: MC**

Aim: To facilitate the competence to understand the harmony in nature/existence and participation of human being in the nature/existence.

Course Outcomes: Students will be able to

CO1. Ensure the clarity about human aspirations, goal, activities and purpose of life.
CO2. Develop the understanding of human tradition and its various components.
CO3. Critically evaluate their preconditioning and present beliefs.
CO4. Begin with, and then to continue within the student leading to continuous self- evolution.
CO5. Verify the truth or reality in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
CO6. Set do's and don'ts related to values.

UNIT-I INTRODUCTION 6

The basic human aspirations and their fulfillment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.

UNIT-II UNDERSTANDING HUMAN BEING AND ITS EXPANSION 6

The domain of right understanding starts from understanding the human being (the knower, the experience and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).

UNIT-III ACTIVITIES OF THE SELF 6

Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self.

UNIT-IV UNDERSTANDING CO-EXISTENCE WITH OTHER ORDERS 6

The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

UNIT-V EXPANSION OF HARMONY FROM SELF TO ENTIRE EXISTENCE 6

Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.

Total Periods 30

References

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Sangal, G. P. Bagaria (2010), Excel Books, New Delhi [ISBN 978-8-174-46781-2]
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
3. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
4. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA
5. Ishandi Nau Upnishad, Shankaracharya, Geeta press, Gorakhpur,
6. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
7. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1						2		2		2		3				1
CO2						2		2		3		3				1
CO3						2		1		3		3				1
CO4						2		2		3		3				1
CO5						2		2		4		3				1
CO6						2		2		3		3				1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191MC05	YOGA	L-T-P	C
		2-0-0	0

Programme: B.E., / B. Tech **Category:** MC

Aim: To promote positive health, prevention of stress related health problems and rehabilitation through Yoga.

Course Outcomes: Students will be able to

CO1. Know about the history and evolution of Yoga**.**
CO2. Practice skills in Yoga for health.
CO3. Find out the habits to ensure mental and emotional balance.
CO4. Demonstrate basic skills associated with yoga activities including strength and flexibility, balance and coordination.
CO5. Demonstrate the ability to perform yoga movements in various combination and forms.
CO6. Demonstrate the ability to create and present various yoga sequences.

UNIT-I FOUNDATIONS OF YOGA 5

Origin of Yoga, History and Development of Yoga; Etymology and Definitions, Misconceptions, Aim and Objectives of Yoga, True Nature and Principles of Yoga.

UNIT-II YOUTH AND YOGA 5

Youth and yoga- yoga as a tool for healthy lifestyle, Yoga as a preventive, promotive and curative method. Pranayama and Different Yoga traditions and their impacts.

UNIT-III ROLE OF YOGA IN PREVENTIVE HEALTH CARE 5

Role of Yoga in preventive health care – Yoga as a way of life, Heyam dukham anagatam; Potential causes of Ill-health: Tapatrayas and Kleshas, Physical and Physiological manifestation of Disease: Vyadhi, Alasya, Angamejayatva and Ssvasa-prashvasa.

UNIT-IV METHODS OF TEACHING YOGA 5

Teaching and Learning: Concepts and Relationship between the two; Principles of Teaching: Levels and Phases of Teaching, Quality of perfect Yoga Guru; Yogic levels of learning, Vidyarthi, Shishya, Mumukshu; Meaning and scope of Teaching methods, and factors influencing them; Sources of Teaching methods;

UNIT-V ASAN AND PRANAYAM 10

Asan and Pranayam:

- Various yog poses and their benefits for mind & body
- Regularization of breathing techniques and its effects
- Different Phases in Pranayama Pracice:
  - Puraka (Inhalation), Kumbhaka (Retension) and Recaka (Exhalation)
  - Breathing Ratio in Pranayama Practice
  - Application of Bandhas in Pranayama
  -

Total Periods 30

References

1. Yogic Asanas for Group Tarining-Part-I", Janardan Swami Yogabhyasi Mandal, Nagpur.

2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature" Advaita Ashrama Publication, Kolkata.
3. Silva Mehta, Mira Mehta and Shyam Mehta, "Yoga: The Iyengar Way", Knopp publication, 1990.
4. Vishnu-Devananda, "The Complete Illustrated Book of Yoga", 1995.
5. Timothy McCall, "Yoga as Medicine: The Yogic Prescription for Health and Healing", Harmony, 2007.
6. Hathayoga Pradipika of Swatmarama - Kaivalyadhama, Lonavala
7. The Science of Yoga - Taimini - Theosophical Publishing House, Adyar, Madras

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1												3				1
CO2												3				1
CO3												3				1
CO4												3				1
CO5												3				1
CO6												3				1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)