NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF

ELECTRICAL ANDELECTRONICS ENGINEERING

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM AND SYLLABI

REGULATION 2021

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION
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Regulation : 2021

Curriculum and Syllabi

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Faculty of Electrical Engineering

Department of Electrical and Electronics Engineering

Vision of the Department

To evolve into a nationally recognized department in the frontier areas of Electrical and Electronics Engineering and to be recognized by the government and society at large and by the industry and commerce in particular as an institution able to deliver excellence with relevance in the field of technical education focusing on the needs of the nation in tune with the technological revolution.

Mission of the Department

To produce Electrical and Electronics Engineering graduates having professional excellence, to provide technical support to budding entrepreneurs and existing industry and to Develop the

institution as a centre of Excellence , keeping pace with advances in the field, so as to provide quality higher Education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Programme Educational Objectives – PEO	
PEO-01	Technically competent and successful Electrical and Electronics Engineers with their strong educational foundations such as designing, planning, installing, maintaining and servicing the electrical equipmentsto meet the demands of industry academia, and public service.
PEO-02	Engineers with their creative mindset, provide innovative solutions for the problems of the real world.
PEO-03	Empowered with leadership qualities and ethical values have concern for society and sustainable environment.
PEO-04	To indoctrinate an attitude in the graduates for life- long learning process
PEO-05	To train graduates in technical communication and Interpersonal skills in multidisciplinary teams for success in their professional life.

Graduate	
GA-1	**Innovative Engineering Solutions** Develop creative and innovative solutions to complex engineering problems, incorporating the latest technologies and approaches to address current and future challenges.
GA-2	**Global Perspective in Engineering** Understand and apply engineering solutions in a global context, recognizing the diversity of global issues, standards, and the impact of engineering decisions on different cultures and communities.
GA-3	**Sustainable Development and Green Engineering** Design and implement engineering solutions that prioritize sustainability, resource efficiency, and environmental protection, contributing to a sustainable future.
GA-4	**Social Responsibility and Community Engagement** Demonstrate a commitment to social responsibility by engaging with and contributing to local communities, understanding societal needs, and addressing social challenges through engineering
GA-5	**Adaptability and Lifelong Learning** Exhibit a proactive approach to continuous learning and adaptability, keeping pace with technological advancements and industry changes, and engaging in professional development activities.
GA-6	**Entrepreneurship and Innovation** Foster an entrepreneurial mindset, identifying opportunities for innovation and creating value through new technologies, products, and processes that meet market needs.
GA-7	**Interdisciplinary Collaboration** Work effectively in interdisciplinary teams, integrating knowledge from various fields to develop comprehensive solutions to

GA-8	**Ethical Leadership and Integrity** Lead with integrity and ethical principles, ensuring transparency, fairness, and respect in all professional and personal
GA-9	**Digital and Data Literacy** Utilize advanced digital tools and data analytics techniques to solve engineering problems, optimize processes, and make informed
GA-10	**Safety, Health, and Risk Management** Prioritize safety, health, and risk management in engineering practices, ensuring the well-being of individuals and communities while minimizing potential risks and hazards.
GA-11	**Effective Communication and Negotiation Skills** Communicate ideas, solutions, and technical information effectively to a variety of audiences, and engage in negotiation to resolve conflicts and reach consensus.
GA-12	**Impact Assessment and Policy Making** Assess the impact of engineering projects on society and the environment, and contribute to policy-making processes that promote sustainable and responsible engineering practices.

Programme Outcome – PO	
PO-A	Graduates are capable to apply the knowledge of mathematics, science, engineering fundamentals to the real-world applications.
PO-B	Graduates are able to identify, formulate and solve engineering problems.
PO-C	Graduates are able to design electrical and electronic circuits and conduct experiments with electrical systems, analyze and interpret data.
P0-D	Graduates are able to understand different kinds of complex problem solving methods through the imparted domain knowledge.
PO-E	Graduates are capable to design an ICT based system for optimal analysis of systems.
PO-F	Graduates are able to apply contextual knowledge to assess social, health, safety and cultural issues and endure the consequent responsibilities relevant to professional engineering practice.
PO-G	Graduates are able to utilize core engineering knowledge in a global, economic, environmental, and societal context for sustainable development.
PO-H	A Graduate understands the responsibility of taking professional decisions based on the impact of socio-techno- economical issues
PO-I	Graduates develop their skill to function effectively as an individual or a team member or a leader to accomplish a common goal in a multi disciplinary team
PO-J	Graduates are able to communicate effectively

PO-K	Graduates are capable to apply engineering and management principles for the development of projects.
PO-L	Graduates develop their confidence for self education and ability for life-long learning.

Mapping of Graduate Attributes and Programme Educational Objectives

GAs / PEOs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10	GA-11	GA-12
PEO-1	H	A	A	A	A	Not	A	A	A	A	A	A
PEO-2	A	H	A	A	A	A	A	A	A	A	A	A
PEO-3	A	A	A	H	A	A	A	A	A	A	A	A
PE0-4	A	H	H	H	A	A	A	A	A	A	A	A
PEO-5	A	A	H	H	A	A	A	A	A	A	A	A

H- Highly Associated A- Associated Not – Not Associated

Mapping of Graduate Attributes and Programme Outcomes (PO)

GAs / PEOs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10	GA-11	GA-12
PO-A	H	H	A	A	A	A	H	Not	H	Not	A	A
PO-B	H	H	A	A	A	A	H	Not	H	Not	A	A
PO-C	H	H	H	H	H	A	H	Not	H	Not	A	A
P0-D	H	H	A	A	H	H	H	Not	A	Not	A	A

PO-E	A	A	A	A	A	H	A	Not	A	Not	Not	Not
PO-F	Not	H	A	A	A	A	H	H	Not	H	H	H
PO-G	H	H	H	H	A	H	A	H	Not	H	H	H
PO-H	A	H	H	H	H	H	A	H	Not	H	A	H
PO-I	A	A	A	A	H	H	H	H	A	H	H	H
PO-J	Not	Not	Not	Not	Not	H	H	H	Not	H	H	H
PO-K	H	A	H	H	H	H	H	H	H	A	A	A
PO-L	H	A	A	A	H	H	H	H	H	A	A	A

H- Highly Associated A- Associated Not – Not Associated

Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

PEO / PO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05
PO-A	H	A	Not	A	A
PO-B	H	H	Not	A	A
PO-C	H	A	Not	A	A
P0-D	H	A	Not	A	A
PO-E	A	A	A	A	A

PO-F	A	A	H	A	A
PO-G	A	H	A	A	A
PO-H	A	A	H	A	A
PO-I	A	A	H	A	H
PO-J	A	A	H	A	H
PO-K	A	H	A	A	A
PO-L	A	A	H	H	A

H- Highly Associated A- Associated Not – Not Associated

Duration of the Programme: 4 years/ 8 Semesters
Total credit : 165

CURRICULUM & SYLLABI

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	EG3101	Technical English	3	1	0	4
2.	MA3101	Engineering Mathematics – I	3	1	0	4
3.	BS3101	Engineering Physics	3	0	0	3
4.	BS3102	Engineering Chemistry	3	0	0	3
5.	CS3101	Fundamentals of Computing and Python Programming	3	0	0	3
PRACTICALS						
6.	CS3171	Fundamentals of Computing and Python Programming Laboratory	0	0	4	2
7.	BS3171	Physics and Chemistry Laboratory	0	0	4	2
TOTAL			**15**	**2**	**8**	**21**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	EG3102	Communicative English	3	0	0	3
2.	MA3102	Engineering Mathematics – II	3	1	0	4
3.	BE3101	Basic Electrical and Electronics Engineering	3	0	0	3
4.	BE3102	Basic Civil and Mechanical Engineering	3	0	0	3
5.	ME3101	Engineering Graphics	3	0	2	4
PRACTICALS						
6.	BE3171	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7.	BE3172	Basic Civil and Mechanical Engineering Laboratory	0	0	2	1
TOTAL			**15**	**1**	**6**	**19**

SEMESTER III

L. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA3201	Engineering Mathematics - III	3	1	0	4
2.	EE3201	Analog Electronics	3	0	0	3
3.	EE3202	Electric circuit Analysis	3	0	0	3
4.	EE3204	Electrical Machines - I	3	0	0	3
5.	EE3205	Electro Magnetic Theory	3	0	0	3
6.	ME3201	Engineering Mechanics	3	0	0	3
PRACTICAL						
7.	EE3271	Analog Electronics Laboratory	0	0	2	1
8.	EE3273	Electrical Machines Laboratory - I	0	0	2	1
9.	ME3274	Mechanical Engineering Laboratory	0	0	2	1
TOTAL			**18**	**1**	**6**	**22**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA3203	Numerical Methods	3	0	0	3
2.	BS3201	Environmental Studies	2	0	0	2
3.	EE3206	Digital Electronics	3	0	0	3
4.	EE3207	Electrical Machines - II	3	0	0	3
5.	EE3208	Power Electronics	3	0	0	3
6.	EE3209	Transmission, Distribution and Cables	3	0	0	3
PRACTICAL						
7.	EE3274	Digital Electronics Laboratory	0	0	2	1
8.	EE3275	Electrical Machines Laboratory - II	0	0	2	1
9.	EE3276	Power Electronics Laboratory	0	0	2	1
10.	EE32P1	Summer Internship-I	0	0	0	2
TOTAL			**17**	**0**	**6**	**22**

SEMESTER -V

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MS3201	Professional and Business Ethics	2	0	0	2
2.	EE3212	Protection and Switchgear	3	0	0	3
3.	EE3213	Control systems	3	1	0	4
4.	CS3212	Microprocessor and Microcontroller	3	0	0	3
5.	EE3214	Power System I	3	0	0	3
6.	EE32**	Elective-I	3	0	0	3
PRACTICAL						
7.	CS3278	Microprocessor and Microcontroller Laboratory	0	0	2	1
8.	EE3280	Control System Laboratory	0	0	2	1
9.	EE3281	Power System Laboratory I	0	0	2	1
TOTAL			17	1	6	21

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	AI32D1**(OE)**	Fundamentals of Artificial Intelligence	3	0	0	3
2.	EE3215	Measurement and Instrumentation	3	0	0	3
3.	EE3216	Power System II	3	0	0	3
4.	EE3217	Solid State Drives	3	0	0	3
5.	EE32**	Elective-II	3	0	0	3
6	EE32**	Elective-III	3	0	0	3
PRACTICAL						
7.	EE3283	Measurement and Instrumentation Laboratory	0	0	2	1
8.	EE3284	Power system Laboratory II	0	0	2	1
9.	EE3285	Electronic Design Laboratory	0	0	2	1
10.	EE32P2	Summer Internship II	0	0	0	2
TOTAL			17	0	6	23

SEMESTER VII

SL. NO.	COURSECODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MS3202	Principles of Management	2	0	0	2
2.	EE3219	Design of Electrical Apparatus	3	1	0	4
3.	EE3220	Electrical Energy Generation, Utilization and Conservation	3	0	0	3
4.	EE32**	Elective-IV	3	0	0	3
5.	EE32**	Elective-V	3	0	0	3
6.	CS32D2**(OE)**	Renewable Energy Systems	3	0	0	3
PRACTICAL						
6.	EE3286	Electrical Wiring and Winding Laboratory	0	0	2	1
7.	EE32P3	Project Stage I	0	0	8	4
TOTAL			16	1	10	22

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	EE32**	Elective –VI	3	0	0	3
2.	EE32**	Elective-VII	3	0	0	3
PRACTICAL						
4.	EE32P5	Project Work	0	0	16	8
TOTAL			6	0	16	14

PROGRAM ELECTIVES

SI. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	EE32A1	Special Electrical Machines	3	0	0	3
2.	EE32A2	Bio Medical Instrumentation	3	0	0	3
3.	EE32A3	High Voltage Direct Current Transmission	3	0	0	3
4.	EE32A4	High Voltage Engineering	3	0	0	3
5..	EE32A5	Power Quality	3	0	0	3
6.	EE32A6	Power System Operation and Control	3	0	0	3
7..	EE32A7	Smart Grid	3	0	0	3

LIST OF ELECTIVES

SI. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	EE32A8	Advanced Control System	3	0	0	3
2.	EE32A9	Modern Power Converters	3	0	0	3
3.	EE32B1	Computer Aided Design of Electrical Apparatus	3	0	0	3
4.	EE32B2	Digital Signal Processing	3	0	0	3
5.	EE32B3	Flexible AC Transmission Systems	3	0	0	3
6.	EE32B4	Principles of Robotics	3	0	0	3
7.	EE32B5	Power Plant Engineering	3	0	0	3
10.	EE32B6	Sustainable and Environmental Friendly HV insulation System	3	0	0	3
11.	EE32B7	Electric Vehicle Architecture	3	0	0	3
12.	EE32B8	Adaptive Control	3	0	0	3
13.	EE32B9	IOT for Electrical Engineering	3	0	0	3

14.	EE32C1	Electrical Safety Engineering	3	0	0	3
15.	EE32C2	Generation of Electrical Energy	3	0	0	3
16.	EE32C3	Soft Computing tools for Electrical Engineering	3	0	0	3
17.	EE32C4	Restructured Power Systems	3	0	0	3
18.	EE32C5	Industrial Electrical Systems	3	0	0	3
19.	CS3214	Cloud Computing Techniques	3	0	0	3
21	CS3215	Cyber Security	3	0	0	3
23.	CS3216	Big Data Analytics	3	0	0	3
24..	AI3205	Internet of Things	3	0	0	3

DETAILED SYLLABUS

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3101	Technical English	3	1	0	4
2.	MA3101	Engineering Mathematics – I	3	1	0	4
3.	BS3101	Engineering Physics	3	0	0	3
4.	BS3102	Engineering Chemistry	3	0	0	3
5.	CS3101	Fundamentals of Computing and Python Programming	3	0	0	3
PRACTICAL						
6.	CS3171	Fundamentals of Computing and Python Programming Laboratory	0	0	4	2
7.	BS3171	Physics and Chemistry Laboratory	0	0	4	2
TOTAL			**15**	**2**	**8**	**21**

EG3101	**Technical English**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES

- To develop the linguistic, communicative and critical thinking competencies of FirstYear Engineering students
- To enhance the understanding of the complex grammatical structures of the English language to students
- To improve the language proficiency of students in English with emphasis onVocabulary, Grammar, Listening, Speaking, Reading, and Writing skills
- To introduce the students to the basic phonetics of English and make them grasp the various sounds of the English language to improve their pronunciation

Course Outcome		Cognitive Skill
CO-01	The students will be able to improve their vocabulary relating to Engineering and Technology, and use articles and prepositions effectively in sentences.	R
CO-02	The students will be able to learn grammatical items like tense, voice, compound nouns etc. and thereby enhance their linguistic competence.	U
CO-03	The students will be able to learn definitions of technical terms, relative pronouns etc. which will develop their language competence.	A
CO-04	The students will be able to acquire the essentials of writing skills relating to CV, Resume, Formal and Business Letters.	U
CO-05	The students will be able to learn English phonemes such as Vowels, Diphthongs and Consonants which will be instrumental in improving their pronunciation and speaking skills.	R

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO -A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G	PO -H	PO - I	PO -J	PO -K	PO--L	PO -M
CO-01	S	M	S	M	S	M	S	M	L	S	S	M	L
CO-02	M	S	M	S	N	L	M	S	M	S	S	S	N
CO-03	S	S	S	M	S	S	M	S	M	S	M	M	S
CO-04	M	S	S	S	S	S	S	M	S	M	M	S	M
CO-05	S	L	S	M	S	M	M	S	M	M	S	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: **9**

Word formation with prefixes and suffixes– Articles – Conjunctions – Prepositions – Expansion of Abbreviations and Acronyms – Writing Checklists – Writing Instructions.

Unit II: **9**

Tense – Voice – Punctuation – Expansion of Compound Nouns – Writing Recommendations – Paragraph Writing – Types, Structures and Features of a Paragraph – Creating Coherence-– Organizing Principles of Paragraphs in Documents.

Unit III: **9**

Discourse Markers – Gerunds and Present Participles – Relative Pronouns – Conditional Clauses – Definitions of Technical Terms – Transcoding : Bar Chart - Flow Chart - Pie Chart-Tree Diagram - Tabular Column.

Unit IV: **9**

Concord – Clauses – Phrases – Numerical Adjectives – CV/Resume Writing – Virtual Communication**:** E-Mail Writing – Essay Writing : Basic Format of an Essay - Types – Examples.

Unit V: **9**

Basic Phonetics **:** Phonemes – Vowels, Diphthongs and Consonants – Classification **:** Pure Vowels/Monophthongs – Vowel Glides /Diphthongs.

TOTAL: L: 45 + T: 15 = 60 HOURS

TEXT BOOK

1. Khaleel Rahuman A., Deepa P., Sheila J., Mathi Vathani J. , *Technical English*, R. K. Publishers, 2023.
2. Shiv Khera, You Can Win, Milan, Delhi, 2004

REFERENCES

1. Nagarajan S., Senthil C. S., Engineering English I & II, Sri Krishna Publications,2004.
2. Jewelcy Jawahar , Rathna P., English Work Book for First Year B.E./ B.Tech., VRB Publishers, Chennai, 2008.

MA3101	Engineering Mathematics - I	L	T	P	C
		3	1	0	4

OBJECTIVES

The course objective is to develop the required skill of the students in the area of Engineering Mathematics with special emphasis on the characteristic equation of matrices, differential calculus, Beta and Gamma functions and to develop basic knowledge to the students in double and triple integration.

Course Outcome		CognitiveSkill
CO-01	Understand the characteristic equation and find eigen values and eigenvector of a real matrix. Compute the eigen value and eigen vector using properties. Verify Cayley Hamilton theorem and its applications.Apply orthogonal transformation of a symmetric matrix.	U, A
CO-02	Define the definitions and formula for curvature, radius of curvature, circle of curvature. Apply the formula and solve problems using the required formulas also find the evolute of the curves.	U, A
CO-03	Know about the differentiation formulae and apply on partial derivatives, total derivatives and Jacobians. Verify the functions be maximum or minimum and Lagrange‟s multiplier method. Express the Taylor‟sexpansion for two variables.	U, A

CO-04	Know the Fundamental concepts of improper integrals, Beta and gammafunction and their properties. Develop the skill in the relation between Beta and Gamma Functions. Calculate definite integral values using Beta and Gamma Functions.	U, A
CO-05	Evaluate the double and multiple integrals and can apply theseconcepts to find areas of regions on a plane or in space.Graph Cartesian and polar equations. Convert Cartesian coordinates intopolar coordinates.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO -A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G	PO -H	P - I	PO - J	PO -K	PO - L	PO - M
CO-01	S	M	S	M	S	M	S	M	L	S	M	M	L
CO-02	M	S	M	S	N	L	M	S	M	S	S	S	M
CO-03	S	S	S	M	S	M	M	S	M	S	M	M	S
CO-04	M	S	S	S	S	S	S	M	S	M	M	S	M
CO-05	S	L	S	M	S	M	M	S	M	M	S	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Matrices **9**

Characteristic Equation – Eigen Values and Eigen Vectors of a Real Matrix – Properties of Eigen Values and Eigen Vectors(without proof)– Cayley Hamilton Theorem (statement only), verification and its Applications – Orthogonal and Symmetric Matrices and their roperties(excluding proof)- Orthogonal Transformation of a Symmetric Matrix to Diagonal Form.

Unit II: Differential Calculus **9**

Curvature – Cartesian Co-ordinates and Parametric Form -Centre and Radius of Curvature, Circle of Curvature – Evolutes.

Unit III: Functions of Several Variables **9**

Partial Derivatives – Total Derivatives – Jacobians – Properties – Maxima and Minima for Functions of Two Variables–Lagrange Multiplier Method- Taylor‟s Expansion.

Unit IV: Improper Integrals **9**

Evaluation of Improper Integrals- Beta And Gamma Functions – Properties – Relation Between Beta and Gamma Functions - Evaluation of Integrals Using Beta and GammaFunctions**.**

Unit V: Multiple Integrals **9**

Evaluation of Double and Triple integrals – Area Enclosed by Plane Curves as DoubleIntegral in Cartesian and Polar co-ordinates– Change of Order of Integration- Transformation of Cartesian Coordinates into Polar Coordinates.

TOTAL: L: 45 + T: 15 = 60 HOURS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics"- 40th Edition , Khanna Publishers,Delhi 2007.

REFERENCES

1. M.Immaculate Mary , K.Uma Samundesvari , K.R.Sobha," Engineering Mathematics
2. I" First Edition ,Anuradha Publications, 2013.
3. Veerarajan T, " Engineering Mathematics (for first year)", Fourth Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi , 2007.
4. Erwin Kreyszig, " Advanced Engineering Mathematics", Seventh Edition, Wiley India, 2007.
5. P.Kandasamy , K.Thilagavathy , K.Gunavathy" Engineering Mathematics" Vol.1 S.Chand & Company Ltd.2002.
6. B.V. Ramana,"Higher Engineering Mathematics" Second Edition Tata McGraw- Hill, Publishing Company Ltd.,New Delhi, 2006 .

BS3101	**Engineering Physics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

The course objective is to provide basic ideas about the principles of physics related toproperties of matter, wave optics, heat, quantum concepts and materials. engineering problems.

	Course Outcome	**Cognitive Skill**
CO-01	Students will be able to understand and apply knowledge about theproperties of materials.	R,U,A
CO-02	Students will be able to understand the types of oscillations and the wave nature of light in interference, diffraction and polarization phenomenon.	R,U,A,E
CO-03	Students will be able to state and explain the various laws of thermodynamics, understand entropy and its application.	R,U,A,An, ,E
CO-04	Students gain basic knowledge about quantum mechanics and will be able to solve time dependent and time independent Schrodinger equation for simple potentials.	R,U,A,E,S
CO-05	Students will be able to know the different types of crystal structures and also gain basic knowledge about nanomaterials and biomaterials.	R,U,A,E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO E	PO -F	PO-G	PO-H	PO -I	PO -J	PO-K	PO–L	PO M
CO-01	S	S	S	S	M	S	M	L	S	M	M	L	S
CO-02	S	S	S	M	L	M	S	M	S	S	S	M	S
CO-03	S	S	S	S	M	M	S	M	S	M	M	S	S
CO-04	S	M	S	S	S	S	M	S	M	M	S	M	M
CO-05	S	S	M	M	M	M	S	M	M	S	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Properties of Matter **9**

Elasticity – Poisson‟s Ratio – Stress-Strain Diagram – Factors Affecting Elasticity – Bending of Beams – Cantilever Depression – Young‟s Modulus- Theory and Experiment of Young‟s Modulus Determination (Uniform and Non-Uniform Bending) –Shear Modulus – Twisting Couple – Hollow Cylinder – Torsion Pendulum – Determination of Rigidity Modulus - Bulk Modulus - Applications of Elastic Behaviours of Materials.

Unit II: Oscillations and Wave optics **9**

Oscillations - Rectilinear Motion - Oscillations or Vibrations - Simple Harmonic Motion - Damped Harmonic Motion - Real Oscillatory System - Forced or Driven Oscillation.Wave Optics - Interference of Light – Photons - Young's Double Slit Experiment - Huygens's Principle - Diffraction - Diffraction Grating - Polarization.

Unit III: Thermal Physics **9**

Transfer of Heat Energy (Conduction, Convection and Radiation) - Thermal Expansion Of Solids And Liquids – Expansion Joints – Bimetallic Strips-Thermal Conductivity- Forbe‟sand Lee‟s Disc Methods (Theory And Experiment)- Thermal Insulation In Buildings -Laws Of Thermodynamics- Heat Exchanger -Solar Power- Applications of Solar Power (Solar Water Heater, Photo Voltaic Cell).

Unit IV: Quantum Physics **9**

Matter Waves- De-Broglie Wavelength - Schrodinger‟s Wave Equation-Time Independentand Time Dependent Equations- Physical Significance of Wave Function- Uncertainty Principle and Its Application- Energy and Momentum Operators-Particle n a One Dimensional Box- Scanning Electron Microscope- Transmission Electron Microscope- Scanning Tunnelling Microscope.

Unit V: Material Physics **9**

Single Crystalline, Polycrystalline and Amorphous Materials- Single Crystals: Unit Cell, Crystal Systems, Bravais Lattices, Directions and Planes in a Crystal, Miller Indices – Inter Planar Distances. Introduction and Applications of Metallic Glasses, Shape Memory Alloys (SMA), Nanomaterials, Biomaterials.

TOTAL: 45 HOURS

TEXT BOOKS

1. Engineering Physics I by Bindhu B, Sagi Rani C, Meenadevi V N, Ganapathi RamanR, RK Publishers 2015.
2. Engineering Physics II by Bindhu B, Geetha Kumari R, SugirthaSuni N Y, RK Publishers 2016.
3. Engineering Physics by R K Gaur And S L Gupta, DhanpatRai Publications 2011.
4. A Text Book Oscillations, Waves & Acoustics by Dr. M. Gosh, Dr. D. Battacharya, S. Chand, Revised Edition.

REFERENCES:

1. Engineering Physics by Rajendran V, McGraw-Hill, New Delhi, 2013
2. Engineering Physics by Arumugam M, Anuradha Publications, 2014.
3. Principles of Physics by Halliday D, Resnick R and Walker J, Wiley 2015.
4. Physics for scientist and Engineers by Serway R A and Jewett J W, Cengage Learning2010.
5. Engineering Physics by Bhattacharya D K and Poonam T, Oxford University Press2015.
6. Engineering Physics by Pandey B K and Chaturvedi,Cengage Learning India 2022.

BS3102	**Engineering Chemistry**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

To make the students conversant with the principles of the following topics:(i) Use of free energy in chemical equilibria(ii) Water chemistry (iii) Periodic properties (iv) Spectroscopic techniques and applications and (v) Organic reactions and synthesis of a drug molecule.

Course Outcome		**CognitiveSkill**
CO-01	Students will be able to access the quality and utility of suitable water forindustrial as well as domestic applications.	U&A
CO-02	To develop awareness and usage of conducting polymers as anengineering material.	U&A
CO-03	To understand the uses of various fuels in economic way..	U
CO-04	To identify the electrolytic cell and electrochemical cells with differenttypes of batteries.	An &A
CO-05	To get basic knowledge about thermodynamically aspects and itsapplications to engineering.	U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO A	PO -B	PO C	PO D	PO -E	PO -F	PO G	PO H	PO -I	PO -J	PO K	PO L	PO M
CO-01	S	S	S	S	S	M	S	S	S	S	S	S	S
CO-02	S	S	S	S	M	M	S	S	S	S	S	S	S
CO-03	S	S	S	S	S	S	S	S	S	S	S	S	S
CO-04	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-05	S	S	S	S	S	M	S	S	S	M	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Use of Free Energy in Chemical Equilibria 9

Thermodynamic Functions: Energy, Entropy and Free Energy. Estimations of Entropy and Free Energies. Free Energy and EMF. Cell Potentials, The Nernst Equation and Applications. Acid Base, Oxidation Reduction and Solubility Equilibria. Corrosion. Use of Free Energy Considerations in Metallurgy Through Ellingham Diagrams.

Unit II: Water Chemistry 9

Water as a Universal Solvent – Hard and Soft Water – Reasons for Hardness – Disadvantages of Hard Water in Washing and Industrial Purposes - Estimation of Hardness by EDTA Method, Problems; Boiler Feed Water – Characteristics- Softening Methods - External Conditioning – Demineralization (Ion Exchange) Process, Desalination by Reverse Osmosis Method- Internal Conditioning (Phosphate, Calgon and Carbonate Conditioning Methods); Stages in Domestic Water Treatment – Disinfection by Chlorination, Ozone and UV Treatments.

Unit III: Periodic Properties 9

Effective Nuclear Charge, Penetration of Orbitals, Variations of S, P, D And F OrbitalEnergies of Atoms in the Periodic Table, Electronic Configurations, Atomic and Ionic Sizes, Ionization Energies, Electron Affinity and Electronegativity, Polarizability, Oxidation States, Coordination Numbers and Geometries, Hard Soft Acids and Bases, Molecular Geometries.

Unit IV: Spectroscopic Techniques And Applications 9

Principles of Spectroscopy and Selection Rules. Electronic Spectroscopy. Fluorescence and Its Applications in Medicine. Vibrational and Rotational Spectroscopy of Diatomic Molecules. Applications. Nuclear Magnetic Resonance and Magnetic Resonance Imaging, Surface Characterisation Techniques. Diffraction and Scattering.

Unit V: Organic Reactions and Synthesis of A Drug Molecule **9**

Introduction to Reactions Involving Substitution, Addition,Elimination, Oxidation, Reduction, Cyclization and Ring Openings. Synthesis of a Commonly used Drug Molecule.

TOTAL: 45 HOURS

TEXT BOOKS

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.

CS3101	Fundamentals of Computing and Python Programming	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples,dictionaries.
- To do input/output with files in Python.

Course Outcome		Cognitive Skill
CO-01	To know the basics of algorithmic problem solving	U & A
CO-02	To read and write simple Python programs	A
CO-03	To develop Python programs with conditionals and loops	U & A
CO-04	To define Python functions and call them	U & A
CO-05	To use Python data structures –- lists, tuples, dictionaries. To do input/output with files in Python	U & A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	S	S	M	S	S	S	S	S	S	S
CO-02	S	S	M	S	M	M	S	S	S	S	S	S	S
CO-03	S	S	M	S	S	S	S	S	S	S	S	S	S
CO-04	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-05	S	S	S	S	S	M	S	S	S	M	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Algorithmic Problem Solving **9**

Algorithms, Building Blocks of Algorithms (Statements, State, Control Flow, Functions), Notation (Pseudo Code, Flow Chart, Programming Language), Algorithmic Problem Solving, Simple strategies for Developing Algorithms (Iteration, Recursion). Illustrative Problems: Find Minimum in a List, Insert a Card In a List of Sorted Cards, Guess an Integer Number in a Range, Towers of Hanoi.

.

Unit II: Data, Expressions, Statements **9**

Python Interpreter and Interactive Mode; Values and Types: Int, Float, Boolean, String, and List; Variables, Expressions, Statements, Tuple Assignment, Precedence of operators, Comments; Modules and Functions, Function Definition and Use, Flow of Execution, Parameters and Arguments; Illustrative Programs: Exchange the Values of Two Variables, Circulate the Values of N Variables, Distance Between Two Points.

Unit III: Control Flow, Functions **9**

Conditionals: Boolean Values and Operators, Conditional (If), Alternative (If-Else), Chained Conditional If-Elif-Else); Iteration: State, While, For, Break, Continue, Pass; Fruitful functions:Return Values, Parameters, Local and Global Scope, Function Composition, Recursion; Strings: String Slices, Immutability, String Functions and Methods, String Module; Lists as Arrays. Illustrative Programs: Square Root, GCD, Exponentiation, Sum an Array of Numbers, Linear Search, Binary Search.

.

Unit IV: Lists,Tuples, Dictionaries **9**

Lists: List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple as Return value; Dictionaries: Operations and Methods; Advanced List Processing - List Comprehension; Illustrative Programs: Selection Sort, Insertion Sort, Merge sort, Histogram.

.

Unit V: Files, Modules, Packages **9**

Files and Exception: Text Files, Reading and Writing Files, Format Operator; Command line Arguments, Errors and Exceptions, Handling Exceptions, Modules, Packages; Illustrative Programs: Word Count, Copy file.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist,2nd edition, UpdatedforPython3,Shroff/O,,ReillyPublishers,2016
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python ,Revised andupdated for Python 3.2, Network Theory Ltd.,2011.

REFERENCES:

1. John V Guttag, ―Introduction to Computation and Programming Using Python, Revised and Revised and expanded Edition, MIT Press ,2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd.,2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) PrivateLtd.,,2015.
4. KennethA.Lambert,―FundamentalsofPython:FirstPrograms‖,CENGAGELearning,2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition,2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC,2013.

CS3171	Fundamentals of Computing and Programming Lab	L	T	P	C
		0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python

Course Outcome		Cognitive Skill
CO-01	To write, test, and debug simple Python	U&A
CO-02	To implement Python programs with conditionals and loops.	U&A
CO-03	Use functions for structuring Python programs.	U&A
CO-04	Represent compound data using Python lists, tuples, dictionaries.	U&A
CO-05	Read and write data from/to files in Python	U&A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	S	S	M	S	S	S	S	S	S	S
CO-02	S	S	M	S	M	M	S	S	S	S	S	S	S
CO-03	S	S	M	S	S	S	S	S	S	S	S	S	S
CO-04	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-05	S	S	S	S	S	M	S	S	S	M	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

List of Programs:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newtons method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

TOTAL: 45 HOURS

BS3171	**Physics & Chemistry Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES

- To teach students, the importance of physics through involvement in experiments andto have knowledge of the world due to constant interplay between observations and hypothesis.
- To develop the interest among the students regarding chemistry and their applicationsin engineering.

Course Outcome		Cognitive Skill
CO-01	The students will be able to analyse the physical principle involved in various instruments and also relate the principle to new applications.	R,U,A,An,E
CO-02	Various experiments in the areas of optics, properties of matter and ultrasonics will nurture the students in all branches of engineering.	R ,U,A, An,E
CO-03	learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification	R,U,A,An,E
CO-04	Able estimate the ions/metal ions present in domestic/industry waste water.	R,U,A,An,E
CO-05	Utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification and spectroscopy.	R,U,A,An,E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	S	S	S	S	S	S
CO-02	S	S	S	M	S	S	S	S	S	S	S	S	S
CO-03	S	S	S	S	S	S	S	S	S	S	S	S	S
CO-04	S	M	S	S	S	M	S	S	S	M	S	S	S
CO-05	S	S	M	M	S	S	M	S	S	S	M	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

List of experiments: Physics Laboratory (Any Five Experiments)

1. Determination of velocity of ultrasonic waves and compressibility of the given liquid by Ultrasonic interferometer.(Real and Virtual Lab)
2. Determination of rigidity modulus by Torsional pendulum. (Real and Virtual Lab)
3. Determination of coefficient of viscosity by Poiseulli"smethod.
4. Determination of Youngs modulus by non-uniform bending method.(Real and VirtualLab)
5. Determination of LASER parameters using LASER diode. (Real and Virtual Lab)
6. Determination of band gap of the semi-conductor.(Real and Virtual Lab)
7. Determination of wavelength of mercury spectrum by diffraction grating.(Real and virtual lab)
8. Determination of wavelength of light by Newton"s rings.(Real and Virtual Lab)

9. Determination of angle of the prism using spectrometer. (Real and Virtual Lab)

List of Experiments : Chemistry Lab (Any FIVE experiments)

1. Determination of conductance of solutions
2. Potentiometry - determination of redox potentials and emfs
3. Synthesis of drug
4. Determination of Chloride content
5. Determination of hardness of water sample
6. Determination of Alkalinity of water sample
7. Virtual lab experiments

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3102	Communicative English	3	0	0	3
2.	MA3102	Engineering Mathematics – II	3	1	0	4
3.	BE3101	Basic Electrical and Electronics Engineering	3	0	0	3
4.	BE3102	Basic Civil and Mechanical Engineering	3	0	0	3
5.	ME3101	Engineering Graphics	3	0	2	4
PRACTICAL						
6.	BE3171	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7.	BE3172	Basic Civil and Mechanical Engineering Laboratory	0	0	2	1
TOTAL			**15**	**1**	**6**	**19**

EG3102	**Communicative English**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To widen and expand students‟ knowledge of English vocabulary
- To develop skills of students in the areas of vocabulary, grammar, listening, speaking, reading, and writing
- To develop the knowledge, skills and strategies the student must possess to becomeproficient readers
- To make the students learn the importance and purpose of communication skills and overcome the communication barriers by gaining confidence
- To make the students understand how to apply technical information and knowledge in practical documents

Course Outcome		Cognitive Skill
CO-01	The students will be able to understand the basic vocabulary items,sentence structures and error detection and correction which, in turn, will expand their knowledge of the English language.	R
CO-02	The students will be able to grasp the LSRW Skills and gain exposure to absorb Comprehension and Note-making.	U
CO-03	The students will get real time practice in speaking through Oral Presentation, Small Talk, Role Play, Debate, Group Discussion etc.	A
CO-04	The students will be able to improve their writing skills through exposure to Report Writing and Letter Writing.	U
CO-05	The students will be able to learn the Theory of Communication, Importance of Communication, and be introduced to the various facets rbal and Nonverbal Communication.	R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	S	S	S	S	M	**S**	S	S	S	S	M	M	M
CO-02	S	S	M	S	S	**S**	S	S	S	M	M	S	S
CO-03	M	S	S	S	M	**S**	S	M	S	S	S	M	S
CO-04	S	S	S	S	S	**S**	S	S	S	S	M	M	S
CO-05	S	S	S	S	S	**S**	S	S	M	S	M	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Vocabulary and Grammar **9**

Parts of Speech – Sentence Structures – Technical Vocabulary – Synonyms – Antonyms – Homonyms – Homophones – Misspelled Words – One word Substitutes – Odd Words Out – Changing words from one form to another – Common Errors in English – Correction of Errors in Sentences.

Unit II: Listening and Reading **9**

Reading Comprehension – Skimming – Scanning – Predicting the Content – Comprehension Questions – Inductive Reading – Close Reading – Note Making – Précis Writing.

Unit III: Speaking **9**

Introducing Oneself **–** Exchanging Personal Information **–** Small Talk: Family, Friends, Studies, Profession **–** Speaking: Greeting, Taking Leave **–** Product Description **–** Completing information **–** Gap Exercises **–** Presentation / Public Speaking Skills – Group Discussion – Debate – Role Play.

Unit IV: Technical Writing **9**

Report Writing – Characteristics of a Report – Categories of Reports – Letter Writing (Formal Letters) **:** Job Application Letter with Resume – Letter Seeking Permission – Letterof Invitation – Letter Declining an Invitation – Letter of Complaint – Letter of Requisition.

Unit V: Technical Communication **9**

The Theory of Communication – Definition and Scope – Nature, Importance and Types – Different Communication Models – Barriers to Communication – Effective Communication (Verbal / Non-verbal).

TOTAL: 45 HOURS

TEXT BOOKS

1. CanField Jack, Chicken Soup for the Soul, Westland, Chennai, 2013
2. Communication Skills. Oxford University Press.
3. Wood, F. T. (2007). Remedial English Grammar. Macmillan.

REFERENCE BOOKS

1. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
2. The Four Skills for Communication – Josh Sreedharan – Foundation Books
3. Communicative English – E. Sureshkumar and P. Sreehari – Orient Blackswan

MA3102	**Engineering Mathematics – II**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES

- To develop basic knowledge to the students in differential equations and vectorcalculus.
- The subject is further broadened to the functions of complex variables and complex integration.
- A thorough knowledge about Laplace transforms is also covered to aid the students solve the differential equations.

Course Outcome		**Cognitive Skill**
CO-01	The Students will be able to solve ordinary differential equations	An , E , S
CO-02	The Students will be able to solve complex variables	E
CO-03	The Students will be able to synthesize complex integration	S
CO-04	The Students will be able to solve Vector Calculus	E , S
CO-05	The Students will be able to Synthesize Laplace transforms	S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

CO \ PO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	M	S	M	S	S	N	M	M	S	S	M	M	M
CO-02	S	M	L	N	L	M	S	L	L	S	M	M	S
CO-03	S	L	S	S	L	L	S	S	M	M	S	S	M
CO-04	S	L	M	S	N	L	S	S	M	S	S	M	S
CO-05	S	L	M	M	M	L	N	S	M	M	M	S	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I : Ordinary Differential Equations **9**

Linear Differential Equations of Second Order with Constant and Variable Coefficients-Cauchy‟s and Legendre‟s Linear Equations – Method of Variation of Parameters.

Unit II: Complex Variables **9**

Functions of a Complex Variable – Analytic Function – Necessary Conditions- Cauchy- Riemann Equations in Cartesian and Polar Co-Ordinates - Sufficient Conditions (Excluding Proof) – Properties of Analytic Function – Harmonic and Its Conjugate – Construction of Analytic Function by Milne Thomson Method – Conformal Mappings W = Z + C, CZ , 1/Z and Bilinear Transformation.

Unit III: Complex Integration **9**

Statement and Applications of Cauchy‟s Integral Theorem and Cauchy‟s Integral Formula – Laurent‟s Expansion – Singular Points – Residues – Cauchy‟s Residue Theorem – Evaluation of Real Definite Integral Using Contour Integration(Excluding Poles on the Real Axis) -

$$\int_0^{2\pi} f(\cos\theta, \sin\theta)\,d\theta \text{ and } \int_{-\infty}^{\infty} \frac{f(x)}{g(x)}\,dx$$

Unit IV: Vector Calculus **9**

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 Parallelopipeds.

UNIT V: Laplace Transforms **9**

Laplace Transform –Existence Condition– Transforms of Elementary Functions – Basic Properties – Transforms of Derivatives and Integrals – Transform of Periodic Functions.

Inverse Laplace Transform – Convolution, Initial and Final Value Theorems (Statement only) Solutions of Linear Ordinary Differential Equation of Second Order with ConstantCoefficients Using Laplace Transform Techniques.

TOTAL L: 45 + T: 15 = 60 HOURS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics"- 40th Edition , Khanna Publishers, Delhi 2007.

REFERENCES

1. M.Immaculate Mary , K.Uma Samundesvari, Engineering Mathematics – II" First Edition, Anuradha Publications, ,2013.
2. Erwin Kreyszig, " Advanced engineering Mathematics", Seventh Edition, Wiley India, 2007.
3. Veerarajan T, " Engineering Mathematics (for first year)", Tata McGraw- Hill Publishing Company Ltd.,New Delhi,2007.
4. P.Kandasamy , K.Thilagavathy , K.Gunavathy" Engineering Mathematics" S.Chand & Company Ltd.2002.
5. B.V. Ramana,"Higher Engineering Mathematics" Second Edition Tata McGraw- Hill, Publishing Company Ltd.,New Delhi, 2006.

		L	T	P	C
BE3101	**Basic Electrical and Electronics Engineering**	**3**	**0**	**0**	**3**

OBJECTIVES

- To understand the basic solutions of AC and DC circuits.
- To study the basic principle and operation of AC and DC machines.
- To study the fundamental operations of measuring instruments.
- To study the layout of power system
- To understand the fundamental operation and characteristics of Electron devices
- To understand the implementation of Boolean expression using logic gates.
- To become familiar with basic concepts of Communication system.

Course Outcome		**Cognitive Skill**
CO-01	To understand the basic solutions of AC and DC circuits and the basic principle and operation of AC and DC machines..	U, R
CO-02	To study the fundamental operations of measuring instruments and the layout of power system	U, R
CO-03	To understand the fundamental operation and characteristics of Electron devices	U, E,S
CO-04	To understand the implementation of Boolean expression using logic gates.	U, E,S
CO-05	To become familiar with basic concepts of Communication system.	U, R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	M	S	S	S	M	M	S	S	S	L	M	S	S
CO-02	S	S	S	S	M	M	M	S	S	S	M	S	S
CO-03	S	M	S	S	S	M	S	M	S	M	M	S	S
CO-04	S	L	S	S	M	M	S	S	S	M	M	S	M
CO-05	S	L	S	M	S	S	S	S	S	M	M	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Electrical Circuits **9**

Ohms Law, Kirchhoff‟s laws, Mesh and Nodal Analysis for DC Circuits. Introduction to AC Circuits, Faraday‟s Law of Electromagnetic Induction, Lenz law, Inductor, Capacitor, Power Factor, Waveforms and RMS Value, Average Value, Peak Factor and Form Factor, Single Phase Circuits- Series and Parallel, Three Phase Balanced Circuits.Fundamentals of Wiring and Earthing.

Unit II: Electrical Measurements, Machines And Power System **9**

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeter and Voltmeter), Dynamometer Type Wattmeter and Energy Meter, Errors in Measurements. Construction, Principle of Operation and Applications of DC Generators, DC Motors, Single Phase Transformers. Structure of Power System.

Unit III: Semiconductor Devices **9**

Introduction to Semiconductors, PN Junction Diode-Zener Diode and its Characteristics-Half Wave and Full Wave Rectifiers-Bipolar Junction Transistor-CB,CE,CC Configuration and Characteristics-JFET and MOSFET Construction, Operation, Characteristics (CS only) and Uses.

Unit IV: Digital Electronics **9**

Number Systems-Binary Arithmetic--Boolean Algebra-Laws and Theorems-Simplification of Boolean Expression- Logic Gates –Implementation of Boolean Expression Using Logic Gates-Standard Forms of Boolean Expression.

Unit V: Communication Systems **9**

Block Diagram of Basic Communication System-Need for Modulation-Types of Modulation-Principles of Amplitude and Frequency Modulation – Pulse Analog and Digital Modulation- AM and FM Transmitter and Receiver (Block Diagram Description Only) –Satellite Communication Radar Systems-Data Transmission and MODEM.

TOTAL: 45 HOURS

TEXT BOOKS

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical,
2. Electronics and Computer Engineering", Tata McGraw Hill, Second Edition,(2006).

REFERENCES

1. V.N. Mittle "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi,1990.
2. V.K.Mehta "Principles of Power System", S.Chand & Company Ltd, New Delhi,2001.
3. R.S.Sedha,"Applied electronics"S.Chand&Co.,2006.

BE3102	**Basic Civil and Mechanical Engineering**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To enable the students to understand the Basic Civil and Mechanical Engineeringconcepts.

Course Outcome		**Cognitive Skill**
CO-01	the basic knowledge in Surveying and civil Engineering materials.	U&R
CO-02	Students can attain the basic knowledge in basic civil structures and building components.	U&R
CO-03	Can obtain the basic fundamental knowledge of Engineering Mechanics	U&R
CO-04	Students can expand their knowledge in knowing about IC engines andpower plants.	U&R
CO-05	Can increase the skill in basic manufacturing processes.	U &A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

(PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	S	S	M	S	S	S	S	M	S	S
CO-02	S	S	S	S	S	M	M	S	S	S	M	S	S
CO-03	S	M	S	S	S	M	S	M	S	M	M	S	S
CO-04	S	S	S	S	M	M	S	S	S	M	M	S	M
CO-05	S	M	S	M	S	S	S	S	S	M	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Surveying and Civil Engineering Materials 9

Surveying: Objects – Types – Classification – Principles – Measurements of Distances – Angles –Leveling–Determination of Areas–Illustrative Examples.

Civil Engineering Materials: Bricks–stones–sand–cement–concrete–steel sections.

Unit II: Building Components and Structures 9

Foundations: Types, Bearing Capacity– Requirement of Good Foundations.

Superstructure: Brick Masonry – Stone Masonry – Beams – Columns – Lintels Roofing – Flooring –Plastering – Mechanics – Internal and External Forces – Stress – Strain – Elasticity Types of Bridges and Dams–Basics of Interior Design and Landscaping.

Unit III: Fundamentals Of Engineering Mechanics 9

Statics –Basics Concepts, Fundamental Principles & Concepts: Newton‟s Laws, Gravitation, Force, Couple, Moment (about Point and about Axis), Varignon‟s Theorem, Resultant of Concurrent and Non-concurrent Coplanar Forces, Problem Formulation Concept; 2-D Statics, Two and Three Force Members, Alternate Equilibrium Equations, 3-D Statics.

Unit IV: Basic Concepts of Thermal Engineering 9

Introduction to IC Engines, Working Principle of Petrol and Diesel Engines – Four Stroke andTwo Stroke Cycles, Working Principle of Steam, Gas, Diesel, Hydro-electric and Nuclear Power Plants, Principle of Vapour Compression and Absorption System.

Unit V: Basic Manufacturing Processes **9**

Foundry-Investment Casting, Die Casting, Centrifugal Casting, Continuous Casting, Stir Casting, Squeeze Casting. Metal Fusion Welding Processes- Oxyfuel Gas Welding – Arc Welding Processes. Additive Manufacturing-3D Printing.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Shanmugam G and Palanichamy MS, “Basic Civil and Mechanical Engineering”,Tata McGraw Hill Publishing Co., New Delhi,(1996).
2. Ramamrutham S., “Basic Civil Engineering”, DhanpatRai Publishing Co.(P)Ltd.(1999).

REFERENCES:

1. SeetharamanS.,“Basic Civil Engineering”, Anuradha Agencies,(2005).
2. Venugopal K. and Prahu Raja V.,“Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam,(2000).
3. ShanthaKumarSRJ., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai,(2000).

ME3101	Engineering Graphics	L	T	P	C
		3	0	2	4

OBJECTIVES

- To develop skills for communication of concepts, ideas and design of Engineering Products.
- To expose them to existing national standards related to technical drawings

Course Outcome		Cognitive Skill
CO-01	To know and understand the conventions and the methods of engineeringdrawing.	U,R
CO-02	Interpret Engineering drawings using fundamental technical mathematics	U,R
CO-03	Construct basic and intermediate geometry.	U,A
CO-04	To improve their visualization skills so that they can apply these skills indeveloping new products.	U,A
CO-05	To improve their technical communication skill in the form of communicative drawings and comprehend the theory of projection.	U,A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	S	S	M	S	S	S	M	M	S	S
CO-02	S	S	S	S	S	M	M	S	S	M	M	S	S
CO-03	M	M	S	S	S	M	S	M	S	M	M	S	S
CO-04	S	S	S	S	M	M	S	S	S	M	M	S	M
CO-05	S	M	S	M	S	S	S	S	S	M	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction **9**

Concepts and conventions: Use of Drafting Instruments, BIS Conventions and Specifications – Size, Layout and Folding of Drawing Sheets, Lettering and Dimensioning. General Principles of Orthographic Projection, First Angle Projection – Layout of Views. **(Not for examination)**

General Plane Curves

Conic sections including the Rectangular Hyperbola (General method); Cycloid, Epicycloid, Hypocycloid and Involute.

Unit II: Projection of Points, Lines & Planes **9**

Projection of points, Projection of Straight Lines Located in the First Quadrant. Determination of True Lengths and True Inclinations. Projection of Planes- Parallel to any One Reference Plane, Perpendicular to any One Reference Plane, Inclined to any One Reference Plane and Inclined to both Reference Planes

Unit III: Projection of Solids & Section of Solids **9**

Prisms, Pyramids, Cylinder and Cone, Axis Perpendicular to any One Reference Plane. Axis Parallel to both the Planes. Axis Inclined to any One Reference Plane.

Sectioning of Solids- Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes Inclined to One Reference Plane. Obtaining The True Shape of Section

Unit IV: Development of Surfaces & Isometric Projection **9**

Development of Surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Isometric view, Isometric scale to Draw Isometric projection, Non-Isometric lines, Construction of Isometric View from Given Orthographic Views and to Construct Isometric View of a Pyramid, Cone, Sphere.

Unit V: Orthographic Projection & Perspective Projection **9**

Fundamental of Projection along with Classification, Projections from the Pictorial view of the Object on the Principal planes for View from Front, Top and Sides using First Angle Projection Method and Third Angle Projection Method, Full Sectional View. Perspective Projection of Solids (Any one Method).

L: 45+P: 15 = TOTAL: 60 HOURS

TEXT BOOKS:

1. Venugopal K and Prabhu Raja V, "*Engineering Graphics*", New Age International Publishers, 2007.
2. Luzadder W J, "*Fundamentals of Engineering Drawing*", Prentice Hall Book Co., New York, 1998
3. Bhat, N.D.& M. Panchal , *Engineering Drawing,* Charotar Publishing House,2008

REFERENCES:

1. Kumar M S, "*Engineering Graphics*", Ninth Edition, DD Publications, Chennai, 2007.
2. Bureau of Indian Standards, "*Engineering Drawing Practices for Schools and Colleges* SP 46-2003", BIS, New Delhi, 2003.
3. Shah, M.B. & B.C. Rana , *Engineering Drawing and Computer Graphics,* Pearson*Education,2008*

BE3171	Basic Electrical and Electronics Engineering Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

- To understand the electric circuit connection
- To measure the electrical parameters
- To obtain the characteristics of electron devices and its applications.

Course Outcome		Cognitive Skill
CO-01	Make basic electrical connection	U.A
CO-02	Measure the electrical parameters	U
CO-03	Gain knowledge about the basic Electronic components	U
CO-04	Analyze the characteristics of some basic electronic devices.	U
CO-05	The Students will be able to understand the working principles of logic gates .	U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	S	M	S	S	S	M	S	L	M	M
CO-02	M	S	S	S	S	M	S	S	S	L	M	L	L
CO-03	S	S	S	S	M	M	M	S	L	M	L	L	M
CO-04	S	S	S	M	S	S	M	S	S	S	M	L	L
CO-05	S	S	S	M	S	S	S	M	S	L	M	L	L

S-Strong, M-Medium,L-Low,N-Not relevant

List of Experiments

I. Electrical Engineering Lab

- Study of Symbols, Cables and Earthing.
- Residential house wiring using switches, fuse, indicator, lamp and energy meter.
- Fluorescent lamp wiring.
- Stair case wiring / Lamp control from three different places/ Doctor Room control/ Go down control
- Measurement of electrical quantities – voltage, current, power & computation ofpower factor in RLC circuit.

- Measurement of energy using single phase energy meter.
- Fan Wiring.

II. Electronics Engineering Lab

- Study of Electronic components and equipments – Resistor, colour coding,
- Measurement of AC signal parameter (peak-peak, rms period, frequency) using
- CRO.
- Characteristics of PN Junction diode
- Characteristics of Zener diode
- Voltage Regulator using Zener diode
- Measurement of ripple factor of HWR and FWR.
- Study of logic gates AND, OR, EX-OR and NOT, NAND and NOR.
- Generation of Clock Signal.
- Soldering practice – Components, Devices and Circuits – Using general purposePCB.

TOTAL: 30 HOURS

		L	T	P	C
BE3172	**Basic Civil and Mechanical Engineering Laboratory**	**0**	**0**	**2**	**1**

OBJECTIVES

- To provide exposure to the students with hands on experience on various basicEngineering practices in Civil & Mechanical Engineering.

Course Outcome		**Cognitiv eSkill**
CO-01	Able to gain fundamental knowledge about Buildings and pipe line works.	U
CO-02	Able to handle Carpentry and power tools.	U
CO-03	Able to gain knowledge in basic welding and machining process.	U
CO-04	Able to attain the practice of using gyroscope in dynamics.	U
CO-05	Able to understand the fundamental knowledge in foundry, fitting, sheet metal and IC engines.	U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO -A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G	PO -H	PO -I	PO -J	PO -K	PO -L	PO M
CO-01	M	S	S	M	S	N	S	S	S	S	S	S	S
CO-02	M	S	S	S	S	N	S	S	S	M	M	S	S
CO-03	L	S	S	S	M	N	M	S	L	M	S	S	S
CO-04	L	S	S	M	S	M	M	S	S	S	M	S	S
CO-05	L	S	S	M	S	M	S	M	S	M	M	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

List of Experiment

Civil Engineering Practice

Buildins:

- Study of plumbing and carpentry components of residential and industrialbuildings. Safety aspects.

Plumbing Works:

- Study of pipeline joints, its location and functions: valves, taps, couplings,unions, reducers, elbows in house hold fittings.
- Study of pipe connections requirements for pumps and turbines.
- Preparation of plumbing line sketches for water supply and sewage works.
- Hands-on-exercise:
- Basic pipe connections – Mixed pipe material connection – Pipe connectionswith different joining components.
- Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

- Study of the joints in roofs, doors, windows and furniture.
- Hands-on-exercise:
- Wood work, joints by sawing, planing and cutting.

II Mechanical Engineering

Practice Welding:

- Preparation of arc welding of butt joints, lap joints and tee joints.

Basic Machining:

- Simple Turning and Taperturning

Dynamics:

- Experiment using Gyroscope/Four bar link mechanism.

Demonstration on:

- Demonstration on foundry, fitting and sheet metal exercises.
- Demonstration on the working principle of two stroke and four stroke I.C.engines.

TOTAL: 30 HOURS

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA3201	Engineering Mathematics - III	3	1	0	4
2.	EE3201	Analog Electronics	3	0	0	3
3.	EE3202	Electric circuit Analysis	3	0	0	3
4.	EE3204	Electrical Machines - I	3	0	0	3
5.	EE3205	Electro Magnetic Theory	3	0	0	3
6.	ME3201	Engineering Mechanics	3	0	0	3
PRACTICAL						
7.	EE3271	Analog Electronics Laboratory	0	0	2	1
8.	EE3273	Electrical Machines Laboratory - I	0	0	2	1
9.	ME3274	Mechanical Engineering Laboratory	0	0	2	1
TOTAL			**18**	**1**	**6**	**22**

MA3201	Engineering Mathematics III	L	T	P	C
		3	1	0	4

OBJECTIVES

- To impart the fundamental knowledge of Engineering Mathematics to the students in order to achieve a well founded knowledge about the principles of Mathematics.
- To develop the skill of the students in the areas of boundary value problems and Transform techniques. This will be necessary for their effective studies in a large number of Engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. This course will also serve as a prerequisite for post graduate and specialized studies and research.

Course Outcome – Cos

At the end of the course students should be able to

CO-01	Recognize a Partial Differential Equation and formulate a Partial Differential Equation from a given equation. Solve linear Partial Differential Equation of both first and second order using various methods.
CO-02	Derive a Fourier series expansion for a given periodic function by evaluating Fourier coefficient and expand Fourier cosine and Sine series for given function. Also find the Fourier series expansion for a given set of numerical values by applying harmonic analysis.
CO-03	Classify the second order Partial Differential Equation and solve second order Partial Differential Equations such as wave equation, heat equation and Laplace equation with boundary and initial conditions applying Fourier series expansion.

CO-04	Know fundamental and mathematical properties of Fourier transform. Calculate the Fourier transform of a given function and inverse Fourier transform of function. Know the applications of Parseval's and convolution theorem.
CO-05	Understand the characteristics and properties of Z-transform. Compute Z-transform of simple functions and inverse z transform of given functions and apply Z-transform for solving difference equations.

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	L	M	M	M	M	L	M	M	M	M
CO-02	S	S	L	M	M	M	M	L	M	M	M	M
CO-03	S	S	L	M	M	M	M	L	M	M	M	M
CO-04	S	S	L	M	M	M	M	L	M	M	M	M
CO-05	S	S	L	M	M	M	M	L	M	M	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Partial Differential Equations **12**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of Clairaut's equations – Lagrange's linear equation –Homogeneous linear partial differential equations of second order with constant coefficients.

Unit II: Fourier Series **12**

Dirichlet's conditions – Fourier series – Change of interval - Odd and Even functions – Half range sine and cosine series – Parseval's identity – Harmonic Analysis.

Unit III: Boundary Value Problems **12**

Classification of second order linear partial differential equations – One dimensional wave and heat equations – Assumptions – Fourier series solution – Steady state solution of two dimensional heat equation (insulated edges excluded) – Fourier series solution in Cartesian co-ordinates.

Unit IV: Fourier Transforms **12**

Statement and meaning of Fourier integral theorem – Fourier transform — Properties - Inverse Fourier transform – Fourier Sine and Cosine transforms – Inverse sine and cosine transforms – Properties -Transforms of simple functions – Convolution theorem – Parseval's identity.

Unit V: Z-Transforms **12**

Z- transform – Elementary properties – convolution theorem-Inverse Z-transform –Partial fraction Method, Inversion integral method and Convolution – Initial and Final value theorems –Formation of difference equations – Solution of difference equations using Z- transform

TOTAL:45+15 = 60 Hours

TEXT BOOK

1. Grewal B.S., "Higher Engineering Mathematics" – 40th Edition , Khanna Publishers, Delhi 2011.

REFERENCES:

2. ErwinKreyszig, "Advanced Engineering Mathematics",10th Edition, John Wiley & Sons, Inc., USA, 2011
3. Kandasamy P, Thilagavathy K, and Gunavathy K., "Engineering Mathematics Volume III", First Edition, S.Chand& Company Ltd., New Delhi.
4. Veerarajan T., "Engineering Mathematics(for Semester III), Third Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi 2007.
5. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Seventh
6. Edition, Lakshmi Publications Pvt. Ltd., New Delhi, 2009

EE3201	**Analog Electronics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To acquaint the students with construction, theory and characteristics of P-N junction diode
- Analyze the different application of diodes
- To familiarize the student with the analysis and modelling of diode.
- Understand the characteristics of transistors.
- Design and analyze various rectifier and amplifier circuits. Design sinusoidal and non sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Derive the drift and diffusion current by understanding the fundamentals of semiconductors.	U and An
CO-02	Learn about the characteristics and applications of semiconductor diodes.	U
CO-03	Evaluate the various parameters of BJT, JFET and MOSFET by understanding their characteristics.	U and E
CO-04	Familiar with the principle of operation and characteristics of special semiconductor devices, Tunnel diode, Gunn diode etc.	R and U
CO-05	Learn about the principle of operation and characteristics of Thyristors and Display devices.	R and U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	s	s	M	S	S	S	S	S	S	S	S	M
CO-02	S	S	M	S	S	S	S	S	S	S	S	M
CO-03	s	s	M	S	S	S	S	S	S	S	S	M
CO-04	S	S	M	S	S	S	S	S	S	S	S	M
CO-05	s	s	M	S	S	S	S	S	S	S	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: P-N Junction Diode **9**

Qualitative Theory of P-N Junction, P-N Junction as a diode , diode equation , volt-ampere characteristics temperature dependence of V-I characteristic ,–resistance levels(static and dynamic), transition and diffusion capacitances, diode equivalent circuits, load linear analysis, zener diode characteristics, Voltage regulation using zener diode.

Special purpose electronic devices: Principal of operation and Characteristics of Tunnel Diode with the help of energy band diagrams, Varactor Diode and photo diode

Unit-II: Semiconductor Devices And Applications **9**

The Junction transistor, Transistor as an amplifier, Transistor construction, Input and Output characteristics of transistor in Common Base, Common Emitter, and Common collector configurations. BJT Hybrid Model, h-parameter representation of a transistor, Analysis of single stage transistor amplifier using h-parameters: voltage gain, current gain, Input impedance and Output impedance. P-N Junction as a rectifier ,Half wave rectifier, full wave rectifier, Bridge rectifier, Inductor filter, Capacitor filter.

Unit-III: Transistor Biasing And Stabilization **9**

Operating point, the D.C and A.C Load lines, Need for biasing , criteria for fixing, operating point, B.J.T biasing, Fixed bias, Collector to base bias Self bias techniques for stabilization, Stabilization factors,(s, sI, sII), Bias Compensation using diode and transistor , (Compensation against variation in VBE,ICO,) Thermal run away, Condition for Thermal stability.

Unit -IV: A/D And D/A Converters **9**

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

Unit-V: Field Effect Transistor And FET Amplifier **9**

JFET, MOSFET - Construction, principal of Operation and Volt –Ampere characteristics. Small signal model of JFET.FET as Voltage variable resistor, MOSFET characteristics in Enhancement and Depletion modes. FET Amplifiers: FET Common source Amplifier, Common Drain

Amplifier.

TOTAL: 45 HOURS

TEXT BOOKS

1. Integrated Electronics Analog Digital Circuits, Jacob Millman and D. Halkias, McGraw Hill.2002.
2. Electronic Devices and Circuits Theory, Boylsted, Prentice Hall Publications, 10th edition,2009.
3. Electronic Devices and Circuits, S.Salivahanan, N.Sureshkumar, McGraw Hill,2018.
4. Electronic Devices and Circuits, Balbirkumar ,shailb.jain, PHI Private Limted, Delhi, Second edition,2014.

REFERENCES:

1. Electronic Devices and Circuits,K.Lal Kishore B.S Publications, 4th edition, 2016.
2. Electronic Devices and Circuits, G.S.N. Raju, I.K. International Publications, New Delhi,2006.
3. Electronic Devices and Circuits,A.PGodse, U.A Bakshi , Technical Publications,2007.
4. Electronic Devices and Circuits K.S. Srinivasan Anurdha Agencies,2008.

EE3202	**Electric Circuit Analysis**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- The methods of analyzing basic and complex circuits
- Analysis of magnetically coupled circuits and resonance and two port networks
- Analysis of circuits using Laplace and Fourier transforms.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Apply network theorems for the analysis of electrical circuits.	A
CO-02	Obtain the transient and steady-state response of electrical circuits.	U
CO-03	Analyze circuits in the sinusoidal steady-state (single-phase and three-phase)	An
CO-04	Analyze two port circuit behavior	An
CO-05	Obtain the maximum power transfer to the load , and Analyze the series resonant and parallel resonant circuit	U,An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	N	N	N	S	N	N	N	N	N	N	L
CO-02	M	L	N	N	N	L	N	N	N	N	N	L
CO-03	N	N	L	N	N	M	M	N	M	N	M	N
CO-04	N	L	M	N	L	M	M	L	N	N	N	M
CO-05	N	L	N	L	N	L	L	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Network Topology **9**

Concept of tree-branch-tree link-incidence matrix-tie set matrix and loop currents; Cut set matrix and node pair potentials-duality.

Unit II: Network Theorem For AC and DC Circuits **9**

Statement of Network theorem: Superposition, Reciprocity, Thevenin's, Norton's, and Maximum Power Transfer Theorem, Millman's theorem.

Unit III: Transients and Resonance Circuits **9**

Transient response of basic RL, RC and RLC series and parallel circuits using Laplace Transform for DC input. Series and parallel response- their frequency response-resonant frequency - bandwidth-Q factor-Solutions.

Unit IV: Two Port Network **9**

Two port network: Driving point and transfer impedance/admittance-voltage/current ratio of two port network-Admittance, impedance, Hybrid, transmission parameters for two port network.

Unit V: Fourier Analysis and Its Application **9**

Trignometric fourier series for non-sinusoidal functions, Circuit analysis: Average power and RMS values using fourier coefficients- exponential fourier series-fourier transform for commonly used periodic and aperiodic function.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Electric Circuit Analysis by T.Nageswara Rao, AR Publishers Tamil Nadu 2009.
2. Electric Circuit Theory by M.Arumugam and N.Premkumar Khanna Publishers, New Delhi 2002
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.

REFERENCES:

1. David E. Johnson, Johny R. Johnson, John L. Hilburn, "Electric Circuit Analysis", Second Edition, Prentice-Hall International Editions.
2. K.V.V.Murthy, M.S. Kamath, "Basic Circuit Analysis", Jaico Publishing House, 1999.
3. Norman Balabanian, "Electric Circuits", International Edition, McGraw-Hill, 1994.
4. Charles K. Alexander & Mathew N. O. Sadiku, "Fundamentals of Electric Circuits" Second Edition, McGraw-Hill 2003.
5. Fundamentals of R.A. Decarlo and P.M.Lin, "Linear circuit analysis" Oxford press, Reprint Edition 2003.

EE3204	Electrical Machines – I	L	T	P	C
		3	0	0	3

OBJECTIVES

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

Course Outcome – Cos		Cognitive Skill
CO-01	Remember the construction and working of any electrical DC machines and transformer under load and unload condition.	R
CO-02	Understand the principle of operation and performance of DC machines and transformer.	U
CO-03	Apply various controls and analyse the responses of DC machine and transformer.	A
CO-04	Troubleshoot the operation of DC machine and transformer.	A
CO-05	Calculate load of DC machine and transformer for a given application and select the suitable DC machine.	E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	L	M	S	N	M	N	N	N	S	S	S
CO-02	L	L	S	M	N	M	N	M	N	S	M	M
CO-03	M	L	M	M	N	M	N	L	N	M	M	M
CO-04	M	L	M	L	N	L	N	M	N	M	L	L
CO-05	S	S	L	L	N	S	M	L	N	S	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Electromechanical Energy Conversion 9

Magnetic circuits- Hysteresis loop – Inductance – Statically and Dynamically coupled circuits

induced EMF – Core losses- Energy in magnetic systems – field energy, co energy and mechanical force – singly and multiply excited systems.

Unit II: Transformers **9**

Construction – principle of operation – emf equation- equivalent circuit – losses- efficiency- All-day efficiency and voltage regulation – three phase transformer connections – parallel operation of transformers – autotransformers-tap changing transformers-testing: open circuit, short circuit, load, polarity and Sumpner's test.

Unit III: DC Generators **9**

Constructional parts – Selection of material – principle of operation-methods of excitation – Separately and Self excited generator-armature winding: lap, wave winding and their uses. EMF generation – emf equation- characteristics of DC Generators: critical resistance, critical speed - armature reaction – commutation -parallel operation and load sharing.

Unit IV: DC Motors **9**

Principles and Theory - torque equation condition for maximum power developed - characteristics of motors –Starters - Speed control methods – Testing: Brake test, Swinburne's test, Hopkinson's test.

Unit V: Applications of DC Motors in Industries **9**

Brushless DC motors-Servo motors-Stepper motors – Geared motors-Brushed DC motors, Comparison of motors-application of motors in medical, industrial and aerospace.

TOTAL: 45 HOURS

TEXT BOOKS

1. Nagrath I. J and Kothari D. P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2017.
2. B.L.Theraja and A.K Theraja,'A text book of Electrical Technology' Volume II, S.Chand& Co. Ltd 2014.
3. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2004.
4. M.G.Say, 'Direct Current Machines', Wiley Publishers, January 2010.

REFERENCES:

1. Fitzgerald.A.E. Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', McGraw Hill Books Company, 2017.
2. P. C. Sen., 'Principles of Electrical Machines and Power Electronics', John Wiley &Sons, 2010.
3. P.S. Bimbhra, 'Electrical Machinery', Khanna Publishers, 2014.

EE3205	Electromagnetic Theory	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize the student to the concepts, calculations and pertaining to electric, magnetic and electromagnetic fields so that an in depth understanding of antennas, electronic devices, Waveguides is possible.
- To analyze fields a potentials due to static changes
- To evaluate static magnetic fields
- To understand how materials affect electric and magnetic fields
- To understand the relation between the fields under time varying situations
- To understand principles of propagation of uniform plane waves.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Gain knowledge about static electric fields.	U,R
CO-02	Gain knowledge about static magnetic fields.	U
CO-03	Gain knowledge about electric and magnetic fields in materials.	R,U
CO-04	Gain knowledge about time varying fields.	U
CO-05	Gain knowledge about electromagnetic waves.	R,A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	L	M	L	L	M	N	M	N	L	L
CO-02	S	S	L	M	L	L	M	N	M	N	L	L
CO-03	S	S	L	M	L	L	M	N	M	N	L	L
CO-04	S	S	L	M	L	L	M	N	M	N	L	L
CO-05	S	S	L	M	L	L	M	N	M	N	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Static Electric Fields **9**

Sources and effects of electromagnetic fields-Introduction to line, Surface and Volume Integrals – Definition of Curl, Divergence and Gradient –Strokes theorem and Divergence theorem. Coulomb's Law in Vector Form – Definition of Electric Field Intensity - Electric Field due to charges distributed uniformly on an infinite and finite line – Electric Field on the axis of a uniformly charged circular disc – Electric Field due to an infinite uniformly charged sheet. Electric Scalar Potential – Relationship between potential and electric field - Potential due to

infinite uniformly charged line – Potential due to electrical dipole - Electric Flux Density .

UNIT II: STATIC MAGNETIC FIELD 9

The Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I – Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I – Ampere's circuital law and simple applications. Magnetic flux density – Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment – Magnetic Vector Potential.

UNIT III: ELECTRIC AND MAGNETIC FIELDS IN MATERIALS 9

Poisson's and Laplace's equation - Definition of Capacitance – Capacitance of various geometries using Laplace's equation – Electrostatic energy and energy density – Boundary conditions for electric fields – Electric current – Current density – point form of ohm's law – continuity equation for current. Definition of Inductance – Inductance of loops and solenoids Energy density in magnetic fields –magnetic boundary conditions.

UNIT IV: TIME VARYING ELECTRIC AND MAGNETIC FIELDS 9

Faraday's law – Maxwell's Second Equation from Faraday's Law. Displacement current – Modified Ampere's circuital law- Maxwell's first equation– Maxwell's third and fourth equation from Gauss law for electric and magnetic fields –Relation between field theory and circuit theory.

UNIT V: ELECTROMAGNETIC WAVES 9

Electromagnetic wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics,conductors- skin depth – Poynting vector – Poyntings theorem.

TOTAL: 45 HOURS

TEXTBOOKS

1. Sandeep Wati "Electromagnetic Theory"Mcmillan Edition 2011.
2. M.N.O.Sadiku: "Elements of Engineering Electromagnetics" Oxford University Press, fourth edition.

REFERENCES:

1. Ramo, Whinnery and Van Duzer: "Fields and Waves in Communications Electronics" John Wiley & Sons (3rd edition 2003)
2. Narayana Rao, N : "Elements of Engineering Electromagnetics" 6th edition, Prentice Hall of India, New Delhi, 2004.
3. E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems." Prentice Hall of India 2nd edition 2003.. McGraw-Hill.
4. D.Sathiah,M.Anitha "Electromagnetic fields" Scitech publication Chennai 2007 edition.

ME3201	Engineering Mechanics	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart the fundamental knowledge of Engineering Mechanics to the students in order to achieve a well-founded knowledge about the principles of mechanics.
- This is a basic engineering course common to all branches to inculcate in the students, problem solving abilities and to enhance their analytical abilities.

Course Outcome - COs		Cognitive Skill
CO-01	Calculate Resultant force for different force systems	R,U,A,An,E
CO-02	Carryout equilibrium analysis of truss	R,U,A,An,E
CO-03	Calculate C.G &centre of mass for simple and composite figures	R,U,A,An,E
CO-04	Apply newton law & conservation law to elastic collision & motion of rigid bodies	R,U,A,An,E
CO-05	Apply the principles of dynamics to solve engineering problem	R,U,A,An,E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	M	M	L	L	L	L	L	L	L	S	L
CO-02	S	M	M	L	L	L	L	L	L	L	S	L
CO-03	S	M	M	L	L	L	L	L	L	L	S	L
CO-04	S	M	L	L	L	L	L	L	L	L	S	L
CO-05	S	M	L	L	L	L	L	L	L	L	S	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Statics of Particles **10**

Statics –Basics Concepts, Fundamental principles & concepts: Vector algebra, Newton‟s laws, gravitation, force (external and internal, transmissibility), couple, moment (about point and about axis), Varignon's theorem, resultant of concurrent and non-concurrent coplanar forces, static equilibrium, free body diagram, reactions. Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, constraints and static determinacy; 3-D statics.

Unit II: Application of Statics & Friction 9

Analysis of Structures- Trusses: Assumptions, rigid and non-rigid trusses; Simple truss (plane and space), analysis by method of joints. Analysis of simple truss by method of sections;

FRICTION: Friction- Coulomb dry friction laws, simple surface contact problems, friction angles, types of problems, wedges. Sliding friction and rolling resistance

Unit III: Centroid, Centre of Gravity and Moment of Inertia 8

Moment of Inertia- First moment of mass and center of mass, centroids of lines, areas, volumes, composite bodies. Area moments and products of inertia, radius of gyration, transfer of axes, composite areas. Rotation of axes, principal area-moments of inertia,. Second moment of mass, Mass moments and products of inertia, radius of gyration, transfer of axes, flat plates (relation between area and mass moments and products of inertia), composite bodies. Rotation of axes, principal mass- moments of inertia.

Unit IV: Particle Dynamics 8

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Unit V: Kinematics & Kinetics of Rigid Bodies 10

Plane kinematics of rigid bodies- Rotation; Parametric motion. Relative velocity, instantaneous center of rotation. Relative acceleration, rotating reference frames. 3-part velocity and 5-part acceleration relations, Coriolis acceleration.Plane kinetics of rigid bodies- Kinetics of system of particles and derivation of moment equation. Translation. Fixed axis rotation; General planar motion.

TOTAL: 45 HOURS

TEXT BOOKS

1. Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics and Dynamics", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2006.
2. Tayal A K, "*Engineering Mechanics- Statics and Dynamics*" , Umesh Publications, Delhi,2004
3. Irving H. Shames, Engineering Mechanics, Prentice Hall, New Delhi 1997.

REFERENCES:

1. Bansal R K, "Engineering Mechanics", Laxmi Publications Pvt. Ltd., New Delhi, 2006.
2. Bhavikatti S S, "Engineering Mechanics", New Age International Pvt. Ltd., New Delhi, 2003.
3. Young D H and Timashenko S, "Engineering Mechanics", Tata Mcgraw-Hill, Fourth Edition, 2006.
4. JivanKhachane, RuchiShrivastava, "Engineering Mechanics: Statics and Dynamics", ANE Books, 2006.
5. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2006.

EE3271	Analog Electronics Lab	L	T	P	C
		0	0	2	1

OBJECTIVES

This laboratory course enables students to get practical experience in design, assembly testing and evaluation of Rectifiers and Voltage Regulators

- BJT characteristics and Amplifiers.
- JFET Characteristics and Amplifiers.
- MOSFET Characteristics and Amplifiers.
- Power Amplifiers.
- RC-Phase shift, Hartley, Colpitts and Crystal Oscillators

Course Outcome – Cos		**Cognitive Skill**
CO-01	Acquire a basic knowledge in solid state electronics including diodes, MOSFET, BJT, and operational amplifier.	U,R
CO-02	Develop the ability to analyze and design analog electronic circuits using discrete components.	R
CO-03	Observe the amplitude and frequency responses of common amplification circuits.	U
CO-04	Design, construct, and take measurement of various analog circuits	An
CO-05	To compare experimental results in the laboratory with theoretical analysis.	R,A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	L	M	L	L	M	N	M	N	L	L
CO-02	S	S	L	M	L	L	M	N	M	N	L	L
CO-03	S	S	L	M	L	L	M	N	M	N	L	L
CO-04	S	S	L	M	L	L	M	N	M	N	L	L
CO-05	S	S	L	M	L	L	M	N	M	N	l	L

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. P-N Junction Diode Characteristics.
2. Zener Diode Characteristics and Zener as Voltage Regulator
3. Half -Wave Rectifier ,Full - Wave Rectifier
4. Design and Construct Common Source MOSFET Amplifier
5. Input And Output Characteristics of Transistor Common Base Configuration
6. Input And Output Characteristics of Transistor Common Emitter Configuration
7. FET Characteristics

8. H-Parameters of CB Configuration
9. H-Parameters of CE Configuration
10. Frequency Response of Common Emitter Amplifier
11. Frequency Response of Common Collector Amplifier
12. Frequency Response of Common Source FET Amplifier

TOTAL=45 HOURS

EE3273	Electrical Machines Laboratory – I	L	T	P	C
		0	0	2	1

OBJECTIVES

To expose the students to the operation of D.C. machines and transformers and give them experimental skill.

Course Outcome – Cos		Cognitive Skill
CO-01	Analyze the regulation of DC generator by different methodologies	An
CO-02	Analyze performance the DC Motor	An
CO-03	Apply the different method to control the speed of DC motor	A
CO-04	Understand the various transformer connection	U
CO-05	Analyze performance of transformer by different method	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	S	M	M	N	L	L	S	S	S	S
CO-02	S	S	S	M	M	N	L	L	S	S	S	S
CO-03	M	S	L	M	L	N	L	M	S	M	S	L
CO-04	M	S	L	M	L	N	L	M	S	M	S	L
CO-05	S	S	S	M	M	N	L	L	S	S	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

List of Experiments

1. Open circuit and load characteristics of separately excited D.C shunt Generator.
2. Open circuit and load characteristics of self excited D.C shunt Generator
3. Load characteristics of D.C. compound generator with differential and cumulative connection
4. Load characteristics of D.C. shunt motor.

5. Load characteristics of D.C compound motor
6. Load characteristics of D.C series motor
7. Swinburne's test
8. Speed control of D.C shunt motor
9. Load test on single-phase transformer
10. Open circuit and short circuit tests on single phase transformer
11. Sumpner's test on transformers
12. Three phase transformer connections

TOTAL = 45 HOURS

ME3274	**Mechanical Engineering Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

To study the components of I.C. engines, boilers, steam turbines and steam engines.

Course Outcome - COs		**Cognitive Skill**
CO-01	Understand the valve timing diagram in 4-stroke engine cut model	U
CO-02	Develop good knowledge about study on port timing diagram in 2-stroke engine cut model	U,A
CO-03	Enable the student for constant speed 4-stroke diesel engine	A
CO-04	Performance test on constant speed single cylinder petrol engine	A
CO-05	To study the Coefficient of discharge of given Orifice meter/ Venturi meter	A,An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	**PO -A**	**PO -B**	**PO-C**	**PO -D**	**PO-E**	**PO-F**	**PO -G**	**PO -H**	**PO-I**	**PO - J**	**PO-k**	**PO -L**
CO-01	S	s	M	L	L	M	M	M	L	S	S	L
CO-02	S	S	M	L	L	M	S	S	L	S	S	L
CO-03	S	s	S	L	L	M	M	M	L	S	S	L
CO-04	S	S	S	L	L	M	M	M	L	S	S	L
CO-05	S	S	M	L	L	M	S	S	L	S	S	L

S- Strong, M- Medium, L-Low, N- Not Relevant

List of Experiments:

1. Experimental study on valve timing diagram in 4-stroke engine cut model
2. Experimental study on port timing diagram in 2-stroke engine cut model
3. Performance test on constant speed 4-stroke diesel engine

4. Variable speed test on multi-cylinder diesel engine
5. Heat balance test on 4-stroke diesel engine
6. Performance test on constant speed single cylinder petrol engine
7. Performance and Energy Balance Test on a Steam Generator/ Steam Turbine
8. Determination of the Coefficient of discharge of given Orifice meter/ Venturi meter
9. Determination of friction factor for a given set of pipes.
10. Conducting experiments and drawing the characteristic curves of centrifugal pump/submergible pump.
11. Conducting experiments and drawing the characteristic curves of reciprocating pump.
12. Conducting experiments and drawing the characteristic curves of Pelton wheel / Kaplan turbine.

TOTAL: 30 PERIODS

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA3203	Numerical Methods	3	0	0	3
2.	BS3201	Environmental Studies	2	0	0	2
3.	EE3206	Digital Electronics	3	0	0	3
4.	EE3207	Electrical Machines - II	3	0	0	3
5.	EE3208	Power Electronics	3	0	0	3
6.	EE3209	Transmission, Distribution and Cables	3	0	0	3
PRACTICAL						
7.	EE3274	Digital Electronics Laboratory	0	0	2	1
8.	EE3275	Electrical Machines Laboratory - II	0	0	2	1
9.	EE3276	Power Electronics Laboratory	0	0	2	1
10.	EE32P1	Summer Internship-I	0	0	0	2
TOTAL			**17**	**0**	**6**	**22**

		L	T	P	C
A3203	**Numerical Methods**	**3**	**0**	**0**	**3**

OBJECTIVES

- With the present development of Computer Technology, it is necessary to develop efficient algorithms for solving problems in science, Engineering and Technology. This course gives a complete procedure for solving different kinds of problems in engineering numerically.
- To have the basic concepts in numerical methods and find the solutions of large system of linear equations where analytical methods fail to give solution.
- To gain the ability to solve engineering problems characterized in the form of non- linear ordinary differential equation or partial differential equation.

Course Outcome – Cos At the end of the course students should be able to	
CO-01	Understand the fundamental theorem and compute the solution of non linear equations using Newton's method and fixed point iteration method. To solve the linear equations using direct and indirect methods.
CO-02	Apply interpolation for equal intervals using Newton's forward and backward formula and using Newton's divided difference formula for unequal intervals and Lagrange's formula.
CO-03	Discuss about numerical differentiation and integration. Apply Newton's forward and backward formula, Lagrange's formula and divided difference formula. To evaluate the integrals by using Trapezoidal rule and Simpson's rule.
CO-04	Understand the first order differential equation. Solve the first order differential equation by using single step method. Apply multi step method to find the solution

	of first order differential equation.
CO-05	Study about classification of partial differential equations. Find the finite difference solution of one dimensional heat equation and wave equation. To solve two dimensional Laplace and poisson equations.

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	M	M	M	M	L	M	S	M	M	M
CO-02	S	M	S	M	M	L	M	M	M	S	S	L
CO-03	S	M	M	S	M	M	M	M	L	M	M	M
CO-04	S	M	M	M	M	L	L	L	M	L	M	L
CO-05	S	M	L	L	M	L	L	L	L	M	M	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit- I: Solution of Equations **9**

Solution of non-linear equations–Newton Raphson method , Fixed point iteration method – Solution of linear system of Equations-Direct methods: Gaussian elimination and Gauss- Jordan methods – Iterative methods: Gauss Jacobi and Gauss – Seidel methods.

Unit- II: Interpolation **9**

Forward and Backward Differences – Interpolation for equal intervals- Newton's forward and Backward formula- Interpolation for unequal intervals-Newton's divided difference and Lagrange's formula.

Unit- III: Numerical Differentiation and Integration **9**

Numerical differentiation using Newton's Forward, Backward, Newton's divided difference and Lagrange's formula – Numerical integration by Trapezoidal , Simpson's 1/3and 3/8rules– Gaussian Quadrature -Two and three point formulae.

Unit -IV: Initial Value Problems For Ordinary Differential Equation **9**

Solution of first order differential equations -Single step Methods : Taylor Series, Euler, Modified Euler methods and Fourth order Runge-Kutta method. Multi-step methods : Milne's and Adam's Predictor and Corrector methods.

Unit- V: Numerical Solution of Boundary Value Problems **9**

Classification of partial differential equation- Finite difference solution of one dimensional heat equation by implicit and explicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

TOTAL: 30+15 =45 HOURS

Outcomes

The students will have a clear perception of the power of numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

The course helps to apply numerical methods to obtain approximate solutions to mathematical problems.

TEXT BOOK

1. Venkatraman M.K, "Numerical Methods" Fifth Edition, National Pub. Company, Chennai 2005.

REFERENCES:

1. Kandasamy, P.Thilakavathy, K and Gunavathy, K. "Numerical Methods" Second Edition, 2008 S.Chand and Co. New Delhi.
2. Scarborough, James B, "Numerical Mathematical Analysis"Oxford Book Company 1930 3.Balagurusamy, E., "Numerical Methods", First Edition, Tata McGraw-Hill Pub. Co. Ltd., New Delhi. 2009
3. Gerald, C.F, and Wheatley, P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2006.

BS3201	**Environmental Studies**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To understand the basic concepts in environmental science
- To gain the knowledge about structure and natural cycles of environment. To get an idea about control methods of pollution.
- To know the information about conservation methods of forest and wild life.

Course Outcomes		**Cognitive Skill**
CO-01	Student will be able to demonstrate a general understanding of interdisciplinary nature of environmental uses and able to characterize natural resources.	U, A, An
CO-02	Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.	R, E ,A
CO-03	Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.	R, U, A
CO-04	Students will be able to understand the effects of human population and know about the awareness programme.	R, A, E
CO-05	Students apply systems concept and methodologies to analyse and understand interaction between social and environmental process.	R, A, An

R-Remember, U-Understand, A-Apply, An-Analyze ,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	M	S	M	M	S	S	S	M	S	S	M
CO-02	M	M	S	M	S	S	S	S	M	S	S	M
CO-03	M	M	S	M	S	S	S	S	M	S	S	M
CO-04	M	M	S	S	M	S	S	S	M	S	S	M
CO-05	M	M	S	S	L	S	M	S	M	S	S	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit-I: Nature of Environment Studies and Natural Resources 9

Environment studies- definition – scope and importance- need for public awareness-Methods to create environmental awareness- Natural resources- Forest resources- energy resources- food resources- water resources – land resources - mineral resources.

Unit-II: Eco Systems and Bio-Diversity 9

Concept and component of eco systems- producer, consumer, decomposer- structure and function of eco system- food chain and food web- energy flow model- aquatic eco system forest eco system- desert eco system- pyramid of biomass- ocean eco system- grass land eco system- Bio diversity in India- value of bio diversity- biodiversity threatens- biodiversity protection- In-situ and Ex-situ conservation.

Unit- III: Environmental Pollution 9

Meaning of environmental pollution- air pollution- acid rain – global warming- water pollution- water pollution control- soil pollution- urban waste and soil pollution- marine pollution- noise pollution- thermal pollution- solid and hazardous waste management- waste disposal methods- solid waste and India- natural disaster and disaster management.

Unit- IV: Human Population and Environment 9

Population growth- distribution of population- factors affecting variation in population theories of population- future of human population- family welfare programme- HIV and AIDS- environment and human health- human rights- value education- women and child welfare.

Unit-V: Social Issues and The Environment 9

Unsustainable to sustainable development- sustainable development in India- water conservation, watershed management and water harvesting- environmental ethics- role of engineer in environmental protection.

TOTAL: 45 HOURS

TEXT BOOKS

1. Cunnigham&saigo: 'Environmental science :A global concern' 4th Ed.W.c. Brown Publishers. USA. 1997
2. Chauhan A.S, 'Environmental studies' 2nd revised ed.2004, Jain Brother publishers, New Delhi.

REFERENCES:

1. 1.Benny Joseph : 'Environmental Science and Engineering', 2006, Tata McGraw- Hill Publication.
2. Siddique K.A. : Elements of Ecology and Environmental Pollution, 1st Ed. 2002, Kushal Publication, Varanasi. M

EE3206	**Digital Electronics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

To learn the basic methods of Boolean Algebra and Binary System for the design of digital circuits and provide the fundamental concepts used in the design of digital systems.

- To introduce the Binary system and methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To introduce the concept of memories and programmable logic devices.
- To illustrate the concept of synchronous and asynchronous sequential circuits
- To illustrate the concept of Digital Circuit construction, System Design and HDLs.

Course Outcome – Cos		**Cognitive Skill**
CO-01	To introduce the Binary system and methods for simplifying Boolean expressions	U,A
CO-02	To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits	U,A
CO-03	To introduce the concept of memories and programmable logic devices.	U,A,E
CO-04	To illustrate the concept of synchronous and asynchronous sequential circuits	U,A,An
CO-05	To illustrate the concept of Digital Circuit construction, System Design and HDLs.	U,A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	S	S	S	M	L	S	S	S	S	S
CO-02	S	S	S	M	S	L	S	S	S	M	M	M
CO-03	M	M	S	M	S	L	L	S	S	S	M	M
CO-04	M	M	M	M	S	L	M	M	M	S	S	L
CO-05	M	M	S	M	S	L	S	S	S	M	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Fundamentals of Digital Systems and Logic Families 9

Digital signals, digital circuits, AND, OR, NOT,NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, error detecting and correcting codes, characteristics of digital lCs, digital logicfamilies, TTL, Schottky TTL and CMOS logic,Tri-state logic.

Unit-II: Combinational Digital Circuit 9

Standard representation for logic functions, K-map representationand simplification of logic functions using K-map, minimization of logical functions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractor, BCD arithmetic, carry lookahead adder, serial adder, paritychecker/generator, code converters.

Unit –III: Sequential Circuits and Systems 9

A 1-bit memory, the circuit properties of Bi-stable latch, the clockedSR flip flop, J-K, T and D types flip-flops, applications of flip-flops, shift registers, applications of shiftregisters, serial to parallel converter, parallel to serial converter, ring counter, sequence generator,ripple counters, synchronous counters, counters design using flip flops, applications of counters.

Unit-IV : Asynchronous Sequential Circuits 9

Analysis Procedure; Stable and Unstable states, output specifications, State reduction, Race free assignments, Hazards; Essential Hazards, Design of Hazard free circuits.

Unit-V: Semiconductor Memories and Programmable Logic Devices 9

Memory organization and operation,classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge decoupled device memory (CCD), ROM as a PLD, Programmable logicarray, Programmable array logic, complex Programmable logic devices (CPLDS).

TOTAL=45 periods

TEXT BOOKS

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016

REFERENCES:

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016

EE3207	**Electrical Machines-II**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To expose the students to the concepts of synchronous and asynchronous machines and analyse their performance.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Understand and explain the principle of operation and performance of synchronous machine, three phase and single phase induction motor	U & R
CO-02	Analyse the response of AC synchronous machine, three phase and single phase induction motor.	An
CO-03	Formulate and then analyses the working of any electrical AC machines under no load and loaded conditions	A
CO-04	Calculate load of AC machine and induction motor for a given application and then select the suitable specification of electrical machine	E
CO-05	Troubleshoot the operation of AC synchronous machine, three phase and single phase induction motor	S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	L	M	S	N	M	N	N	N	S	S	S
CO-02	L	L	S	M	N	M	N	M	N	S	M	M
CO-03	M	L	M	M	N	M	N	L	N	M	M	M
CO-04	M	L	M	L	N	L	N	M	N	M	L	L
CO-05	S	S	L	L	N	S	M	L	N	S	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Three Phase Induction Motor **9**

Constructional details – Types of rotors – Principle of operation – Slip – Equivalent circuit – Torque-slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram; Introduction to double cage rotors , Deep bar

motors– Induction generator-linear induction motor .

Unit-II: Speed Control of Three Phase Induction Motor 9

Need for starters – Types of starters – Stator resistance starter, rotor resistance starter, autotransformer starter and star-delta starters ; Speed control – V/F Method, Change of voltage, number of poles – Cascaded connection – Slip power recovery scheme.

Unit-III: Single Phase Induction Motors and Special Machines 9

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit –Starting methods of single-phase induction motors; Principle & operation of reluctance motor, Hysteresis motor, repulsion motor and AC series motor.

Unit- IV: Synchronous Generator 9

Principle of operation-Types of rotors – emf equation – Synchronous reactance, Armature reaction– Voltage regulation – e.m.f, m.m.f, and z.p.f methods-Power flow and Maximum power condition –Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input – Capability curves-Brushless alternator.

Unit-V: Synchronous Motor 9

Principle of operation –Starting methods– Torque equation – Operation on infinite bus bars – 'V'& inverted 'V' curves for constant power input and power developed – Hunting and Damper winding Synchronous Condenser; Application of Synchronous Motor, Permanent magnet synchronous motor.

TOTAL: 45 HOURS

TEXT BOOKS

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2010.
2. J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2010.

REFERENCES:

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', Tata McGraw Hill publishing Company Ltd, 2003.
2. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2011.
3. K. Murugesh Kumar, 'Electric Machines-II', Vikas publishing house Pvt Ltd, 2010. Sheila.C.Haran, 'Synchronous, Induction and Special Machines', Scitech Publications, 2001.

EE3208	Power Electronics	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

- Different types of power semiconductor devices and their switching
- Operation, characteristics and performance parameters of controlled rectifiers
- Operation, switching techniques and basics topologies of DC-DC switching regulators.
- Different modulation techniques of pulse width modulated inverters

Course Outcome – Cos		Cognitive Skill
CO-01	Able to explain the significance of switching devices and its application to power converters and demonstrate the triggering circuit and snubber circuits.	R,U
CO-02	Compare the operation of two, three Pulse Converters and draw output waveforms with and without source and load inductance	U,A
CO-03	Classify the operation of Choppers and outline the application of SMPS.	R,U
CO-04	Analyze the operation of single phase and three phase Inverters with and without PWM techniques	An
CO-05	Illustrate the operation of AC voltage controller and cycloconverter and its application	R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	M	S	S	S	L	L	S	M	L	N	M	M
CO-02	M	S	S	S	M	L	M	L	L	N	N	N
CO-03	M	S	S	S	M	L	M	L	L	N	N	N
CO-04	S	S	M	S	M	L	M	L	L	N	N	N
CO-05	S	S	M	S	M	L	M	L	L	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit- I: Power Semi-Conductor Devices **9**

Structure; steady-state V-I characteristics; Turn-ON and Turn-OFF characteristics of power diode, SCR, power MOSFET, IGBT and other; Design of gate drive and snubber circuits; Design of heat sinks; Intelligent Power Modules (IPM); Wide-band gap (SiC and GaN) power devices

Unit –II: Phase-Controlled Converters **9**

Single phase half and fully controlled converters: Performance analysis with R and RL load under continuous and discontinuous conduction modes, inverter mode operation, harmonics, input power factor; Concepts of PWM and phase-angle control; Effect of source impedance; Three-phase half and fully controlled converter: Performance analysis, harmonics, input power factor; Dual converters, Applications-light dimmer, Excitation system, Solar PV systems.

Unit- III: DC to DC Converters **9**

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E -Switched mode regulators- Buck, Boost, Buck- Boost regulator, Introduction to Resonant Converters, Applications-Battery operated vehicles.

Unit -IV: Inverters **9**

Single phase and three phase voltage source inverters (both120^0 mode and 180^0 mode)– Voltage& harmonic control-PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM – Introduction to space vector modulation –Current source inverter, Applications- Induction heating, UPS.

Unit-V: AC to AC Converters **9**

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters – Introduction to Matrix converters, Applications –welding .

TOTAL: 45 PERIODS

TEXT BOOKS

1. Muhammad H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Third edition, 2014 / PHI.
2. M. D. Singh, K. B. Khanchandani, Tata McGraw-Hill Education, second edition, 2008.
3. Ned Mohan, Tore.M.Undeland, William.P.Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.

REFERENCES:

1. Cyril.W.Lander, 'Power Electronics', McGraw Hill International, Third edition, 1993.
2. Bimal K. Bose, 'Modern Power Electronics and AC Drives', Pearson Education, 2003

EE3209	**Transmission, Distribution and Cables**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

To become familiar with the function of different components used in Transmission and Distribution levels of power systems and modelling of these components.

- To develop expression for computation of fundamental parameters of lines.
- To categorize the lines into different classes and develop equivalent circuits for these classes.
- To analyse the voltage distribution in insulator strings and cables and methods to improve the same.

Course Outcome – Cos		**Cogniti v e Skill**
CO-01	Articulate power system concepts required to engineering problems	U
CO-02	Discuss various factors governing the performance of transmission line	R,U
CO-03	Find calculation of resistance, inductance and capacitance of transmission lines	A
CO-04	Discuss construction of underground cables	R,U
CO-05	Electrical Technology La Ability to discuss functions of substations	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	S	M	M	L	M	L	L	N	M	N
CO-02	M	S	S	M	M	L	M	L	L	N	M	N
CO-03	S	S	S	M	S	L	M	L	L	N	M	N
CO-04	M	M	S	M	M	L	M	L	L	N	M	N
CO-05	M	M	S	M	M	L	M	L	L	N	M	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit- I: Introduction **9**

Structure of electric power system: Various levels such as generation,transmission and distribution; HVDC and EHV AC transmission: comparison of economics of transmission, technical performance and reliability, application of HVDC transmission system. FACTS (qualitative treatment only): TCSC, SVC, STATCOM, UPFC.

Unit-II: Transmission Line Parameters **9**

Parameters of single and three phase transmission lines with single and double circuits: Resistance, inductance and capacitance of solid, stranded and bundled conductors: Symmetrical and unsymmetrical spacing and transposition; application of self and mutual GMD; skin and proximity effects; interference with neighbouring communication circuits.

Unit- III: Modelling and Performance of Transmission Lines **9**

Classification of lines: Short line, medium line and long line; equivalent circuits, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation; real and reactive power flow in lines: Power-angle diagram; surge-impedance loading, loadability limits based on thermal loading, angle and voltage stability considerations; shunt and series compensation; Ferranti effect and corona loss.

Unit-Iv: Insulators and Cables **9**

Insulators: Types, voltage distribution in insulator string and grading, improvement of string efficiency. Underground cables: Constructional features of LT and HT cables, capacitance, dielectric stress and grading, thermal characteristics.

Unit-V: Substation, Grounding System and Distribution System 9

Types of substations; bus-bar arrangements; substation bus schemes: single bus scheme, double bus with double breaker, double bus with single breaker, main and transfer bus, ring bus, breaker-and-a-half with two main buses, double bus-bar with bypass isolators. Resistance of grounding systems: Resistance of driven rods, resistance of grounding point electrode, grounding grids; design principles of substation grounding system; neutral grounding.Radial and ring-main distributors; interconnectors; AC distribution: AC distributor with concentrated load; three-phase, four-wire distribution system; sub-mains; stepped and tapered mains.

TOTAL: 45 HOURS

TEXT BOOKS

1. B.R. Gupta, 'Power System Analysis and Design', S. Chand, New Delhi, 2005.
2. N. Singh, 'Electric Power Generation, Transmission and Distribution', 2nd Edition Prentice Hall of India Pvt. Ltd, New Delhi, 2008.

REFERENCES:

1. Luces M. Fualkenberry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2008.
2. Hadi Saadat, 'Power System Analysis,' Tata McGraw Hill Publishing Company 2003.
3. M. JeraldinAhila, 'Transmission and Distribution' Lakshmi Publications, Chennai 2014.
4. Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning', New Delhi.
5. 'Tamil Nadu Electricity Board Handbook', recent edition.

EE3274	**Digital Electronics Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To understand the basic truth table of logic gates and combinational circuits
- To construct and verify the truth table of sequential circuits using simulation.
- To design and implement sequential circuits.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Able to understand the basic truth table of logic gates and combinational circuits	U
CO-02	Able to construct adders and subtractors and verify its truth table.	U,A
CO-03	Able to construct the encoders and decoders and verify its truth table.	U,A
CO-04	Able to construct and verify the truth table of sequential circuits using simulation.	U,A
CO-05	Able to design and implement sequential circuits	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	S	S	M	S	S	M	M	M	L	L
CO-02	S	S	S	M	M	S	M	S	S	M	L	M
CO-03	S	S	S	S	S	S	S	S	S	M	M	L
CO-04	S	S	M	S	M	M	S	S	S	L	M	L
CO-05	S	M	M	S	S	S	S	M	M	S	M	L

S- Strong, M- Medium, L-Low, N- Not Relevant

List of Experiments:

1. Realization of Boolean Expressions using Gates
2. Design and realization of logic gates using universal gates
3. Realization of logic gates using DTL, TTL, ECL, etc.,
4. Design a 4 – bit Subtractor
5. Design and realization a 4 – bit gray to Binary and Binary to Gray Converter
6. Design a 4 – bit Adder
7. Design and realization of Asynchronous counters using flip-flops
8. Design and realization of Synchronous counters using flip-flops
9. Design and realization of 8x1 using 2x1 mux
10. Design and realization of 2-bit comparator

TOTAL: 45 PERIODS

EE3275	**Electrical Machines Laboratory-II**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Evaluate the regulation of the alternator by different methodologies	E
CO-02	Analyze performance the synchronous motor	An
CO-03	Analyze performance of 3 Phase Induction Motor &1 Phase Induction motor	An
CO-04	Apply the equivalent circuit of 3 Phase Induction Motor	A
CO-05	Analyze performance of 3 Alternator	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	S	M	M	N	L	L	S	S	S	S
CO-02	S	S	S	M	M	N	L	L	S	S	S	S
CO-03	S	S	S	M	M	N	L	L	S	S	S	S
CO-04	S	S	S	M	M	N	L	L	S	S	S	S
CO-05	S	S	S	M	M	N	L	L	S	S	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

List of Experiments

1. Load test on three-phase induction motor.
2. No load and blocked rotor test on three-phase induction motor.
3. Separation of No-load losses of three-phase induction motor.
4. Load test on single-phase induction motor
5. No load and blocked rotor test on single-phase induction motor.
6. Regulation of three phase alternator by emf and mmf methods
7. Regulation of three phase alternator by ZPF and ASA methods
8. Regulation of three phase salient pole alternator by slip test
9. Measurements of negative sequence and zero sequence impedance of alternators.
10. V and Inverted V curves of Three Phase Synchronous Motor.

TOTAL: 45 HOURS

EE3276	**Power Electronics Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To study the characteristics of switching devices and its applications in rectifier, inverter, chopper and resonant converter.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Draw the VI characteristics of SCR and generate the Gate Pulse using R, RC and UJT	R,U
CO-02	Plot the characteristics of MOSFET and IGBT	R,U
CO-03	Simulate a single phase AC to DC half and fully controlled converter	A
CO-04	Draw the output response of step up and step down MOSFET based chopper and simulate a single phase IGBT based PWM inverter	A
CO-05	Plot the output response of AC voltage controller and simulate the Power Electronic Circuits	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

CO / **PO**	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	M	M	S	L	L	N	M	N	M	L	M	M
CO-02	M	M	S	L	L	N	M	N	M	L	S	M
CO-03	S	S	S	M	L	N	M	N	M	L	L	M
CO-04	M	M	S	M	L	N	L	N	M	L	M	M
CO-05	M	M	S	M	L	N	L	N	M	L	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

List of experiments

1. Characteristics of SCR
2. Characteristics of TRIAC
3. Characteristics of MOSFET and IGBT
4. Transient characteristics of SCR and MOSFET
5. Analyze gate pulse logic, modes of operation, verify the input and output waveforms of the single-phase AC-DC fully controlled converter
6. Analyze gate pulse logic, modes of operation, verify the input and output waveforms of the single-phase AC-DC half controlled converter
7. Step down and step up MOSFET based choppers
8. IGBT based single-phase PWM inverter
9. IGBT based three-phase PWM inverter
10. Resonant dc-to-dc converter
11. Single-phase cyclo converter
12. Single phase cascaded multi-level inverter

TOTAL: 45 PERIODS

SEMESTER –V

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MS3201	Professional and Business Ethics	2	0	0	2
2.	EE3212	Protection and Switchgear	3	0	0	3
3.	EE3213	Control systems	3	1	0	4
4.	CS3212	Microprocessor and Microcontroller	3	0	0	3
5.	EE3214	Power System I	3	0	0	3
6.	EE32**	Elective-I	3	0	0	3
PRACTICAL						
7.	CS3278	Microprocessor and Microcontroller Laboratory	0	0	2	1
8.	EE3280	Control System Laboratory	0	0	2	1
9.	EE3281	Power System Laboratory I	0	0	2	1
TOTAL			17	1	6	21

MS3201	Professional And Business Ethics	L	T	P	C
		2	0	0	2

OBJECTIVES

- To Recognize legal and ethical issues in business decision-making.
- To Understand and apply ethical rules and constraints.
- To Enhance analytical problem-solving skills and ethical decision-making abilities.

Course Outcome – Cos		Cognitive Skill
CO-01	Ability to understand the relationship between ethics, morals and values in the workplace.	U
CO-02	Ability to help the students to recognize legal and ethical issues when making business decisions.	U
CO-03	Ability to improve analytical problem solving and ethical decision making skills.	U &R
CO-04	Ability to gain an enhanced understanding of following ethical rules and safety constraints.	U &R
CO-05	Ability to formulate ethical philosophy to deal with the global issues faced by multinational corporations	U &R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

CO / PO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	S	L	S	S	L	S	M	L	S	S
CO-02	S	S	S	L	S	S	L	S	S	L	S	S
CO-03	S	S	S	S	S	S	S	S	S	S	S	S
CO-04	S	S	S	M	S	M	M	S	S	M	S	S
CO-05	S	S	S	S	S	S	S	S	S	S	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Human Values **6**

Morals, Values, and Ethics - Integrity and Work Ethic - Caring, Sharing, and Honesty - Commitment, Empathy, and Self-Confidence.

Unit II: Engineering Ethics **6**

Senses of 'Engineering Ethics' and Moral Issues -Moral Autonomy and Ethical Theories - Models of Professional Roles.

Unit III: Engineering as Social Experimentation **6**

Engineering as Experimentation - Engineers as Responsible Experimenters - Codes of Ethics and Legal Perspectives.

Unit IV: Safety, Responsibilities, and Rights **6**

Safety, Risk, and Risk Assessment - Collegiality, Loyalty, and Respect for Authority - Professional and Employee Rights.

Unit V: Global Issues **6**

Multinational Corporations and Environmental Ethics - Engineers as Managers, Consultants, and Expert Witnesses.

TOTAL: 30 HOURS

TEXTBOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering," McGraw-Hill, New York, Latest edition: 4th edition (2022).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics," Prentice Hall of India, New Delhi, Latest edition: 2nd edition (2021).

REFERENCES:

1. Charles D. Fleddermann, "Engineering Ethics," Pearson Education/Prentice Hall, New Jersey, Latest edition: 4th edition (2022).
2. Charles E Harris, Michael S. Protchard, and Michael J Rabins, "Engineering Ethics - Concepts and Cases," Wadsworth Thompson Learning, United States, Latest edition: 2nd edition (2023).
3. John R Boatright, "Ethics and the Conduct of Business," Pearson Education, New Delhi, Latest edition: 8th edition (2021).

EE3212	Protection And Switchgear	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the significance of protection, protection schemes and role of earthing.
- To study the characteristics, functions and application areas of various relays.
- To acquire practical knowledge about common faults in power system apparatus and applying suitable protective schemes.
- To understand the functioning of static relays and Numerical protection concepts.
- To understand the problems associated with circuit breaking and to discuss about various circuit breakers.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand and select proper protective scheme and type of earthing.	U
CO-02	Explain the operating principles of various relays.	R
CO-03	Suggest suitable protective scheme for the protection of various power system apparatus.	An
CO-04	Analyze the importance of static relays and numerical relays in power System protection.	An
CO-05	Summarize the merits and demerits and application areas of various circuit breakers.	R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	L	L	M	L	M	L	L	L	L	M	N
CO-02	S	L	L	M	L	M	L	L	L	L	M	N
CO-03	S	L	L	M	L	M	L	L	L	L	M	N
CO-04	S	L	L	M	L	M	L	L	L	L	M	N
CO-05	S	L	L	M	M	M	L	L	L	L	M	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Protection Schemes 9

Significance and need for protective schemes – nature and causes of faults –types of faults Effects of faults - Zones of protection and essential qualities of protection – Types of Protection schemes - Power system Grounding and Methods of Grounding.

Unit II: Basics of Relays 9

Operating principles of relays –Universal torque equation - R-X diagram – Electromagnetic Relays – Over current, Directional and non-directional, Distance, Differential, Negative

sequence and Under frequency relays.

Unit III: Overview of Equipment Protection 9

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

Unit IV: Static Relays and Numerical Protection 9

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, and distance protection of transmission lines.

Unit V: Circuit Breakers 9

Physics of arcing phenomenon and arc interruption — DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive current - resistance switching - Types of circuit breakers — air blast, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – HVDC Breaker.

TOTAL : 45 HOURS

TEXT BOOKS

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, Four Edition,2010.
2. Badri Ram ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New AgeInternational Pvt Ltd Publishers, Second Edition2011.
3. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New AgeInternational (P) Ltd., Second Edition, 2018.
4. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2018.

REFERENCES:

1. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection'Y., Second Edition,Prentice Hall of India Pvt. Ltd., New Delhi,2013.
2. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2018
3. VK Metha," Principles of Power Systems", S. Chand, Reprint, 2013
4. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2nd Edition 2018.

EE3213	Control Systems	L	T	P	C
		3	1	0	4

OBJECTIVES

- To familiarize with various representations of systems.
- To analyze the stability of linear systems in the time domain and frequencydomain.
- To analyze the stability of linear systems in the frequency domain.
- To design compensator based on the time and frequency domainspecifications.
- To develop linear models: mainly state variable model and Transfer function model

Course Outcome - COs		Cognitive Skill
CO-01	Represent simple systems in transfer function and state variable forms.	R
CO-02	Analyze simple systems in time domain.	An
CO-03	Analyze simple systems in frequency domain.	An
CO-04	Infer the stability of systems in time and frequency domain.	U
CO-05	Interpret characteristics of the system and find out solution for simple control problems	R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	POA	POB-	POC	POD	PO-E	PO-F	P-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	S	S	S	N	N	L	N	N	N	S
CO-02	S	S	S	S	S	N	N	L	N	N	N	S
CO-03	S	S	S	S	S	N	N	L	N	N	N	S
CO-04	S	S	S	S	S	N	N	L	N	N	N	S
CO-05	S	S	S	S	S	N	N	L	N	N	N	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Modeling of Linear Time Invariant System 9

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical, Electrical and Electromechanical systems – Transfer function representations: Block diagram and Signal flow graph.

Unit II: Time Domain Analysis 9

Standard test inputs – Time response – Time domain specifications – Stability analysis: Concept ofstability – Routh Hurwitz stability criterion – Root locus: Construction and Interpretation. Effect of adding poles and zeros

Unit III: Frequency Domain Analysis 9

Bode plot, Polar plot and Nyquist plot: – Frequency domain specifications Introduction to closed loop Frequency Response. Effect of adding lag and lead compensators.

Unit IV: State Variable Analysis 9

State variable formulation – Non uniqueness of state space model – State transition matrix – Eigen values – Eigen vectors - Free and forced responses for Time Invariant and Time

Varying Systems –Controllability – Observability

Unit V: Design of Feed Back Control System 9

Design specifications – Lead, Lag and Lag-lead compensators using Bode plot techniques – PID controller - PID control in State Feedback form.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Benjamin C. Kuo, "Automatic Control Systems", 7th edition PHI Learning Private Ltd, 2010.
2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering",
3. New Age International Publishers 2010.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", EducationPearson,3Impression 2009.
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& FrancisReprint 2009.
3. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Ltd, 5thEdition,2010
4. NPTEL Video Lecture Notes on "Control Engineering" by Prof.S.D.Agashe, IIT Bombay.

CS3212	Microprocessors and Microcontroller	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the architecture and programming of 8085 and 8086microprocessor.
- To introduce the interfacing of peripheral devices with 8085 microprocessor.
- To introduce the architecture and programming of Pentium and ARMprocessors.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the architecture, instructions of 8085 and 8086 microprocessor and apply the instructions to create and analyze various applications.	U, A
CO-02	Design the interfacing circuits and develop the programming skills to interface the i/o devices for the system.	U, A
CO-03	Understand and remember the architecture, instructions of Pentium and ARM processors and apply the skills for the computing system.	U, R,A
CO-04	Understand the 8051 microcontroller basics, instructions and apply them to create application programs for the engineering application domain.	U, A
CO-05	Understand the PIC microcontroller basics, instructions and apply them to create application programs for the engineering application domain.	U, A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	M	L	L	M	S	S	N	N	N	N	L
CO-02	L	M	M	L	M	S	M	N	N	N	N	L
CO-03	S	M	M	L	L	M	S	N	N	N	N	L
CO-04	M	L	M	M	L	M	S	N	N	N	N	L
CO-05	S	M	M	M	M	M	S	N	N	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: 8-Bit Microprocessor And 16- Bit Microprocessor 9

8085 Architecture – Instruction set – Addressing modes – Assembly language programming – Intel 8086 Internal Architecture – 8086 Addressing modes- Instruction set- 8086 Assembly language Programming–Interrupts.

Unit II: I/O Interfacing 9

Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

Unit III: Advanced Processors- Pentium & Arm 9

High Performance CISC Architecture- Pentium- CPU Architecture- Bus Operations – Pipelining –Multitasking – Exception and Interrupts – Instruction set – Addressing modes - High Performance RISC Architecture – ARM- Core & Architectures - Registers – Pipeline - Interrupts – ARM organization- ARM instruction set.

Unit IV: 8051 Microcontroller 9

Architecture - Pin Configuration - Addressing Modes - Instruction Set Programming - Timers – Counters - Programming - Interrupts- Communication Interfaces - Interfacing With DAC, ADC, Stepper Motor.

Unit V: PIC Microcontroller 9

PIC Family - PIC16F84A: Features - Architecture – Data Memory Organization RAM - Program Memory - ROM – Instruction Types And Addressing Modes- Instruction Cycle - Ports - Introduction To Programming PIC Microcontrollers Using MPLAB.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 6th Edition, Penram International Publishing, New Delhi, 2013.
2. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family
3. Architecture, Programming and Design", Second Edition, Prentice Hall of India,2007.
4. Steve Furber , "ARM System –On –Chip architecture, Pearson Education,2014.
5. James L. Antonakos , " The Pentium Microprocessor", Pearson Education, 2002.
6. Mohammed Ali Mazidi and Janice GillispieMazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education Asia, New Delhi, 2011.
7. Tim Wilmshurst, Designing Embedded Systems with PIC Microcontrollers, Newnes Publisher, ISBN:9780080961842, 2009.
8. PIC: 18F2420, 16F84A data sheet ,by Microchip

REFERENCES:

1. A.K. Ray and K.M.Burchandi, Intel Microprocessors Architecture Programming and Interfacing, McGraw Hill International Edition, 2002.
2. M. Rafi Quazzaman, Microprocessors Theory and Applications: Intel and Motorola Hall of India, Pvt. Ltd., New Delhi, 2003.

EE3214	**Power System-I**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis.
- To model and carry out short circuit studies on power system.
- To model and analyze stability problems in power system.

Course Outcome – Cos		**Cognitive Skill**
CO-01	To understand the role of power system analysis tools on the planning and operation of power system and develop the one line diagram	U,A
CO-02	To compute Ybus and Zbus matrices for power system networks and find the load flow solution by Gauss-Seidal and Newton-Raphson method.	U,A
CO-03	Understand the types of fault and balance three phase fault	U,A
CO-04	To apply symmetrical component techniques for unsymmetrical faultanalysis.	U,A
CO-05	To solve the swing equation of a power system using different numericaltechniques.	U,E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO- G	PO-H	PO- I	PO-J	PO-k	PO-L
CO-01	S	L	L	N	N	N	N	N	N	N	N	L
CO-02	S	S	L	N	N	N	N	N	N	N	N	L
CO-03	M	M	S	N	N	L	L	N	N	N	N	L
CO-04	L	L	M	N	N	L	L	N	N	N	N	M
CO-05	L	L	L	M	N	L	L	N	L	N	N	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Power System – An Overview and Modelling: 9

Need for system planning and operational studies – Power scenario in India, Modern Power System - Basic Components of a power system - Per Phase Analysis; Generator model - Transformer model - line model. The per unit system - Change of base.

Unit-II: Power Flow Analysis: 9

Importance of power flow analysis, Introduction - Bus Classification - Bus admittance matrix – Bus impedance matrix-Solution of non-linear Algebraic equations - Gauss seidal method – Newton raphson method-Fast decoupled method.

Unit-III: Fault Analysis-Balanced Fault 9

Introduction-Importance of short circuit analysis and basic assumptions in short circuit – Balanced three phase fault – short circuit capacity – systematic fault analysis using bus impedance matrix –Nature and causes of faults-Types of faults.

Unit-IV: Fault Analysis –Unbalanced Fault: 9

Introduction – Fundamentals of symmetrical components – sequence impedances – sequence networks – single line to ground fault – line to line faults - Double line to ground fault – Unbalanced fault analysis.

Unit-V: Power System Stability 9

Introduction to steady Stability Analysis: state and transient stability of power systems, swing equation, equal area criteria, solution of swing equation, methods of improving stability, Introduction to voltage stability.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Hadi Saadat " Power system analysis", Tata McGraw Hill Publishing Company, New Delhi, 2010.(Unit I, II, III, IV)
2. P.Kundur, "Power System Stability and Control", Tata McGraw Hill Publishing Company, New Delhi, 2010 (Unit V)
3. I.J.Nagrath and D.P.Kothari, 'Modern Power System Analysis', Tata McGraw-Hill publishing company, New Delhi, 2011.
4. John J.Grainger and W.D.Stevenson Jr.,'Power System Analysis',McGraw-Hill

International Book Company,2015.

REFERENCES:

1. M.A. Pai, 'Computer Techniques in power system Analysis', Tata McGraw – Hill publishing company, New Delhi, 2007.
2. Mohammed Ali Mazidi and Janice GillispieMazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education Asia, New Delhi, 2011.
3. Tim Wilmshurst, Designing Embedded Systems with PIC Microcontrollers, Newnes Publisher, ISBN:9780080961842, 2009.
4. PIC: 18F2420, 16F84A data sheet ,by Microchip.

CS3278	Microprocessors and Microcontroller Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

- To Introduce ALP concepts, features and coding methods.
- Write ALP for arithmetic and logical operations in 8085, 8086 and 8051
- Differentiate Serial and Parallel Interface.
- Interface different I/Os with Microprocessors.
- Be familiar with MASM.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the instructions of 8085, 8086 and 8051and performarithmetic and logical operations.	U, A
CO-02	Remember and apply the designs and concepts of 8086 microprocessor to perform string operations and move a data block without overlap.	R, U, A
CO-03	Apply the interfacing circuit design concept and perform interfacing with8085/8086 microprocessor.	R, U,A
CO-04	Remember and apply the serial communication and interface the stepper motor and traffic light controller using 8085/8086programming.	R,A
CO-05	Understand and perform arithmetic and Logical operations using MASMsoftware.	U, A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	L	M	M	S	M	N	N	N	N	N
CO-02	S	M	L	L	L	M	S	N	N	N	N	N
CO-03	S	L	L	M	M	N	S	N	N	N	N	N
CO-04	M	M	L	L	L	M	S	N	N	N	N	N
CO-05	S	M	L	L	M	M	S	N	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

LIST OF PROGRAMS:

1. Programs for 8/16 bit Arithmetic and Logical operations (Using 8085, 8086 and 8051).
2. Programs for Sorting and Searching (Using 8085, 8086 and 8051).
3. Programs for String manipulation operations (Using 8086).
4. Program to move a data block without overlap (Using 8086).
5. Arithmetic and Logical Operations using MASM Software.
6. Interfacing ADC and DAC.
7. Interfacing and Programming 8279, 8259, and 8253.
8. Interfacing and Programming of Stepper Motor and Traffic Light Controller.

TOTAL:45 HOURS

EE3280	**Control System Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To provide a platform for understanding the basic concepts of linear control theory and its application to practical systems.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Ability to understand control theory and apply them to electrical engineering problems.	R,U,A,
CO-02	Ability to analyze the various types of controllers	U, An
CO-03	Ability to design compensators	R,S
CO-04	Ability to study the simulation package	R,U
CO-05	Ability to analyse the stability of system	An, U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	N	N	M	N	N	N	L	N	N	N	N
CO-02	S	M	M	N	N	N	N	M	N	N	N	N
CO-03	S	S	S	S	N	M	N	M	N	N	N	N
CO-04	S	N	M	N	N	N	N	N	N	N	N	N
CO-05	S	M	S	M	N	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Determination of transfer function parameters of a DC servo motor.
2. Determination of transfer function parameters of AC servo motor.
3. Analog simulation of type-0 and type-1 system.
4. Digital simulation of linear systems.
5. Digital simulation of non-linear systems.
6. Design and implementation of compensators.
7. Design of P, PI and PID controllers.
8. Stability analysis of linear systems.
9. Closed loop control system.
10. Study of synchros. 11.Study of stepper motor.
11. Study of speed control system.

TOTAL: 45 PERIODS

EE3281	**Power System Laboratory-I**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES:

- To provide a better understanding of modelling of transmission lines I impedance and admittance forms.
- To apply iterative techniques for power flow analysis and to carry out short
- circuit and stability studies on power system.
- To analyze the load – frequency and voltage controls.
- To analyze optimal dispatch of generators and perform state estimation.
- To understand the operation of relays, characteristics, and applications

Course Outcome - COs		Cognitive Skill
CO-01	Model and analyze the performance of the transmission lines.	A,An
CO-02	Perform power flow, short circuit, and stability analysis for any power system network.	A
CO-03	Understand, design, and analyze the load frequency control mechanism.	U, A, An
CO-04	Perform optimal scheduling of generators and compute the state of thepower system.	R
CO-05	Understand, analyze, and apply the relays for power system protection	U, An, A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO – I	PO-J	PO-k	PO – L
CO-01	L	L	N	S	L	S	M	N	N	N	S	N
CO-02	S	N	N	S	N	L	S	N	N	N	M	N
CO-03	S	S	N	L	N	L	L	N	N	N	S	N
CO-04	S	L	N	L	N	S	S	N	N	N	L	N
CO-05	L	N	N	L	N	S	S	N	N	N	M	N

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS:

1. Computation and modelling of transmission Lines.
2. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems.
3. Formation of Bus Admittance and Impedance Matrices.
4. Power Flow Analysis Using Gauss-Seidel Method.
5. Power Flow Analysis Using Newton Raphson Method.
6. Symmetric and Unsymmetrical Fault Analysis.
7. Performance analysis of impedance relay.
8. Testing of CT, PT, and Insulator string.
9. Relay Coordination in Radial Feeder Protection Scheme.
10. Digital Over Current Relay Setting and Relay Coordination using Suitable software packages.
11. Co-ordination of over-current and distance relays for radial line protection

TOTAL: 45 PERIODS

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	AI32D1**(OE)**	Fundamentals of Artificial Intelligence	3	0	0	3
2.	EE3215	Measurement and Instrumentation	3	0	0	3
3.	EE3216	Power System II	3	0	0	3
4.	EE3217	Solid State Drives	3	0	0	3
5.	EE32**	Elective-II	3	0	0	3
6	EE32**	Elective-III	3	0	0	3
PRACTICAL						
7.	EE3283	Measurement and Instrumentation Laboratory	0	0	2	1
8.	EE3284	Power system Laboratory II	0	0	2	1
9.	EE3285	Electronic Design Laboratory	0	0	2	1
10.	EE32P2	Summer Internship II	0	0	0	2
TOTAL			17	0	6	23

AI32D1	Fundamentals of Artificial Intelligence	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the basic concepts of intelligent agents.
- Develop general-purpose problem-solving agents, logical reasoning agents, and agents that reason under uncertainty.
- Employ AI techniques to solve some of today's real-world problems.

Course Outcome		Cognitive Skill
CO-01	Explain autonomous agents that make effective decisions in fully informed, partially observable, and adversarial settings.	U
CO-02	Choose appropriate algorithms for solving given AI problems	A
CO-03	Design and implement logical reasoning agents	R, A
CO-04	Design and implement agents that can reason under uncertainty	R, A
CO-05	Understand the basic areas of artificial intelligence including problem solving, knowledge representation, reasoning, decision making, planning, perception, and action.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO- I	PO-J	PO-K	PO-L
CO-01	L	L	L	M	L	M	M	L	N	N	N	L
CO-02	M	M	S	M	M	M	L	L	N	N	N	N
CO-03	M	M	M	M	M	S	S	L	N	N	N	N
CO-04	S	M	S	L	L	M	S	L	N	N	N	N
CO-05	M	M	L	L	M	M	S	L	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: AI Agents **9**

Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments – Structure of agents – Problem solving agents–Search algorithms–Uninformed search strategies.

Unit II: Problem Solving **9**

Heuristic search strategies–heuristic functions - Local search and optimization problems – Local search in continuous space – Search with non-deterministic actions – Search in partially observable environments – Online search agents and unknown environments.

Unit III: Theory of Game Playing **9**

Game theory – Optimal decisions in games – Alpha-beta search – Monte-Carlo tree search – Stochastic games– Partially observable games.Constraint Satisfaction Problems – Constraint propagation – Backtracking search for CSP – Local search for CSP– Structure of CSP.

Unit IV: Knowledge Based Logical Agents **9**

Knowledge-based agents – Propositional logic – Propositional theorem proving – Propositional model checking– Agents based on propositional logic.First-order logic – Syntax and semantics – Knowledge representation and engineering – Inferences in first-order logic–Forward chaining– Backward chaining–Resolution.

Unit V: Knowledge Representation 9

Ontological engineering – Objects and categories–Events–Mental objects and Modal logic– Reasoning systems for categories – Reasoning with default information. Classical planning–Algorithms for classical planning– Heuristics for planning–Hierarchical planning–non-deterministic domains– Time, Schedule, and Resources– Analysis.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education,2020.

REFERENCES:

1. Dan W. Patterson, "Introduction to AI and ES," Pearson Education,2007.
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence," McGrawHill,2008.
3. Patrick H. Winston, "Artificial Intelligence," Third edition, Pearson Edition,2006.
4. Deepak Khemani, "Artificial Intelligence," Tata McGraw Hill Education, 2013.
5. Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases -byDennisRothman,2018.

EE3215	**Measurement and Instrumentation**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To educate the fundamental concepts and characteristics of measurement and errors
- To impart the knowledge on the functional aspects of measuring instruments
- To infer the importance of various bridge circuits used with measuring instruments.
- To educate the fundamental working of sensors and transducers and their applications
- To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.

Course Outcome		**Cognitive Skill**
CO-01	Ability to understand the fundamental art of measurement in engineering.	U
CO-02	Ability to understand the structural elements of various instruments.	U
CO-03	Ability to understand the importance of bridge circuits.	U
CO-04	Ability to understand about various transducers and their characteristics by experiments.	U
CO-05	Ability to understand the concept of digital instrumentation and virtual instrumentation by experiments.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	S	N	S	M	N	M	N	N	N	S
CO-02	S	M	S	M	N	N	N	N	N	S	N	S
CO-03	S	M	S	N	S	M	N	N	N	N	N	S
CO-04	S	M	S	M	N	N	N	M	N	N	N	N
CO-05	S	M	S	M	S	N	N	N	N	S	N	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Concepts of Measurements **9**

Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics – Measurement standards-Errors-Types of Errors –Statistics of errors-Statistical evaluation of measurement data.

Unit II: Measurement of Parameters in Electrical Systems **9**

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Currenttransformers and potential transformers – principle of working -ratio and phaseangle errors.

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Unit III: AC/DC Bridges and Instrumentation Amplifiers **9**

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien, and Schering bridges – Errors and compensation in A.C. bridges - DC Hall effect sensors - Instrumentation Amplifiers.

Unit IV: Transducers for Measurement of Non- Electrical Parameters **9**

Definition and classification of transducers - LVDT- Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers - Smart Sensors.

Unit V: Digital Instrumentation 9

A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements &Instrumentation,’ Dhanpat Rai and Co, New Delhi, Edition2011.
2. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010

REFERENCES:

1. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology,'Prentice Hall India, New Delhi, 2009
2. J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011
3. W. Bolton, Programmable Logic Controllers, 6th Edition, Elsevier, 2015.
4. R.B. Northrop, 'Introduction to Instrumentation and Measurements,' Taylor & Francis, New Delhi,3rd. Edition 2014.
5. E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design," Tata McGraw-Hill, New Delhi, 6th Edition2017.
6. R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation," Chand Pub, 2016

EE3216	**Power System-II**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To introduce various solution techniques to solve the large-scale power systems.
- To impart in-depth knowledge on different power flow solution methods for large power system networks.
- To perform various optimal power flow methods involving operating
- and security constraints.
- To perform short circuit fault analysis for various fault conditions on three phase basis.
- To Illustrate different numerical integration methods and influencing transient stability

Course Outcome		**Cognitive Skill**
CO-01	Ability to solve large scale simultaneous linear equations and the ordering schemes for preserving sparsity.	A, An
CO-02	Ability to solve large scale power flow problems	A, An
CO-03	Ability to solve optimal power flow problem using various solution methods	A, An
CO-04	Ability to do fault calculations for various fault conditions on three phase basis	R
CO-05	Ability to do stability studies under various disturbances using numerical integration methods	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO- I	PO-J	PO-K	PO-L
CO-01	S	N	S	N	S	S	N	N	N	N	N	N
CO-02	S	M	S	N	N	N	N	N	N	N	M	N
CO-03	S	N	S	N	S	S	N	N	N	N	N	N
CO-04	S	N	S	N	M	L	N	N	N	N	N	N
CO-05	S	N	S	M	M	S	N	N	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction **9**

Sparse Matrix techniques for large scale power systems - Optimal ordering schemes for preserving sparsity - Flexible packed storage scheme for storing matrix as compact arrays - Factorization by Bifactorization and Gauss elimination methods - Repeat solution using Left and Right factors and L and U matrices.

Unit II: Power Flow Analysis **9**

Power flow equation in real and polar forms - Review of Newton Raphson method for solution; Adjustment of P-V buses - Review of Fast Decoupled Power Flow method - Sensitivity factors for P-V bus adjustment.

Unit III: Optimal Power Flow **9**

Problem statement - Solution of Optimal Power Flow (OPF) - The gradient method - Newton's method - Linear Sensitivity Analysis - LP methods - With real power variables only - LP method with AC power flow variables and detailed cost functions - Security constrained Optimal Power Flow - Interior point algorithm - Bus Incremental costs.

Unit IV: Short Circuit Analysis **9**

Formation of bus impedance matrix with mutual coupling (single phase basis and three phase basis) - Computer method for fault analysis using ZBUS and sequence components - Derivation of equations for bus voltages -fault current and line currents - both in sequence and phase - symmetrical and unsymmetrical faults.

Unit V: Transient Stability Analysis **9**

Introduction - Numerical Integration Methods - Euler and Fourth Order Runge-Kutta methods - Algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model - Factors influencing transient stability - Numerical stability and implicit Integration methods.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. J. Wood and B. F. Wollenberg, "Power Generation Operation and Control," John Wiley and sons, New York, 2016.
2. M. A. Pai," Computer Techniques in Power System Analysis," Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.

REFERENCES:

1. G W Stagg, A.H El. Abiad, "Computer Methods in Power System Analysis," McGraw Hill,1968.
2. P. Kundur, "Power System Stability and Control," McGraw Hill, 1994.
3. D. P. Kothari and I. J. Nagrath, 'Modern Power System Analysis,' Fourth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.
4. K. Zollenkopf, "Bi-Factorization: Basic Computational Algorithm and Programming Techniques; pp:75-96; Book on "Large Sparse Set of Linear Systems" Editor: J. K. Rerd, Academic Press, 1971.

EE3217	**Solid State Drives**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To introduce the basics of electric drives
- To explain the operation of phase-controlled DC drives
- To elucidate the theory of chopper fed DC motor drives
- To explain the different speed control mechanisms for induction motor drives
- To articulate the theory for operating synchronous motor and special machine drives.

Course Outcome		**Cognitive Skill**
CO-01	Understand the basics of electric drives	U
CO-02	Analyze the operation of phase-controlled dc drives	An
CO-03	Apply the theory of self-commutated switches to the operation of chopper fed drives	A
CO-04	Analyze the speed control mechanisms for induction motor drives	An
CO-05	Understand the operation of synchronous motor and special machine drives	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	M	L	S	M	L	L	N	N	N	L	L
CO-02	M	M	M	S	S	L	L	N	N	N	L	L
CO-03	M	M	M	S	S	L	L	N	N	N	L	L
CO-04	M	M	M	M	S	L	L	N	N	N	L	L
CO-05	M	M	M	M	S	L	L	N	N	N	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Performance of Electric Drives 9

Electric Drives – Types of electric drives - Characteristics of Electric Drives - Advantages of electric drives - speed torque characteristics of various types of loads and drive motors - Joint speed torque characteristics - Selection of power rating for drive motors based on thermal limits, overload capacity and load variation factors.

Unit II: Phase Controlled DC Drives 9

Solid state Drives: Introduction - comparison between solid state and conventional drives - open loop and closed loop speed control - DC motor transfer function - speed and current control loops - converter fed DC drives(using thyristors) - single, two and four quadrant operations - Reversible drives - Armature and field current reversal - Dynamic and regenerative braking.

Unit III: Chopper Controlled DC Drives 9

Principles of chopper operation - chopper configuration - chopper fed D.C. motors, analysis, and performance characteristics - Dynamic and regenerative braking of chopper- controlled drives - regenerative reversals.

Unit IV: Induction Motor Drives 9

Speed control of three phase induction motor - stator voltage and frequency control – V/F control- Rotor control - static control of rotor resistance using DC chopper - slip power recovery scheme – Static Kramer and Scherbius drives.

Unit V: Synchronous Motor and Special Machine Drives 9

Speed control of synchronous motors - modes of operation - Adjustable frequency operation - controlled current operation - voltage source inverter and current source inverter fed synchronous motor drive - PWM inverter fed synchronous motor drives – cycle converter fed synchronous motor drives Special Machines Drives (qualitative treatment) – Principle of

operation, Brush less DC, and Permanent Magnet Synchronous Motor drives. Design of controller: current controller and speed controller.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Dubey, G.K., "Fundamentals of Electrical Drives," Narosa PublishingHouse, New Delhi, 2004.
2. P.C. Sen., "Thyristor DC Drives," John Wiley and Sons, New York, 1981.
3. Bimal K. Bose, "Modern Power Electronics and AC Drives," Pearson Education Asia2003.

REFERENCES:

1. Pillai, S.K., "A First course on Electric Drives," Wiley Eastern Ltd, Bombay,1988.
2. Vedam Subramanayan, "Electric Drives - Concepts and Applications",Tata McGraw Hill Publishing Company Limited, New Delhi, 2007.
3. Murphy, J.M.D. and Turnbull, F.G., "Power Electronic Control of A.C. Motors," Pergamon Press, Oxford.
4. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives," Clarendon Press, Oxford, 1989.
5. Gopal K. Dubey, "Power Semi-Conductor Controlled Drives," Prentice Hall New Jersey, 1989.

EE3283	Measurement and Instrumentation Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

- The objective this is, the student acquires sufficient knowledge experience and enhance his capability for handling the equipment and ease of measurement.

Course Outcome		Cognitive Skill
CO-01	Capable to use CRO effectively.	R, U, A,
CO-02	Capable to measure unknown resistance, inductance and capacitance values.	U, An
CO-03	Can calibrate different meters.	R, S
CO-04	Capable of designing bridge circuits.	R, U
CO-05	Gain knowledge about analysis of errors.	An, U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	M	M	N	N	N	N	M	N	N	N	N
CO-02	M	M	N	N	N	N	N	M	N	N	N	N
CO-03	S	S	M	N	N	N	N	M	N	N	N	N
CO-04	S	S	M	N	N	N	N	M	N	N	N	N
CO-05	S	S	S	N	N	N	N	M	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

LIST OF EXPERIMENTS:

1. Statistical analysis of random errors.
2. CRO Measurements.
3. Study of transients.
4. Measurement of medium resistance using Wheat stone's bridge.
5. Kelvin's Double Bridge.
6. Calibration of single-phase energy meter.
7. Calibration of wattmeter.
8. Anderson Bridges.
9. Calibration of ammeter and voltmeter.
10. Measurement of displacement using LVDT.
11. Schering's Bridge.
12. Measurement of power using two wattmeter method.

TOTAL: 45 PERIODS

EE3284	**Power System Laboratory II**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To provide a better understanding of modelling of transmission lines in impedance and admittance forms.
- To apply iterative techniques for power flow analysis and tocarry out short circuit and stability studies on power system.
- To analyze the load – frequency and voltage controls.
- To analyze optimal dispatch of generators and perform state estimation.
- To understand the operation of relays, characteristics, and applications.

Course Outcome		Cognitive Skill
CO-01	Apply advanced tools to simulate the model of power network for power system problems	A
CO-02	Acquire expertise in usage of modern techniques for Power System Issues	U, R
CO-03	Apply soft computing techniques to Power System problems and evaluate the solution	R
CO-04	Analyze the solution obtained through soft computing techniques	An
CO-05	Suggest suitable technique as applicable to power system problem	U, R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	L	L	N	S	L	S	M	N	N	N	S	N
CO-02	S	N	N	S	N	L	S	N	N	N	M	N
CO-03	S	S	N	L	N	L	L	N	N	N	S	N
CO-04	S	L	N	L	N	S	S	N	N	N	L	N
CO-05	L	N	N	L	N	S	S	N	N	N	M	N

S-Strong, M-Medium, L-Low, N-Not relevant

LIST OF EXPERIMENTS:

1. Solution of Unit commitment Problem through Evolutionary algorithm
2. Solution of Economic Dispatch using Evolutionary algorithm
3. Automatic Voltage Regulator with Power System Stabilizer
4. State Estimation of Power System
5. Intelligent control techniques for Automatic Generation Control
6. Soft Computing Techniques for Power System Problems
7. Simulation of Solar PV & Wind Energy Conversion System
8. Analysis of Power grid in presence of Renewable Energy Sources

TOTAL: 45 PERIODS

EE3285	Electronic Design Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

- To enable the students to understand the design for various electronic circuits using transistor and simulate each circuit using PSSPICE.

Course Outcome		Cognitive Skill
CO-01	Analyze various types of feedback amplifiers	An
CO-02	Design oscillators, tuned amplifiers	A
CO-03	Design wave-shaping circuits.	A
CO-04	Design multi vibrators	A
CO-05	Design integrator and differentiator	A
CO-06	Design and simulate feedback amplifiers, oscillators, tuned amplifiers, wave-shaping circuits and multivibrators using PSSPICE Tool.	S

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	M	L	M	L	N	N	L	N	N	N
CO-02	S	S	S	L	M	L	N	N	L	N	N	N
CO-03	S	S	S	L	M	L	N	N	L	N	N	N
CO-04	S	M	L	L	M	L	N	N	L	N	N	N
CO-05	M	M	S	L	M	L	N	N	L	N	N	N
CO-06	M	M	S	L	M	L	N	N	L	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

LIST OF EXPERIMENTS:

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Series and Shunt feedback amplifiers-Frequency response, Input, and output impedance calculation
2. RC Phase shift oscillator
3. Wien Bridge Oscillator
4. Hartley Oscillator

5. Colpitts Oscillator
6. Single Tuned Amplifier
7. RC Integrator and Differentiator circuits
8. Astable and Monostable multivibrator
9. Clippers and Clampers

SIMULATION USING SPICE (Using Transistor):

1. Tuned Collector Oscillator
2. Twin -T Oscillator / Wein Bridge Oscillator
3. Bistable Multivibrator

TOTAL: 45 PERIODS

SEMESTER VII

SL. NO.	COURSECODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MS3202	Principles of Management	2	0	0	2
2.	EE3219	Design of Electrical Apparatus	3	1	0	4
3.	EE3220	Electrical Energy Generation, Utilization and Conservation	3	0	0	3
4.	EE32**	Elective-IV	3	0	0	3
5.	EE32**	Elective-V	3	0	0	3
6.	CS32D2**(OE)**	Renewable Energy Systems	3	0	0	3
PRACTICAL						
6.	EE3286	Electrical Wiring and Winding Laboratory	0	0	2	1
7.	EE32P3	Project Stage I	0	0	8	4
TOTAL			16	1	10	22

MS3202	Principles of Management	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce students to the basic concepts and functions of management.
- To understand the role and responsibilities of managers in various organizational settings.
- To develop an understanding of the planning, organizing, leading, and controlling functions of management.
- To examine the impact of management theories and practices on organizational performance.
- To equip students with the skills necessary to manage people and processes effectively in a technical environment.

Course Outcome – Cos		Cognitive Skill
CO-01	Define and explain the key concepts and functions of management.	U, R
CO-02	Analyse the roles and responsibilities of managers in different organizational contexts.	An
CO-03	Apply planning, organizing, leading, and controlling principles to real-world scenarios.	A
CO-04	Evaluate the effectiveness of different management theories and practices.	E
CO-05	Demonstrate management skills necessary for leading teams and projects in a technical environment.	A

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO - I	PO-J	PO-k	PO -L
CO-01	S	S	L	L	S	L	S	L	M	S	S	M
CO-02	L	L	S	L	S	L	M	S	S	M	S	M
CO-03	L	L	S	L	S	L	M	S	S	M	S	M
CO-04	S	L	M	S	S	M	S	S	M	L	M	S
CO-05	S	S	L	L	S	L	S	L	M	S	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Introduction to Management **7**

Definition, nature, and importance of management - Functions of management: Planning, Organizing, Leading, Controlling - Roles and skills of managers - Evolution of management thought: Classical, Behavioural, and Modern theories - Scientific Management (Taylor) - Administrative Theory (Fayol) - Human Relations Movement (Mayo) - Contemporary approaches (Systems Theory, Contingency Theory)

Unit II: Planning **5**

Nature and purpose of planning - Types of plans: Strategic, Tactical, Operational - Planning process and techniques - SWOT Analysis, SMART Goals , Scenario Planning - Decision making: Process, types, and tools- Rational Decision-Making Model - Bounded Rationality - Group Decision-Making Techniques (Brainstorming, Delphi Technique)

Unit III: Organizing **5**

Organizational structure and design - Types of organizational structures: Functional, Divisional, Matrix, Network - Authority, responsibility, and delegation - Coordination and communication within organizations - Formal and Informal Communication Channels - Role of Technology in Organizational Communication (Emails, Video Conferencing, Collaborative Tools)

Unit IV: Leading **7**

Leadership theories and styles - Trait Theory - Behavioural Theories (Ohio State Studies, Michigan Studies) - Contingency Theories (Fiedler's Model, Path-Goal Theory) - Transformational vs. Transactional Leadership - Motivation theories and practices, Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory, McClelland's Theory of Needs, Modern Approaches (Self-Determination Theory) -Group dynamics and team management - Stages of Team Development (Forming, Storming, Norming, Performing) - Managing Virtual Teams

Unit V: Controlling **6**

Nature and purpose of control - Control process and techniques, Establishing Standards, Measuring Performance, Correcting Deviations - Types of control: Feed forward, Concurrent, Feedback - Quality control and management, Total Quality Management (TQM), Six Sigma, Lean Management, Use of Data Analytics in Quality Control.

TOTAL: 30 PERIODS

TEXTBOOKS :

1. Robbins, S. P., Coulter, M., & DeCenzo, D. A. (2020). *Fundamentals of Management* (11th ed.). Pearson.
2. Griffin, R. W. (2022). *Management: Principles and Practices* (12th ed.). Cengage Learning.
3. Jones, G. R., & George, J. M. (2021). *Essentials of Contemporary Management* (9th ed.). McGraw-Hill Education.

REFERENCES:

1. Daft, R. L. (2021). *Management* (14th ed.). Cengage Learning.
2. Bateman, T. S., & Snell, S. A. (2020). *Management: Leading & Collaborating in a Competitive World* (14th ed.). McGraw-Hill Education.
3. Schermerhorn, J. R. (2021). *Management* (14th ed.). Wiley.
4. Hill, C. W. L., Schilling, M. A., & Jones, G. R. (2020). *Strategic Management: Theory & Cases* (13th ed.). Cengage Learning.
5. Kinicki, A., & Williams, B. K. (2021). *Management: A Practical Introduction* (10th ed.). McGraw-Hill Education.

EE3219	**Design of Electrical Apparatus**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES:

- Have a good understanding on the design and applications of DC &AC machines
- To introduce the basic design concepts and cooling arrangement of transformers.
- To introduce computer aided machine design.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Understand and remember the concepts of magnetic circuit in static and dynamic AC machines and their heating and cooling methods	U, R
CO-02	Design the main dimensions of DC machines for the given specification	A
CO-03	Design the core, yoke, windings and cooling systems of single phase and three phase transformers for the given specification and Analyze the equivalent circuit parameter from design data of transformer.	A, An
CO-04	Design of stator and rotor of induction machines and synchronous machines and evaluate the performance of a given synchronous machine	A, E
CO-05	Apply the importance of computer aided design methods on electrical machines.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO - I	PO-J	PO-k	PO -L
CO-01	S	S	L	L	S	L	S	L	M	S	S	M
CO-02	L	L	S	L	S	L	M	S	S	M	S	M
CO-03	S	L	M	S	S	M	S	S	M	L	M	S
CO-04	L	L	S	L	S	L	M	S	S	M	S	M
CO-05	L	L	S	L	S	L	M	S	S	M	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Fundamentals of Electrical Machine Design 9

Characteristics of materials selection- conductors, materials, insulation. Standard specification of frame size, conductors and insulation - Magnetization and loss curves – Real and Apparent flux density- Heating and cooling methods of electrical machines.

Unit-II: D.C Machines 9

Construction details – Output equation – Main dimensions- Choice of specific loadings – Choice of number of poles- armature design – design of field poles and field coils – Design of commutator and brushes. Losses and efficiency- Case study for the validation of commercial available machines.

Unit-III: Transformers 9

Construction details of core and shell type transformers – output rating of single phase and three phase transformers – optimum design of transformers - design of yoke, core and winding for core and shell type transformers-equivalent circuit parameters from design data- Design of tank and cooling tubes of transformers. No load current calculations. Leakage Reactance of core type transformer with concentric coils, Losses and efficiency- Case study for the validation of commercial available machines.

Unit-IV: A.C. Machines 9

Construction details of A.C. machines – output equation – main dimensions- Choice of specific loadings –design of stator – design of squirrel cage and slip ring rotor - equivalent circuit parameter from design data – Short circuit ratio- design of rotor of cylindrical pole and salient pole machines, Estimation of No Load Current and Leakage Reactance.

Unit-V: Computer Aided Design 9

Need for computer aided design – Analysis method – Synthesis method - Introduction to analysis of Electric machine parameters using FEM.

L: 45 T + 15 = TOTAL: 60 HOURS

TEXT BOOKS:

1. A.K.Sawhney , ‘A course in Electrical Machine Design’ , Dhanpat Rai and sons, 2004,fifth edition, New Delhi.
2. SK Sen, ‘Principles of Electrical Machine Design with Computer Programme’, Oxford and IBH publishing Co. Pvt Ltd., New Delhi, Second edition 2009.

REFERENCES:

1. R.K Agarwal,'Principles of Electrical Machine Design' , S.K.Kataria sons , NewDelhi, 2009.
2. V.N Mittle and A. Mittle, 'Design of Electrical Machines', Standard Publications and Distributors , Delhi , 2005.
3. Sheppard J. Salen, "FEA of Electrical Machines, Springer International Edition, First Indian reprint, 2007.
4. M.G. Say "Performance and Design of AC machines" CBS Publishers and distributors, New Delhi, first Indian Edition, Reprint 1998.
5. A.E. Clayton and N.H.Hancook "Performance and design of DC machines" ELBS: Pitman edition, 1962.

EE3220	Electrical Energy Generation, Utilization and Conservation	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on

- Generation of electrical power by conventional and non – conventional methods.
- Electrical energy conservation, energy auditing and power quality.
- Principle and design of illumination systems and methods of heating and welding.
- Electric traction systems and their performance.
- Industrial applications of electric drives.

Course Outcome – Cos		Cognitive Skill
CO-01	Gain knowledge about different methods of power generation	A,U
CO-02	Gain knowledge about illuminating different places	A,U,R
CO-03	Gain knowledge about heating and welding	A,U,R
CO-04	Gain knowledge about traction.	A,U,R
CO-05	Gain knowledge about electric energy conservation.	A,E

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	M	M	N	N	L	S	M	L	N	M	M
CO-02	S	L	S	N	N	M	M	L	L	N	M	M
CO-03	S	N	N	N	N	M	M	M	L	N	S	L
CO-04	S	L	M	M	N	M	M	L	L	N	M	L
CO-05	S	M	L	L	N	M	M	M	N	N	M	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Generation 9

Generation of electrical power by conventional methods: Hydro, thermal and nuclear generations. Generation from non conventional methods: tidal, wind, MHD, geothermal and solar sources– a brief view. Introduction to the concept of distributed generation – effect on system operation.

Unit-II: Illumination 9

Nature of radiation – definition-laws – photometry – lighting calculations – design of illumination systems (for residential, industrial, commercial, health care, street lightings, sports, administrative complexes) - types of lamps - energy efficiency lamps, improvement in illumination.

Unit-III: Heating and Welding 9

Methods of heating, requirement of heating material – design of heating element – furnaces – welding generator – welding transformer and its characteristics. High frequency heating, Dielectric heating.

Unit-IV: Electric Traction and Drives 9

Introduction – requirements of an ideal traction system – supply systems – mechanics of train movement – traction motors and control – multiple units – braking – current collection systems – recent trends in electric traction, Hybrid Electric Vehicles.

Introduction – motor selection for different drives –Characteristics of drive system -acceleration-deceleration and degeneration – load equalization– modern methods of speed control of industrial drives and its industrial applications.

Unit-V: Conservation 9

Economics of generation – cost of electrical energy – availability based tariff – need for electrical energy conservation – methods – energy efficient equipment – energy management – energy auditing. Economics of power factor improvement – design for improvement of power factor using power capacitors – effect on conservation.

L: 45 T + 15 = TOTAL: 60 HOURS

TEXT BOOKS:

1. E. Openshaw Taylor, 'Utilization of Electrical Energy in SI Units', Orient Longman Pvt.Ltd, 2003.
2. B.R. Gupta, 'Generation of Electrical Energy', S.Chand Ltd, 7th Edition,2017.

REFERENCES:

1. H. Partab, 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Co, New Delhi, 2014.
2. Gopal.K.Dubey, 'Fundamentals of Electrical Drives', Narosa Publishing House, New Delhi, 2010.
3. C.L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', New Age international Pvt,2015.
4. J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K.Kataria and Sons, 2013.

EE3286	Electrical Wiring and Winding Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide a platform for all kind of practical jobs like wiring, repairing of fan and starters, machines and maintenance work of various electrical appliances.

Course Outcome – Cos		Cognitive Skill
CO-01	Ability to identify different types of weather proof wires	R,U,
CO-02	Ability to analyze the charging parameters of Lead acid Battery	U, An
CO-03	Ability to identify the faults in fan and DC generator and test it to run	U, An
CO-04	Ability to identify the faults in starters and test it to run	R,U
CO-05	Ability to Dismantle over haul and assemble a three phase squirrel cage	An, U

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO - I	PO-J	PO-k	PO -L
CO-01	S	S	S	M	N	N	M	M	M	N	N	S
CO-02	S	S	S	M	N	N	M	M	M	N	N	S
CO-03	S	S	S	M	N	N	M	M	M	N	N	S
CO-04	S	S	S	M	N	N	M	M	M	N	N	S
CO-05	S	S	S	M	N	N	M	M	M	N	N	S

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Identification of single core (SC), twin core (TC), three cores (3c), fourcores (4c); copper and aluminum PVC, VIR & Weather proof (WP) wire and prepare Britannia T joint and Married joint
2. Cutting copper and aluminum cable and crimping lug to them from $4mm^2$ to $25mm^2$, cross section.
3. Study battery charger and make charging of lead acid battery (record charging voltage,

current and specific gravity).

4. Fault finding & repairing of Fan – prepare an inventory list of parts.
5. Find out fault of D.C. generator, repair and test it to run.
6. Find out fault of D.C. motor starters and A.C motor starter – prepare an inventory list of parts used in different starters.
7. Dismantle, over haul and assemble a single phase induction motor. Test and run it. – prepare an inventory list.
8. Dismantle over haul and assemble a three phase squirrel cage and phase wound motor. Test and run them
9. Overhaul a single phase / 3 phase variac.

TOTAL =45 PERIODS

Open Elective -Semester-VII

CS32D2	**Renewable Energy Systems**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To Provide knowledge about various renewable energy technologies
- To enable students to understand and design a PV system.
- To provide knowledge about wind energy system.
- To Provide knowledge about various possible hybrid energy systems
- To gain knowledge about application of various renewable energy technologies

Course Outcome – Cos		**Cognitive Skill**
CO-01	Attained knowledge about various renewable energy technologies	R, U
CO-02	Ability to understand and design a PV system.	A
CO-03	Understand the concept of various wind energy system.	An
CO-04	Gain knowledge about various possible hybrid energy systems	E
CO-05	Attained knowledge about various application of renewable energy technologies	A

R-Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / **CO**	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO - I	PO-J	PO-k	PO -L
CO-01	S	N	N	N	N	N	N	S	S	N	N	N
CO-02	S	M	N	N	N	N	N	S	S	N	N	N
CO-03	S	M	N	N	N	N	N	S	S	N	N	N
CO-04	S	M	N	N	N	N	N	S	S	N	N	N
CO-05	S	M	N	N	N	N	N	S	S	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit- I: Renewable Energy vs Non-Renewable Energy 9

Primary energy sources, renewable vs. non-renewable primary energy sources, renewable energy resources in India, Current usage of renewable energy sources in India, future potential of renewable energy in power production and development of renewable energy technologies.

Unit- II: Introduction to Solar Energy 9

Solar Radiation and its measurements, Solar Thermal Energy Conversion from plate Solar Collectors, Concentrating Collectors and its Types, Efficiency and performance of collectors. Direct Solar Electricity Conversion from Photovoltaic, types of solar cells and its application of battery charger, domestic lighting, street lighting, and water pumping, power generation schemes. Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems.

Unit- III Introduction to Wind Energy 9

Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and applications**.**

Unit IV: Introduction to Bio-Energy 9

Energy from biomass, Principle of biomass conversion technologies/process and their classification, Bio gas generation, types of biogas plants, selection of site for biogas plant, classification of biogas plants, Advantage and disadvantages of biogas generation, thermal gasification of biomass, biomass gasifies, Application of biomass and biogas plants and their economics**.**

Unit- V: Other Types of Energy 9

Energy conversion from Hydrogen and Fuel cells, Geo thermal energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini- hydel power plants and their economics.

TOTAL: 45 PERIODS

REFERENCES:

1. Twidell &Wier, 'Renewable Energy Resources' CRC Press (Taylor & Francis), Second Edition,2015.
2. Tiwari and Ghosal/ Narosa, 'Renewable energy resources: Basic Principles and Applications,2004.
3. D.P.Kothari, K.C.Singhal,' Renewable energy sources and emerging technologies', P.H.I.
4. D.S.Chauhan, S.K. Srivastava, 'Non – Conventional Energy Resources', New Age Publishers, 2006.
5. B.H.Khan, 'Non – Conventional Energy Resources', Tata Mc Graw Hill, 2006.

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	EE32**	Elective –VI	3	0	0	3
2.	EE32**	Elective-VII	3	0	0	3
PRACTICAL						
4.	EE32P5	Project Work	0	0	16	8
TOTAL			6	0	16	14

]

PROGRAM ELECTIVES

SI. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	EE32A1	Special Electrical Machines	3	0	0	3
2.	EE32A2	Bio Medical Instrumentation	3	0	0	3
3.	EE32A3	High Voltage Direct Current Transmission	3	0	0	3
4.	EE32A4	High Voltage Engineering	3	0	0	3
5..	EE32A5	Power Quality	3	0	0	3
6.	EE32A6	Power System Operation and Control	3	0	0	3
7..	EE32A7	Smart Grid	3	0	0	3

PROGRAM ELECTIVES-DETAILED SYLLABUS

EE32A1	Special Electrical Machines	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM
- To derive torque equation and study the characteristics of special machines
- To design the controller for special machines
- To study the working principle of synchronous reluctance motor
- To simulate closed loop operation of BLDC motor

Course Outcome – Cos		Cognitive Skill
CO-01	Ability to model and analyze power electronic systems and equipment using computational software.	A,An
CO-02	Ability to optimally design magnetics required in special machines based drive systems using FEM based software tools.	A
CO-03	Ability to analyze the dynamic performance of special electrical machines	An
CO-04	Ability to understand the operation and characteristics of other specialelectrical machines.	U
CO-05	Ability to design and conduct experiments towards research.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	N	N	N	N	N	N	L	L	N	S	L
CO-02	S	S	S	S	N	N	M	L	M	N	S	S
CO-03	S	N	N	N	N	N	N	L	L	N	S	L
CO-04	S	S	S	S	N	N	N	L	S	N	S	S
CO-05	S	S	S	S	S	N	S	L	S	N	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Stepper Motors **9**

Constructional features –Principle of operation –Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Drive circuits – Closed loop control – Applications

Unit II: Switched Reluctance Motors **9**

Constructional features –Principle of operation- Torque prediction– Characteristics- Power controllers – Control of SRM drive- Speed control- current control-design procedures- Sensor less operation of SRM — Current sensing-rotor position measurement and estimation methods- sensor less rotor position estimation-inductance based estimation –applications.

Unit III: Permanent Magnet Brushless DC Motors **9**

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics- Controller design-Transfer function – Machine, Load and Inverter-Current and Speed Controller.

Unit IV: Permanent Magnet Synchrounous Motors **9**

Permanent Magnet ac Machines, Machine Configurations, PMSM - Principle of operation – EMF and Torque equations - Phasor diagram - Torque speed characteristics –evaluation of control characteristics- design of current and speed controllers- Constructional features, operating principle and characteristics of synchronous reluctance motor.

Unit V: Study Of Other Special Electrical Machines 9

Principle of operation and characteristics of Hysteresis motor – AC series motors–Linear motor–Applications.

TOTAL: 45 HOURS

TEXT BOOKS

1. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford,1989.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

REFERENCES:

1. Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2008.
2. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications-CRC 2019.
3. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives -CRC Press, Marcel Applications -CRC Press 2009
4. T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, NewDelhi, 2000 Dekker 2009
5. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Clarendon press, London, 1989

EE32A2	Biomedical Instrumentation	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce an fundamentals of transducers as applicable to physiology
- To explore the human body parameter measurements setups
- To make the students understand the basic concepts of forensic techniques.
- To give basic ideas about how multimedia evidences are useful in crime investigation.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the physiology of biomedical system	U
CO-02	Measure biomedical and physiological information	An
CO-03	Discuss the application of Electronics in diagnostics and therapeutic area	R
CO-04	Understand the different usage of special biomedical instruments	U
CO-05	Remember the various types of equipments used in biomedical field forreal time applications	A,R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	S	L	S	M	S	L	N	L	N	N	N	N	N
CO-02	S	M	S	M	S	L	M	L	N	N	N	N	N
CO-03	L	S	L	M	L	L	M	L	N	N	N	N	N
CO-04	L	S	S	M	L	M	M	L	N	N	N	N	N
CO-05	L	S	S	M	L	M	M	L	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Physiology and Transducers Cell and its Structure, Resting and Action Potential, Nervous System **9**

Functional organization of the nervous system, Structure of nervous system, neurons, synapse, transmitters and neural communication, Cardiovascular system, respiratory system, Basic components of a biomedical system, Transducers, selection criteria, Piezo-electric, ultrasonic transducers, Temperature, measurements - Fiber optic temperature sensors

Unit-II: Electro – Physiological Measurements Electrodes 9

Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes, Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier. ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms. Electrical safety in medical environment: shock hazards, leakage current-Instruments for checking safety parameters of biomedical equipment

Unit-III:Non-Electrical Parameter Measurements 9

Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analyzers : pH of blood, measurement of blood pCO2, pO2, finger-tipoximeter, ESR, GSR, measurements, Standard HL7

Unit-IV: Special Instruments 9

Medical Imaging Radiographic and fluoroscopic techniques, X rays, Computer tomography, Mammography, MRI, f MRI, Ultrasonography, Endoscopy, Thermography, Differentt ypes of biotelemetry systems and patient monitoring

Unit-V: Biomedical Equipments,Machines and Meters 9

Assisting and therapeutic equipments Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart Lung machine, Audio meters, Dialyzers, Lithotripsy

TOTAL:45PERIODS

TEXT BOOKS

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, Third Edition, 2013.

REFERENCES:

1. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II edition, Pearson Education, 2002 / PHI.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
4. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley &Sons, 1975.

EE32A3	High Voltage Direct Current Transmission	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about the following topics:
- To study HVAC and HVDC for overhead and underground transmission systems and factors governing the choice of them.

- To learn about hvdc converters.
- To learn about the bundle conductors and reducing the corona loss.
- To introduce modern developments in HVDC transmission and FACTS.
- To learn about the overvoltage problem, cables and insulation in extra high voltage system.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Understand the factors governing the choice of HVAC and HVDCfor overhead and underground transmission system.	U
CO-02	Remember the basic concepts of six pulse and twelve pulse circuits.	R
CO-03	Learn about bundled conductors and corona loss.	R,U
CO-04	Learn the DC transmission system in case of harmonics and as wellas multi-terminal DC transmission system.	R,U
CO-05	Impart the knowledge of over voltage problem cables and insulating materials.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO- G	PO-H	PO- I	PO-J	PO-k	PO-L
CO-01	S	N	N	N	N	N	L	N	N	M	N	N
CO-02	S	M	N	N	N	N	M	N	N	N	N	N
CO-03	S	N	N	N	N	N	M	N	N	N	N	N
CO-04	S	N	N	N	N	N	M	N	N	N	N	N
CO-05	S	N	N	N	N	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Introduction to EHVAC And HVDC Transmission 9

EHVAC and HVDC transmission -Comparison between HVAC and HVDC overhead and underground transmission scheme - Standard transmission voltages - Factors concerning choice of HVAC and HVDC transmission - Block diagram of HVAC and HVDC transmission schemes.

Unit Ii: 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.

Unit–III: Corona **9**

Properties of bundled conductors - Inductance and capacitance of EHV line - Surface voltage gradient on single, double, and more than three conductor bundles -Corona effects - Power loss - Increase in radius of conductors - Charge-voltage diagram - Qualitative studyof corona pulses, their generation and properties.

Unit–IV: DC Transmission **9**

Review of rectification and inversion process -Constant current and constant extinction angle modes of operations - Analysis of DC transmission systems –Harmonics on AC and DC sides and filters for their suppression - Multiterminal DC transmission systems -Parallel operation of AC and DC transmission - Modern developments in HVDC transmission/Introduction to FACTS.

Unit–V: Overvoltage in EHV Systems **9**

Origin and types - Ferro resonance overvoltage - switching surges, reduction of switching surges on EHV systems. Introduction to EHV cable transmission, electrical characteristics of EHV cables, properties of cable insulation materials. EHV insulators - characteristics and pollution performance -Protection of HVAC and HVDC systems.

TOTAL :45 PERIODS

TEXT BOOKS

1. Rakesh Das Begamudre "Extra High Voltage AC Transmission Engineering", New AgeInternational Publishers, Reprint 2014.
2. K. R. Padiyar"HVDC Power Transmission Systems: Technology and SystemInteractions", New Age International, 1990.

REFERENCES:

1. Rao. S, "EHV_AC and HVDC Transmission & Distribution Engg. - 3rd edition",Khanna Publication-2007.

EE32A4	High Voltage Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination.

Course Outcome – Cos		Cognitive Skill
CO-01	Explain various over voltages andits effects on power systems.	U, A
CO-02	Understand the breakdown phenomena in different medium under uniform and non-uniform fields.	U
CO-03	Explain the methods of generating and measuring High DC, AC, Impulse voltage and currents.	U, R
CO-04	Suggest and Conduct suitable HV testing of Electrical power apparatus asper Standards.	U, A
CO-05	Explain the Industrial Applications of Electrostatic Fields.	U,R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO- C	PO-D	PO- E	PO- F	PO-G	PO-H	PO - I	PO- J	PO- k	PO -L
CO-01	M	M	N	N	N	N	N	N	N	N	N	N
CO-02	S	M	N	L	N	N	N	N	N	N	N	N
CO-03	M	M	S	L	N	N	N	N	N	M	N	S
CO-04	L	M	S	L	N	N	L	L	N	N	N	S
CO-05	M	M	L	N	N	N	N	N	N	M	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Over Voltages in Electrical Power Systems 9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages — Reflection and Refraction of Travelling waves- protection against over voltages_ Insulation Coordination.

Unit II: Dielectric Breakdown 9

Properties of Dielectric materials - Gaseous breakdown in uniform and non- uniform fields – 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 equipment.

Unit III: Generation and Measurements of HighVoltages and High Currents 9

Generation of High DC, AC, impulse voltages and currents - Analysis of DC/AC and Impulse generator circuits - Tripping and control of impulse generators, Measurement of High voltages and High currents-High Resistance with series ammeter — Dividers - Resistance,

Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters, Electrostatic Voltmeters – Sphere Gaps, High current shunts- Digital techniques in high voltage measurement.

Unit IV: High Voltage Testing & Insulation Coordination 9

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

Unit V: Application in Industry 9

Introduction – electrostatic applications- electrostatic precipitation, separation, painting / coating, spraying, imaging, printing, Transport of materials – manufacturing of sand paper – Smoke particle detector – Electrostatic spinning, pumping, propulsion – Ozone generation – Biomedical applications

TOTAL 45 PERIODS

TEXT BOOKS

1. M.S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition, Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, FourthEdition, 2020.

REFERENCES:

1. L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2006.
2. C.L.Wadhwa, High voltage Engineering, New Age International Publishers, Fourth Edition,2020
3. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering – Theory &Practice,Second Edition, Taylor & Francis Gourp, 2019
4. Subir Ray." An Introduction to High Voltage Engineering "PHI Learning Private Limited, New Delhi,Second Edition-2011.

EE32A5	**Power Quality**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To learn the basic definitions in Power Quality.
2. To study the power quality issues in Single Phase and Three Phase Systems.
3. To understand the principles of Power System Harmonics.
4. To know the way to use DSTATCOM for Harmonic Mitigation.
5. To learn the concepts related with Series Compensation.

Course Outcome – Cos		Cognitive Skill
CO-01	Use various definitions of power quality for power quality issues	U,R
CO-02	Describe the concepts related with single phase / three phase, linear /nonlinear loads and single phase / three phase sinusoidal, non-sinusoidalsource	R
CO-03	Solve problems related with mitigation of Power System Harmonics	A
CO-04	Use DSTATCOM for load compensation	R
CO-05	Demonstrate the role of DVR, SAFs UPQC in power distributionsystems	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	POA	POB	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	S	S	N	N	S	S	N	S	N	S
CO-02	S	S	S	S	N	N	S	S	N	S	N	S
CO-03	S	S	S	S	N	N	S	S	N	S	N	S
CO-04	S	S	S	S	N	N	S	S	N	S	N	S
CO-05	S	S	S	S	N	N	S	S	N	S	N	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Introduction **9**

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage –Power quality standards.

Unit II: Analysis of Single Phase and Three Phase System **9**

Single phase linear and non-linear loads – single phase sinusoidal, non- sinusoidal source – supplying linear and nonlinear loads – three phase balanced system – three phase unbalanced system – three phase unbalanced and distorted source supplying non-linear loads – concept of power factor – three phase- three wire – three phase - four wire system.

Unit III: Mitigation of Power System Harmonics **9**

Introduction - Principle of Harmonic Filters – Series-Tuned Filters – Double Band-Pass Filters – damped Filters – Detuned Filters – Active Filters – Power Converters – Harmonic Filter Design – Tuned Filter – Second-Order Damped Filter – Impedance Plots for Filter Banks – Impedance Plots for a Three-Branch 33 kV Filter

Unit IV: Load Compensation using DSTATCOM 9

Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.

Unit V: Series Compensation of Power Distribution System 9

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – Voltage Restoration – Series Active Filter – Unified Power Quality Conditioner.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Arindam Ghosh and Gerad Ledwich "Power Quality Enhancement Using Custom PowerDevices", Kluwer Academic Publishers, First Edition,2002
2. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, Second Edition, 2011.
3. George J. Wakileh, "Power System Harmonics – Fundamentals, Analysis and Filter Design",Springer – Verlag Berlin Heidelberg, New York, 2019.

REFERENCES:

1. R.C.Duggan "Electric Power Systems Quality", Tata MC Graw Hill Publishers, ThirdEdition, 2012.
2. Arrillga "Power System Harmonics", John Wiely and Sons, 2003 2nd Edition.
3. Derek A.Paice "Power Electronic Converter Harmonics" IEEE Press, 1995, Wiley – IEE Press1999, 18th Edition.

EE32A6	Power System Operation and Control	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on,
- The significance of power system operation and control.
- Real power– frequency interaction and design of power– frequency controller.
- Reactive power– voltage interaction and the compensators for maintaining the voltage profile.
- The generation scheduling and economic operation of power system.
- SCADA and its application for real time operation and control of power systems.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the day – to – day operation of power system.	U
CO-02	Model and analyse the control actions that are implemented to meet theminute-to-minute variation of system real power demand.	A, An
CO-03	Model and analyze the compensators for reactive power control and various devices used for voltage control.	A, An
CO-04	Prepare day ahead and real time economic generation scheduling.	E
CO-05	Understand the necessity of computer control of power systems.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	M	L	N	N	N	L	N	N	N	N	N	M
CO-02	S	M	L	L	N	M	N	M	N	M	N	M
CO-03	S	M	L	L	N	M	N	M	N	M	N	M
CO-04	S	M	L	L	N	M	N	M	N	M	N	M
CO-05	M	L	N	N	N	L	N	M	N	M	N	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I : Introduction 9

Power scenario in Indian grid – National and Regional load dispatching centres – Requirements of good power system – Necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - System load variation, load curves – Load forecasting – Computational methods in load forecasting – Load shedding and Islanding – deregulation - Basics of electrical energy tariff.

Unit II: Real Power Frequency Control 9

Basics of speed governing mechanisms and modelling – Speed regulation of two generators in parallel Load Frequency Control (LFC) of single area system – Static and dynamic analysis – LFC of two area system –Tie line modelling – Block diagram representation of two area system – Static and dynamic analysis – Tie line with frequency bias control – State variable model – Integration of economic dispatch control with LFC.

Unit III: Reactive Power – Voltage Control 9

Generation and absorption of reactive power – Basics of reactive power control – Automatic Voltage Regulator (AVR) – Brushless AC excitation system – Block diagram representation of AVR loop static and dynamic analysis – Stability compensation – Voltage drop in transmission line –Methods of reactive power injection – Tap changing transformer, SVC and STATCOM for voltage control.

Unit IV: Economic Operation of Power System 9

Statement of economic dispatch problem – Input and output characteristics of thermal plant incremental cost curve – Optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) — Lambda–iteration method — Base point and participation factors method. Statement of Unit Commitment (UC) problem – Constraints on UC problem – Solution of UC problem using priority list – Special aspects of short term and long-term hydrothermal scheduling problems.

Unit V: Computer Aided Control of Power System 9

Need of computer control of power system – Concept of energy control centers and functions – PMU system monitoring, Data acquisition and controls – System hardware configurations – SCADA and EMS functions-State estimation – Measurements and errors – Weighted least square estimation –Various operating states – State transition diagram.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Olle. I. Elgerd, 'Electric Energy Systems theory – An introduction', McGraw Hill Education Pvt.Ltd., New Delhi, 2nd edition, 2017.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', JohnWiley & Sons, Inc., 3rd edition, 2013.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHIlearning Pvt. Ltd., New Delhi, Fourth Edition, 2018.

REFERENCES:

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw– Hill Education,Second Edition, Reprint 2018.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 23rdreprint, 2015.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi,12th reprint, 2015.
4. B.M. Weedy, B.J. Cory et al, 'Electric Power systems', Wiley, Fifth Edition, 2012.

EE32A7	**Smart Grid**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the evolution of Smart and Interconnected energy systems.
- To understand the various challenges and benefits of smart grid and the national and international initiatives taken
- To understand the concepts related with transmission and distribution in smart grid technologies.
- To get an insight of the various smart measurement technologies.
- To understand the various computing technologies for Smart Operation of the Grid.

Course Outcome – Cos		**Cognitive Skill**
CO-01	To be able to understand the importance and objectives of Power SystemGrid.	U
CO-02	To be able to know and understand the concept of a smart grid;	R,U
CO-03	To identify and discuss smart metering devices and associatedtechnologies.	R,U
CO-04	To be able to get an overview of Microgrid and Electric Vehicle Technology.	R,U
CO-05	To be able to have an up to date knowledge on the various computing technologies; to understand the role of Big Data and IoT for effectiveand efficient operation of Smart Grid.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	M	S	S	N	N	L	N	N	N	M
CO-02	S	S	M	S	S	N	N	L	N	N	N	M
CO-03	S	S	M	S	S	N	N	L	N	N	N	M
CO-04	S	S	M	S	S	N	N	L	N	N	N	M
CO-05	S	S	M	S	S	N	N	L	N	N	N	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Introduction **9**

Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.

Unit II: Smart Metering **9**

Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).

Unit III: Smart Grid Technologies (Transmission) **9**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

Unit IV: Smart Grid Technologies (Distribution) **9**

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High- Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.

Unit V: High Performance Computing For Smart GridApplications **9**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Smart Grids Advanced Technologies and Solutions, Second Edition, Edited by Stuart Borlase,CRC, 2018.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid:Technology and Applications”, John Wiley,2012
3. James Momoh ,Smart Grid Fundamentals of Design and Analysis, IEEE press 2012.

REFERENCES:

1. Ahmed F. Zobaa, Trevor J. Bihl, Big data analytics in future power systems, 1st Edition, CRC press 2018.
2. C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," in IEEE Transactions on Industrial Informatics, vol. 7, no. 4, pp. 529-539, Nov. 2011.doi: 10.1109/TII.2011.2166794.
3. X. Fang, S. Misra, G. Xue and D. Yang, "Smart Grid — The New and Improved Power Grid: A Survey," in IEEE Communications Surveys & Tutorials, vol. 14, no. 4, pp. 944-980, Fourth Quarter 2012. doi: 10.1109/SURV.2011.101911.00087.
4. Stuart Borlase "Smart Grid : Infrastructure, Technology and Solutions", CRC Press 2012.

LIST OF ELECTIVES

SI. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	EE32A8	Advanced Control System	3	0	0	3
2.	EE32A9	Modern Power Converters	3	0	0	3
3.	EE32B1	Computer Aided Design of Electrical Apparatus	3	0	0	3
4.	EE32B2	Digital Signal Processing	3	0	0	3
5.	EE32B3	Flexible AC Transmission Systems	3	0	0	3
6.	EE32B4	Principles of Robotics	3	0	0	3
7.	EE32B5	Power Plant Engineering	3	0	0	3
10.	EE32B6	Sustainable and Environmental Friendly HV insulation System	3	0	0	3
11.	EE32B7	Electric Vehicle Architecture	3	0	0	3
12.	EE32B8	Adaptive Control	3	0	0	3
13.	EE32B9	IOT for Electrical Engineering	3	0	0	3
14.	EE32C1	Electrical Safety Engineering	3	0	0	3
15.	EE32C2	Generation of Electrical Energy	3	0	0	3
16.	EE32C3	Soft Computing tools for Electrical Engineering	3	0	0	3
17.	EE32C4	Restructured Power Systems	3	0	0	3
18.	EE32C5	Industrial Electrical Systems	3	0	0	3
19.	CS3214	Cloud Computing Techniques	3	0	0	3
21	CS3215	Cyber Security	3	0	0	3
23.	CS3216	Big Data Analytics	3	0	0	3
24..	AI3205	Internet of Things	3	0	0	3

Electives-Detailed Syllabus

EE32A8	Advanced Control System	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on design state feedback control and state observer.
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- iv.To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

Course Outcome - COs		Cognitive Skill
CO-01	Gain knowledge on state variables	U,R,A
CO-02	Gain knowledge on design of state feedback control and state observer.	U,E
CO-03	Gain knowledge of modeling and analysis of sampled data control system.	R,U,E
CO-04	Gain knowledge about non linear systems	U, An,.E
CO-05	Gain knowledge about optimal control	R,A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	M	M	N	N	L	L	L	L	S	L
CO-02	S	S	M	M	N	N	L	M	N	L	S	L
CO-03	S	S	M	M	N	N	S	L	N	L	S	L
CO-04	S	S	M	M	N	N	S	L	L	L	S	L
CO-05	S	S	M	M	N	N	M	L	L	L	S	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: State Variable Analysis 9

Introduction-concepts of state variables and state model-State model for linear continuous time systems, Diagonalisation-solution of state equations-Concepts of controllability and observability.

Unit-II: State Variable Design 9

Introduction to state model: Effect of state feedback-Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design, Design of state observers-Separation principle-Design of servo systems: State feedback with integral control.

Unit-III: Sampled Data Analysis 9

Introduction spectrum analysis of sampling process signal reconstruction difference equations The Z transform function, the inverse Z transform function, response of Linear discrete system, the Z transform analysis of sampled data control systems, response between sampling instants, the Z and S domain relationship. Stability analysis and compensation techniques.

Unit-IV: Non Linear Systems 9

Introduction, common physical non linearity's, The phase plane method: concepts, singular points, stability of non linear systems, construction of phase trajectories system analysis by phase plane method. The describing function method, stability analysis by describing function method, Jump resonance.

Unit-V: Optimal Control 9

Introduction: Classical control and optimization, formulation of optimal control problem, Typical optimal control performance measures-Optimal state regulator design: Lyapunov equation, Matrix Riccati equation-LQR steady state optimal control–Application examples.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. .M.Gopal, "Digital Control and State Variable Methods", 4thedition, Mc Graw Hill India, 2012
2. K. Ogata, 'Modern Control Engineering', 5th Edition, Pearson, 2012.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.

REFERENCES:

1. M.Gopal, Modern Control System Theory, 3rdedition, New Age International Publishers, 2014.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
3. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory–Multivariable and Non-Linear Methods", Taylor & Francis,2002.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

EE32A9	Modern Power Converters	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge about the following topics:

- Switched mode power supplies
- Matrix Converter
- Soft switched converters

Course Outcome – Cos		Cognitive Skill
CO-01	DC Power supplies and Classification	U
CO-02	Switched mode AC-DC converters.	U
CO-03	Multi-level Inversion-concept	A
CO-04	Matrix converters	An
CO-05	Soft switching techniques. ZVS, ZCS, quasi resonance operation	S

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO- C	PO-D	PO- E	PO- F	PO-G	PO-H	PO - I	PO- J	PO- k	PO -L
CO-01	S	S	S	S	S	S	S	L	L	L	L	L
CO-02	S	M	M	S	M	M	M	M	N	N	N	N
CO-03	S	S	S	M	M	M	M	L	N	N	N	N
CO-04	S	M	M	M	M	S	S	L	N	N	N	N
CO-05	S	S	S	S	S	M	M	L	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Switched Mode Power Supplies (SMPS) 9

DC Power supplies and Classification; Switched mode dc power supplies-with and without isolation, single and multiple outputs; Closed loop control and regulation; Design examples on converter and closed loop performance.

Unit-II: AC-DC Converters 9

Switched mode AC-DC converters. synchronous rectification-single and three phase topologies-switching techniques-high input power factor . reduced input current harmonic distortion. improved efficiency. with and without input-output isolation. performance indices design examples

Unit-III: DC-AC Converters 9

Multi-level Inversion-concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Modulation schemes.

Unit-IV: AC-AC Converters with and without DC Link 9

Matrix converters. Basic topology of matrix converter; Commutation–current path; Modulation techniques-scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link-topologies and operation-with and without resonance link-converter with dc link converter; Performance comparison with matrix converter with DC link converters.

Unit-V: Soft-Switching Power Converters 9

Soft switching techniques. ZVS, ZCS, quasi resonance operation; Performance comparison hard switched and soft switched converters.AC-DC converter, DC-DC converter, DC-AC converter.; Resonant DC power supplies .

TOTAL :45 PERIODS

TEXT BOOKS:

1. Power Electronics Handbook, M.H. Rashid, Academic press, New york, 2000.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, NewYork, 2004.
3. Control in Power Electronics-Selected Problem, Marian P.Kazmier kowski, R.Krishnan and Frede Blaabjerg, Academic Press (Elsevier Science), 2002.

REFERENCES:

1. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2004
2. Power Electronics for Modern Wind Turbines, FredeBlaabjerg and Zhe Chen,Morgan & Claypool Publishers series, United States of America, 2006.
3. Krein Philip T, Elements of Power Electronics, Oxford University press, 2008
4. Agarwal ,Power Electronics: Converters, Applications, and Design, 3rd edition, JaiP, Prentice Hall,2000
5. L. Umanand, Power Electronics: Essentials & Applications, John Wiley and Sons,2009.

EE32B1	Computer Aided Design of Electrical Apparatus	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

- Learn the importance of computer aided design method.
- Understand the basic electromagnetic field equations and the problem formulation for CAD applications.
- Become familiar with Finite Element Method as applicable for Electrical Engineering.
- Apply Finite Element Method for the design of different Electrical apparatus.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the Conventional design procedure of basic principles of energy conversion	U, A
CO-02	Understand the basics of capacitance and inductance.	U, A
CO-03	Design the mathematical model for 2D field problem	R, U
CO-04	Understand and remember the elements of a CAD system	U, R,A
CO-05	Design of solenoid actuator and calculation of torque.	R, U

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO- C	PO-D	PO- E	PO- F	PO-G	PO-H	PO - I	PO- J	PO- k	PO -L
CO-01	S	S	L	M	L	L	M	N	M	N	L	L
CO-02	S	S	L	M	L	L	M	N	M	N	L	L
CO-03	S	S	L	M	L	L	M	N	M	N	L	L
CO-04	S	S	L	M	L	L	M	N	M	N	L	L
CO-05	S	S	L	M	L	L	M	N	M	N	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Introduction 9

Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.

Unit-II: Mathematical Formulation of Field Problems 9

Electromagnetic Field Equations –Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in Electric and Magnetic fields – Capacitance - Inductance- Laplace and Poisson's Equations – Energy functional.

Unit-III: Mathematical Formulation and Solution 9

Mathematical models Differential/Integral equations – Finite Difference method– Finite element method – Energy minimization – Variational method- 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

Unit-IV: Cad Packages 9

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions – Setting up solution – Post processing.

Unit-V: Design Applications 9

Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator Inductance and force calculation – Torque calculation in Switched Reluctance Motor.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.J Salon, 'Finite Element Analysis of Electrical Machines', Kluwer Academic Publishers, London, 1995.
2. Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor & Francis, 2005.

REFERENCES:

1. Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite Element Methods', Marcell Dekker Inc., 2003.
2. P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
3. D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.

EE32B2	Digital Signal Processing	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about signals & systems.
- To study DFT ,FFT and its computation
- To study the design techniques for digital filters
- To study the fundamentals of digital signal processors.

Course Outcome - COs		Cognitive Skill
CO-01	Gain knowledge about discrete time signals	U,R
CO-02	Gain knowledge in discrete fourier Transform.	U,E
CO-03	Gain knowledge in Fast Fourier Transform.	R,U,E
CO-04	Gain knowledge in design of digital filters.	U, An,.E
CO-05	Gain knowledge in digital signal processors.	R,A

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	M	M	N	N	L	L	L	L	S	L
CO-02	S	S	M	M	N	N	L	L	N	L	S	L
CO-03	S	S	M	M	N	N	S	L	N	L	S	L
CO-04	S	S	M	M	N	N	L	L	L	L	S	L
CO-05	S	S	M	M	N	N	M	L	L	L	S	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Introduction 9

Introduction to Digital Signal Processing: Discrete time signals & sequences, linear shift invariant systems, stability, and causality. Linear constant coefficient difference equations -Frequency domain representation of discrete time signals and systems.

Unit-II: DFT 9

Discrete Fourier series: Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear convolution of sequences using DFT, Computation of DFT.

Unit-III: FFT 9

FAST FOURIER TRANSFORMS: Fast Fourier transforms (FFT) – Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT, and FFT for composite N.

Unit-IV: Digital Filters Design 9

Amplitude and phase responses of FIR filters – Linear phase filters – Windowing techniques for design of Linear phase FIR filters – Rectangular, Hamming, Hanning, Bartlett, Kaiser windows – frequency sampling techniques – IIR Filters- Design of Butterworth and Chebyshev Filters - Bilinear transformation – pre warping, impulse invariant transformation.

Unit-V: Digital Signal Processors 9

Introduction to DSP architecture – Harvard architecture - Dedicated MAC unit - Multiple ALUs, Advanced addressing modes, Pipelining, Overview of instruction set of TMS320F28XX series.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John G Proakis, Dimtris G Manolakis, Digital Signal Processing Principles, Algorithms and Application, PHI, 3rd Edition, 2003.
2. S.Salivahanan, A.Vallavaraj, Gnanapriya, Digital Signal Processing, McGraw-Hill / TMH, 2000.

REFERENCES:

1. Alan V Oppenheim, Ronald W Schafer, John R Back, Discrete Time Signal Processing, PHI, 2nd Edition 2000,
2. Avtar singh, S.Srinivasan DSP Implementation using DSP microprocessor with Examples from TMS32C54XX -Thomson / Brooks cole Publishers, 2003
3. Johny R.Johnson :Introduction to Digital Signal Processing, Prentice Hall, 1984.
4. S.K.Mitra, "Digital Signal Processing- A Computer based approach", Tata McGraw-Hill, 2013, New Delhi.
5. B.Venkataramani & M. Bhaskar, Digital Signal Processor Architecture, Programming and Application, TMH 2002. (UNIT – V)

EE32B3	Flexible AC Transmission Systems	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Performance of power systems with FACTS controllers.
- FACTS controllers for load flow and dynamic analysis

Course Outcome – Cos		Cognitive Skill
CO-01	Remember the concept of power system	R
CO-02	Understand the various static VAR compensator	U
CO-03	Identify the objectives of series and shunt compensation of power systems. CO3 Analyse the performance of Series	A
CO-04	Identify the objectives of series and shunt compensation of power systems. CO3 Analyse the performance of Series	A
CO-05	Identify the objectives of series and shunt compensation of power systems. CO3 Analyse the performance of Series	A

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO- C	PO-D	PO- E	PO- F	PO-G	PO-H	PO - I	PO- J	PO- k	PO -L
CO-01	L	L	M	S	N	M	N	N	N	S	S	S
CO-02	S	S	L	L	S	L	S	L	M	S	S	M
CO-03	S	L	M	S	S	M	S	S	M	L	M	S
CO-04	S	L	M	S	S	M	S	S	M	L	M	S
CO-05	S	L	M	S	S	M	S	S	M	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Introduction 9

Real and reactive power control in electrical power transmission lines–loads & system compensation-Uncompensated transmission line–shunt and series compensation.

Unit-II: Static Var Compensator (SVC) and Applications 9

Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator–TCR-FC-TCR-Modelling of SVC for power flow and fast transient stability–Applications: Enhancement of transient stability–Steady state power transfer–Enhancement of power system damping.

Unit-III: Thyristor Controlled Series Capacitor (TCSC) and Applications 9

Operation of the TCSC–Different modes of operation–Modelling of TCSC, Variability reactance model–Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit–Enhancement of system damping.

Unit-IV: 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–modelling of SSSC in load flow and transient stability studies-Dynamic voltage restorer(DVR).

Unit-V: Advanced FACTS Controllers 9

Interline DVR(IDVR)-Unified Power flow controller (UPFC)-Interline power flow controller(IPFC)-Unified Power quality conditioner (UPQC).

TOTAL : 45PERIODS

TEXT BOOKS:

1. R.MohanMathur, Rajiv K.Varma, "Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.
2. NarainG.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi,2011.
3. T.J.E Miller, Power Electronics in power systems, John Wiley and sons.

REFERENCES:

1. K.R.Padiyar,"FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T.John,"FlexibleA.C.TransmissionSystems",InstitutionofElectricalandElectronicEngineers(IEEE), 1999.
3. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

EE32B4	Principles of Robotics	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To introduce the functional elements of Robotics
2. To impart knowledge on the direct and inverse kinematics
3. To introduce the manipulator differential motion and control
4. To educate on various path planning techniques
5. To introduce the dynamics and control of manipulators

Course Outcome – Cos		Cognitive Skill
CO-01	Classify robots based on joints and arm configurations.	R
CO-02	Compute forward and inverse kinematics of robots and determine trajectory plan.	A
CO-03	Force and moment Balance	A
CO-04	Program robot to perform typical tasks including Pick and Place	A
CO-05	Design and select robots for Industrial and Non-Industrial applications.	S

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO- C	PO-D	PO- E	PO- F	PO-G	PO-H	PO - I	PO- J	PO- k	PO -L
CO-01	S	S	S	S	S	S	S	L	L	L	L	L
CO-02	S	M	M	S	M	M	M	M	N	N	N	N
CO-03	S	S	S	M	M	M	M	L	N	N	N	N
CO-04	S	M	M	M	M	S	S	L	N	N	N	N
CO-05	S	S	S	S	S	M	M	L	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Basic Concepts 9

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues-Various manipulators–Sensors-work cell-Programming languages.

Unit-II: Direct and Inverse Kinematics 9

Mathematical representation of Robots-Position and orientation–Homogeneous transformation-Various joints-Representation using the Denavit Hattenberg parameters-Degrees of freedom-Direct kinematics-Inverse kinematics-SCARA robots-Solvability–Solution methods.

Unit-III: Manipulator Differential Motion and Statics 9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse-Wrist and arm singularity-Static analysis-Force and moment Balance.

Unit-IV: Path Planning 9

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique-Parametric descriptions-Straight line and circular paths-Position and orientation planning-applications.

Unit-V: Dynamics and Control 9

Lagrangian mechanics-2DOFManipulator-Lagrange Euler formulation-Dynamic model–Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator-applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCES:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. .K. K. Appu Kuttan, Robotics, I K International, 2007.
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.6.S.Ghoshal, " Embedded Systems & Robotics"–Projects using the 8051 Microcontroller", Cengage Learning, 2009.

EE32B5	Power Plant Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the coal based thermal power plants.
- To study the diesel, gas turbine and combined cycle power plants.
- To learn the basic of nuclear engineering and power plants.
- To learn the power from renewable energy
- To study energy, economic and environmental issues of power plants

Course Outcome – Cos		Cognitive Skill
CO-01	To remember the layout, construction and working of the components inside a thermal power plant.	R
CO-02	To Understand the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.	U
CO-03	To understand the concept of layout, construction and working of the components inside nuclear power plants.	U
CO-04	Remember layout, construction and working of the components inside Renewable energy power plants	R
CO-05	Analyse the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.	An

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO- C	PO-D	PO- E	PO- F	PO-G	PO-H	PO - I	PO- J	PO- k	PO -L
CO-01	L	L	M	L	S	S	M	L	L	L	L	L
CO-02	S	S	L	L	L	L	L	L	L	L	L	L
CO-03	S	L	M	L	L	L	M	L	L	L	L	L
CO-04	S	L	M	L	M	M	L	L	L	L	L	L
CO-05	S	L	M	L	M	M	M	L	L	L	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Coal Based 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. Binary Cycles and Cogeneration systems.

Unit-I: Diesel, Gas, Turbine and Combined Gas Power Plants 9

9Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

Unit-III: 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.

Unit-IV: 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 (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

Unit-V: 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: 45 PERIODS

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineeringby R.K. Rajput | 1 January 2016

REFERENCES:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Power Plant Engineeringby B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2019
5. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019

EE32B6	Sustainable and Environmental Friendly HV insulation System	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the necessity of sustainable and environmental energy and products.
- To study about the different types of insulators used in systems.

Course Outcome – Cos		Cognitive Skill
CO-01	Know about sustainable and environmental energy and products.	U
CO-02	Describe the alternate green gaseous insulators.	U,R
CO-03	Describe the alternate green liquid insulators.	U,R
CO-04	Describe the alternate green solid insulators.	U,R
CO-05	Elaborate the standards for Green insulation systems.	A,E

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	M	M	L	L	S	N	S	S	S	L	L	L
CO-02	M	M	L	L	S	S	L	S	S	L	L	L
CO-03	M	M	L	L	S	S	L	S	S	L	L	L
CO-04	M	M	L	L	S	S	L	S	S	L	L	L
CO-05	M	M	L	L	S	S	L	S	S	L	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Sustainable and Environmental Energy and Products 9

Carbon print-global warming potential- environment requirement for any product and system.

Unit-II: Alternate Green Gaseous Insulators 9

SF6 gas and its hazardous environmental effects-alternate gases-gaseous mixtures and other sources and it's properties.

Unit- III: Alternate Green Liquid Insulators 9

Hazardous effects of existing liquid dielectric materials (such as organic oil)-alternate sources of environmental friendly liquid such as ester oil-vegetable oils- dielectric and it's properties.

Unit-IV: Alternate Green Solid Insulators 9

Hazardous effects of existing solid dielectric materials, alternate sources of environmental friendly

solid dielectric and its properties.

Unit-V: Evolving Standards for Green Insulation Systems 9

Requirements, evolving standards of management, testing, usage and disposal of alternate insulation systems, Major applications and standards.

TOTAL: 45 PERIODS

REFERENCES:

1. https://www.iso.org/standard/79064.html
2. https://www.ictfootprint.eu/en/iec-tr-627252013-factsheet
3. https://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID,FSP_LANG_ID:1275,25
1. 4.https://www.iec.ch/ords/f?p=103:41:628762356646470::::FSP_ORG_ID,FSP_LANG_ID:3237,25.
   5.https://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID,FSP_LANG_ID:1299,25
6. https://www.iec.ch/sdgs/sdg13
2. 7.https://highperformanceinsulation.eu/wpcontent/uploads/2016/08/sustainability_a_guide.pdf.

EE32B7	Electric Vehicle Architecture	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the structure of Electric Vehicle, Hybrid Electric Vehicle
- To study about the EV conversion components
- To know about the details and specifications for Electric Vehicles
- To understand the concepts of Plug-in Hybrid Electric Vehicle
- To model and simulate all types of DC motors

Course Outcome – Cos		Cognitive Skill
CO-01	Summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid EVs	A,U
CO-02	Describe the various EV components	R
CO-03	Describe the concepts related in the Plug-In Hybrid Electric Vehicles	R
CO-04	Analyse the details and Specifications for the various EVs developed	An
CO-05	Describe the hybrid vehicle control strategy	U

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	M	S	S	S	S	S	S	S	S	M	M
CO-02	L	M	S	S	S	S	S	S	S	S	M	M
CO-03	L	M	S	S	S	S	S	S	L	S	M	M
CO-04	L	M	S	S	S	S	S	S	L	S	M	M
CO-05	L	L	L	L	L	L	L	s	L	S	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit- I : Vehicle Architecture and Sizing 9

Electric Vehicle History, and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs. -Details and Specifications.

Unit-II: Vehicle Mechanics 9

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire –Road mechanics, Propulsion System Design.

Unit- III: Power Components and Brakes 9

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example.

Unit- IV: Hybrid Vehicle Control Strategy 9

Vehicle supervisory control, Mode selection strategy, Modal Control strategies.

Unit-V: Plug-In Hybrid Electric Vehicle 9

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs

.

TOTAL: 45 PERIODS

REFERENCES:

1. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
2. Build Your Own Electric Vehicle,Seth Leitman , Bob Brant, McGraw Hill, Third Edition 2013.
3. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.
4. The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles Mark Warner, HP Books, 2011.
5. Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021.
6.

EE32B8	Adaptive Control	L	T	P	C
		3	0	0	3

Objectives:

- To impart knowledge on how to recursively estimate the parameters of discrete input output models using recursive parameter estimation methods.
- To make the student understand the principles of STR, MRAC and Gain scheduling.

Course Outcome – Cos		Cognitive Skill
CO-01	Ability to apply the estimation algorithm to estimate the parameters of the process	A,U
CO-02	Ability to apply the adaptive control concepts to control a process	A,U,R
CO-03	Use appropriate software tools for design of adaptive controllers and analysis of the process	A,U,R
CO-04	Identify, formulate, and carry out research by designing suitable adaptive schemes for complex instrumentation problem	A,U,R
CO-05	Apply the concepts to design adaptive control for multidisciplinary problem	A,E

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	M	M	M	S	S	S	L	S	S	S	S
CO-02	L	M	M	M	S	S	S	L	S	S	S	S
CO-03	L	L	L	L	S	S	S	L	S	L	S	S
CO-04	L	M	L	L	S	S	S	L	S	L	S	S
CO-05	L	M	M	M	S	S	S	L	S	S	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Introduction 9

Introduction – Adaptive Schemes – The Adaptive Control Problem – Applications – Parameter estimation: - LS, RLS and ERLS

Unit-II: Gain Scheduling 9

Introduction – The principle – Design of gain scheduling controllers – Nonlinear transformations – application of gain scheduling – Auto-tuning techniques: Methods based on Relay feedback.

Unit-III: Deterministic Self-Tuning Regulators 9

Introduction – Pole Placement design – Indirect Self-tuning regulators – direct self-tuning regulators – Disturbances with known characteristics.

Unit-IV: Stochastic and Predictive Self-Tuning Regulators 9

Introduction-Design of Minimum Variance Controller- Design of Moving Average Controller-Stochastic Self Tuning Regulators.

Unit-V: Model-Reference Adaptive System 9

Introduction-MIT Rule-Determination of Adaptation Gain-Lyapunov Theory-Design of MRAS Using Lyapunov Theory-Relations Between MRAS And STR.

TOTAL: 45 Hours

TEXT BOOKS:

1. K.J.Astrom and B.J.Wittenmark, "Adaptive Control", Second Edition, Pearson Education Inc., second Edition 2013.

REFERENCE BOOKS:

1. T. Soderstorm and Petre Stoica , " System identification", Prentice Hall International(UK) Ltd., 1989, !st Edition.
2. Lennart Ljung, "System Identification: Theory for the User", Second Edition, Prentice Hall, 1999.

EE32B9	IOT for Electrical Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on the basic concepts of IoT.
- To convey the significance of computing techniques for IoT.
- To describe how IoT be applied for power system.
- To study in depth about the IoT application to Electric Vehicles.
- To familiarize with the design considerations and application of IIoT

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the basic concepts of IoT.	U
CO-02	Understand about the significance of computing techniques for IoT.	U
CO-03	Familiarize with how IoT be applied for power system.	A
CO-04	Understand various in- depth concepts about the IoT application to Electric Vehicles.	U,R
CO-05	Familiarize with the design considerations and application of IIoT	A

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	L	M	L	L	L	L	L	L	M	L	L
CO-02	L	M	M	L	L	M	L	L	M	L	M	M
CO-03	L	L	M	M	L	M	M	M	L	M	M	M
CO-04	L	L	M	M	L	M	M	M	M	M	M	M
CO-05	L	M	M	M	L	M	M	M	L	M	L	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit-I: Introduction to Internet of Things (IoT) 9

Internet of Things Concepts - Core Concepts - Machine-to-Machine communications- Industrial Internet of Things- Internet of Things framework- characteristics of IoT - application of IoT - Information and Communication Technology Infrastructure - Architecture and Reference Models .

Unit-II: Computing Techniques for IoT 9

Cloud and Fog Computing in IoT- IoT system requirements - Cloud Computing in IoT - characteristics of cloud computing - Cloud computing service models - Common cloud-based IoT architecture - Advantages of using Cloud for IoT - Industrial domain - Smart Cities - Key Challenges of Cloud-Based IoT - Fog Computing in IoT - need for and requirements - - architecture of Fog computing - Revised fog-enabled architecture combining fog and cloud- based IoT - advantages of using Fog for IoT - Potential Future Fog usages in IoT for Smart grid - Connected Vehicles - Smart buildings.

Unit-III: IoT for Power systems 9

Evolution of the electric power grid - Extended energy value chain and IoT use cases - Generation - Transmission - Distribution and Metering - Storage - Marketing, Sales, and Service - Customers - Smart grid IoT connections - Energy Case Studies - Smart Monitoring and Diagnostics Systems at Major Power Plants - Smart generation architecture - Smart logging and analytics architecture - Smart Monitoring and Diagnostics Systems in Major Power Plants - Asset Integration Architecture of Smart M&D - Microgrids and Virtual Power Plants - Overview of virtual power plant / microgrid management system (VPP/MMS).

Unit-IV: IoT for Electric Vehicles 9

Electric Vehicles (EV) - classifications - charging - eMobility - EV charging services - eRoaming - EV remote management - AIA for Reva Remote Management - EVs and cross- energy management - Intermodal Services - automated driving: technologies - system architecture - Digital Horizon - Automated parking smart parking - Smart City - projects - Relevance for IoT - Ignite | IoT Strategy Execution - IoT opportunity categories - Innovation Project Canvas with AIA - IoT Opportunity Management Indian EV - 4 wheelers - 3 wheelers - 2 wheelers - electric bus - E Trucks - V2V - V2I - V2C - Vehicle-to-Everything (V2X) paradigm - Intelligent connected Vehicles - benefits and challenges of V2X communication.

Unit-V: Industrial IoT (IIoT) 9

Introduction -requirements - design considerations- application of IIoT - benefits and challenges of IIoT - real-time monitoring and control of processes - deploying smart machines, smart sensors, and smart controllers with proprietary communication and internet technologies - maximize safety, security and reliability through high precision automation and control

TOTAL: 45 PERIODS

REFERENCES:

1. Qusay F. Hassan, Internet of Things A to Z Technologies and Applications, John Wiley & Sons, Inc., NewJersey, 2018.
2. Jeeva Jose, Internet of Things, Khanna Publishers, New Delhi, 2018.
3. Dirk Slama, Frank Puhlmann, Jim Morrish & Rishi M. Bhatnagar, Enterprise IoT Strategies & Best Practices for Connected Products & Services, O'Reilly Media, Inc., Sebastopol, USA, 2016.
4. Stuart Borlase, Smart Grids Advanced Technologies and Solutions, Second Edition, CRC Press, Boca Raton, 2018.
5. Ravi Ramakrishnan, Loveleen Gaur, Internet of Things Approach and Applicability in Manufacturing, CRC Press, Boca Raton, 2019, ISBN 978-1-138-59815-7.

EE32C1	Electrical Safety Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about safety requirements
- To provide guidance on prevention of electrical shocks
- To study about various first aid methods
- To create awareness about various Hazardous areas
- To familiarize with safety management

Course Outcome – Cos		Cognitive Skill
CO-01	Get an insight on Electrical safety, IE act and IE rules	U,R
CO-02	Acquire knowledge about prevention of electrical shocks	U,R
CO-03	Familiarize with various first aid measures	A
CO-04	Recommend electrical safety measures in hazardous areas	A
CO-05	Understand the significance of safety management	U

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	L	M	N	N	S	N	N	N	N	S	L
CO-02	L	L	M	N	N	M	N	N	M	N	N	L
CO-03	L	N	L	L	M	M	N	N	N	N	N	L
CO-04	L	N	L	L	M	M	N	N	M	N	N	L
CO-05	L	N	N	L	M	M	N	S	L	L	S	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit–I: Introduction 9

General Background-Objectives of safety and security measures-Hazards associated with electric current and voltage-principles of electrical safety- Approaches to Prevent Accidents- Fire Prevention and Fire Fighting-Objectives and scope of IE act and IE rules- General requirements for electrical safety as per IE rules

Unit–II: Electrical Shocks and their Prevention 9

Primary and Secondary Electric Shocks- Occurrence of Electric Shock-Shocks Due to Flashovers/Spark-overs- Lightning Strokes on Overhead Transmission Lines and Outdoor Substations - Safety Precautions in Small LV Installations, Residential Buildings, Shops - Safety Procedures in Electrical Plant Installation and description of Earthing System- Equipment Earthing - Substation Earthing.

Unit–III: First Aid 9

Introduction- Removal of Contact with Live Conductor- First Principles of Actions after Electric Shock - Artificial Respiration - Schafer's Prone Pressure Method- Silvester's Method- Nielson's Arm-lift Back-pressure Method- Mouth to Mouth Method- Use of Artificial Resuscitator- External Cardiac Massage- Cardiac Pulmonary Resuscitation-First aid treatment of Heat Exhaustion and heat stroke.

Unit–IV: Electrical Safety in Hazardous Areas 9 9

Introduction-Classification of Hazardous zones-causes of sparks and flashovers in electrical plants and machines-functional requirements of electrical equipment and installations for hazardous area/zones-classification of equipment/enclosure for hazardous locations.

Unit–V: Electrical Safety Management 9

Introduction-Principles of safety management-management's safety policy-safety organization-organization charts for construction phase of a project, maintenance mode of a plant and for safety department – safety auditing-training and supervision-annual reports - motivation to managers, supervisors and employees.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. Rao and H.L. Saluja, "Electrical Safety, Fire Safety and Safety Management", Khanna Publishers, 2012.
2. W.F.Cooper, "Electrical Safety Engineering", Butterworth and Company, London, 1998.

REFERENCES:

1. J. Cadick, D. Neitzel and A. Winfield, "Electrical Safety HandBook", McGraw Hill Education, 2012.
2. J. Maxwell Adams, "Electrical Safety-A Guide to the Causes and Prevention of Electric Hazards", The Institution of Electric Engineers, 3rdReprint, 2009.
3. Martha J. Boss and Gayle Nicoll, "Electrical Safety - Systems, Sustainability and Stewardship", CRC Press, 2015.

EE32C2	Generation of Electrical Energy	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To emphasize on power generation technology using conventional and non-conventional energy sources
- To create an understanding of conversion of various forms of energy to electrical energy.
- To highlight the operation and major components of electric generating plants.
- To highlight the operation and major components of hydro power plant
- To introduce to the basics of Tariff structure for energy production.

Course Outcome – Cos		Cognitive Skill
CO-01	Know different types of power plants, their functions and issues related to them.	R
CO-02	Understand the significance of Hydro Energy and its economical benefits.	U
CO-03	Understand the principle of operation and performance of various nuclear reactors and their impact on environment.	U
CO-04	Understand the importance of renewable energy sources as an alternative to energy crisis.	U
CO-05	Learn the basics of Tariff structure for energy production.	A,E

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	S	L	N	S	M	M	L	L	L	L	M
CO-02	L	M	M	N	N	M	M	L	L	L	L	L
CO-03	L	M	M	N	N	S	S	L	L	L	L	L
CO-04	L	M	L	S	N	S	N	L	L	L	L	L
CO-05	L	S	L	N	S	M	N	L	L	L	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit – I: Thermal, Gas and Diesel Power Plants **9**

Thermal Power Plant: Plant layout, Components of thermal power plant, Advantages and disadvantages, choice of site.Gas Turbine Power Plants: Plant layout, advantages and disadvantages, Applications, Open cycle and closed cycle gas turbine power plant, combined cycle power plant, Comparison with steam power plants.Diesel power plant: Plant Layout, advantages and disadvantages, Applications, Choice and characteristic of diesel engines, auxiliaries.

Unit – II: Hydro Power Plant ***9***

Advantages and disadvantages, choice of site, Classification, Schematic arrangement, constituents of hydro power plant, Hydro turbines, Economics of small hydro schemes, Pumped storage plants, types, Advantages.

Unit – III: Nuclear Power Plant **9**

Location and size selection, Layout and components of Nuclear Power Plants, Nuclear reactors-types and applications, Safety measures for Nuclear Power Plants-Radiation shielding, Radioactive and waste disposal

Unit- IV: Power from Renewable Energy **9**

Principle, Construction, working and types of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas, Fuel Cell and Magneto-Hydro dynamic system.

Unit-V: Power Plant Economics and Tariffs **9**

Factors affecting cost of generation, Selection of type of generation and generation equipment, Load curve, load duration curve, Effect of load on power plant design, tariffs, depreciation, causes and effects of low power factor and its improvement.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. B.R. Gupta , “Generation of Electrical Energy”, S. Chand and Co., 2010
2. Nagpal G.R. “Power Plant Engineering”, Khanna Publishers: 2007.

REFERENCES:

1. Uppal S.L. “Electrical Power”, Khanna Publishers: 2007.

2. Arora S.C. and Domakundwar S. “A Course in power plant engineering” DhanpatRai & Co (P)Ltd., Delhi: 2005.
3. Nag. P.K., "Power Plant Engineering”, Tata McGraw – Hill., 2008.
4. Singhai D.K. “Fundamentals of Nuclear Power Engineering” Khanna Publishers: 2007.

EE32C3	Soft Computing tools for Electrical Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To familiarize the students with the various architectures and learning algorithms of Artificial Neural Network.
2. To make the students to understand the basis of classifying neural networks and suitability for different applications.
3. To enable the students to acquire knowledge on Fuzzy logic and their operations
4. To acquire the ability of designing Fuzzy logic controllers and Neuro Controllers.
5. To introduce the concept of genetic algorithm and its operators.

Course Outcome – Cos		Cognitive Skill
CO-01	Analyze and select a suitable technique for the particular problem domain.	An
CO-02	Recognize the merits and demerits of applying a particular ANN model for a particular problem.	R
CO-03	Design and apply fuzzy Logic based reasoning to handle uncertainty in engineering problems.	A
CO-04	Apply Neuro-controller, Fuzzy Logic Controller for non-linear controlling applications.	A
CO-05	Solve combinatorial optimization problems using genetic algorithm.	A,E

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	M	L	M	M	M	M	L	L	L	L	L	L
CO-02	L	M	L	M	M	L	L	L	L	L	L	L
CO-03	L	M	L	M	L	L	L	L	S	L	L	L
CO-04	L	L	L	M	L	L	L	L	L	L	L	L
CO-05	L	L	M	M	L	L	L	L	L	L	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit–I: Artificial Neural Networks **9**

Motivation for the development of neural networks- biological neural networks- artificial neural networks – Fundamental Concepts - weights – biases and thresholds - common activation functions. McCulloch-Pitts neuron: Architecture, algorithm - Hebb Net- Architecture - algorithm - Perceptron –Architecture- algorithm- applications- Linear separability - Perceptron learning rule convergence theorem - Delta rule.

Unit – II: Neural Network Architecture and Algorithms **9**

Back propagation Neural Net: Standard back propagation -architecture - algorithm - number of hidden layers - Discrete Hopfield neural net- architecture - algorithm – Competitive Neural Networks -Fixed-weight competitive nets – Korhonen self-organizing Maps – Adaptive Resonance Theory- Basic architecture - Algorithm - Introduction to Neuro controllers - Application of ANN for Economic Load Dispatch problem.

Unit – III: Fuzzy Logic **9**

Fuzzy sets - Properties of Classical and Fuzzy sets- Operations on Fuzzy sets- Fuzzy relations- Linguistic variables - Linguistic Hedges- Fuzzy statements- Assignment statements- Conditional statements- unconditional statements- Fuzzy rule base- Canonical rule formation- Decomposition of compound rules.

Unit – IV: Fuzzy Logic Controller **9**

Fuzzy logic controller: Functional diagram - Fuzzification -Membership value assignments using intuition - Membership functions-Defuzzification: Max-Membership principle - centroid method – weighted average method - Inference Engine – Knowledge Base -Rule base –Case studies- Fuzzy logic controller for DC motor speed control.

Unit – V: Genetic Algorithm **9**

Optimization – Traditional optimization methods – Concept of Evolutionary Algorithm – Genetic Algorithm – encoding and decoding of variables – GA operators – reproductions – Cross over – mutation – fitness function –fitness scaling.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. LawreneFaussett, "Fundamental of neural networks", Prentice Hall, 2004.
2. Rajasekaran and VilyalakshmiPai G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms – Sysnthesis and Apllications”, Prentice Hall, 2015
3. David Goldberg. E,” Genetic algorithms in search optimization and machine learning,” Addison Wesley, Pearson Education, Asia, 2001.

REFERENCES:

1. Driankov. Hellendoornarow D.H Reinfrank M., "An introduction to Fuzzy Control”,Narosa Publishing co., New Delhi, 2006.
2. Ross T.J,"Fuzzy Logic with Engineering Applications", McGraw-Hill, Newyork, 2005.
3. Sivanandham. SN and Deepa. SN, “Neural networks with Matlab”, TMH 2007.

EE32C4	Restructured Power Systems	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of restructured power systems
- To learn the significance of Independent System Operator
- To impart knowledge on transmission open access and pricing
- To know about the ancillary services and their management
- To study about the power system analysis under market environment.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the difference between traditional and restructured power systems	U
CO-02	Understand about various entities involved in power markets.	U
CO-03	Familiarize with transmission open access and electricity pricing	R
CO-04	Understand various ancillary services management	U
CO-05	Understand the power system analysis under market environment	U

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	L	M	L	S	L	L	L	L	L	L	L
CO-02	L	M	S	L	S	M	L	L	M	L	M	S
CO-03	L	M	S	L	M	M	S	S	L	L	M	M
CO-04	S	M	S	M	S	M	S	S	S	S	S	M
CO-05	L	S	S	M	M	M	S	S	L	S	L	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit–I: Introduction to Restructuring **9**

Reasons for restructuring of power industry-Vertically Integrated Utilities and Power Pools-Different Entities Involved-Market Models-Benefits from a Competitive Electricity Market-Worldwide Movement of Power Industry Restructuring

Unit–II: Power System Operation in Competitive Environment **9**

Role of the Independent System Operator (ISO)- Operational Planning Activities of ISO- The

ISO in Pool Markets- The ISO in Bilateral Markets- Operational Planning Activities of a Genco- The Genco in Pool Markets- The Genco in Bilateral Markets- Market Participation Issues- Competitive Bidding.

Unit–III: Transmission Open Access and Pricing 9

Power Wheeling- Transmission Open Access- Types of Transmission Services in Open Access- Cost Components in Transmission- Pricing of Power Transactions- Embedded Cost Based Transmission Pricing- Incremental Cost Based Transmission Pricing.

Unit–IV: Ancillary Services Management 9

General Description of Some Ancillary Services-Frequency Control-Reserves Services- Reactive power and voltage control service-Black start capability service- Scheduling and Dispatch Services- Synchronous Generators as Ancillary Service Providers.

Unit–V: Power System Analysis in Market Environment 9

Electricity Price Forecasting- Issues of Electricity Pricing and Forecasting- Factors Considered in Price Forecasting- Performance Evaluation of Price Forecasting- Price Based Unit Commitment (PBUC)- PBUC Formulation- System Constraints- Unit Constraints- PBUC Solution- Electricity Market Analysis using AC Optimal Power Flow and Economic Load Dispatch.

TOTAL: 45PERIODS

TEXT BOOKS

1. K. Bhattacharya, M. Bullen, J.E. Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, 2001.
2. S.C. Srivastava and S.N. Singh, "Operation and Management of Power System in Electricity Market", Alpha Science, 2015.

REFERENCES:

1. Mohammad Saidpur and MuwaffaqAlomoush, "Restructured Electric Power System Operation Trading and Volatility", Marcel Dekker Inc.,2001.
2. Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd, England, 2001.
3. Xiao-Ping Zhang, "Restructured Electric Power Systems: Analysis of Electricity Markets with Equilibrium Models", John Wiley & Sons, 2010.

EE32C5	Industrial Electrical Systems	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart a wide knowledge about the components of LT system wiring components and their selection.
- To provide basic concepts regarding residential and commercial wiring systems and guide lines for their installation.

Course Outcome – Cos		Cognitive Skill
CO-01	Familiarize with different electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.	U,R
CO-02	Understand various components of industrial electrical systems.	U
CO-03	Analyse and select the proper size of various electrical system components.	An
CO-04	Acquire knowledge about various industrial automation system.	R
CO-05	Train and get exposed with the design of illumination system.	E

R- Remember, U-Understand, A-Apply, An-Analyse, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	L	L	M	M	M	L	L	L	L	L	S
CO-02	L	L	M	M	M	L	L	M	L	L	L	M
CO-03	M	L	M	M	M	L	L	M	L	L	L	M
CO-04	M	L	M	M	M	M	L	L	L	L	L	S
CO-05	M	L	M	M	M	M	L	L	L	L	L	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit - I: Electrical System Components **9**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Unit - II: Residential and Commercial Electrical Systems **9**

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, Earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit - III: Industrial Electrical Systems **9**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit - IV: Industrial Electrical System and Automation **9**

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG,

UPS and Battery Banks, Selection of UPS and Battery Banks. Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Unit - V: Illumination Systems **9**

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, floodlighting.

TOTAL:45 PERIODS

TEXT BOOKS:

1. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating &Costing", Khanna publishers,2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International,2007.

REFERENCES:

1. S. Singh and R. D. Singh, "Electrical estimating and costing", DhanpatRai and Co.,1997.
2. Web site for IS Standards.
3. H. Joshi,"Residential Commercial and Industrial Systems", McGraw Hill Education,2008.

CS3214	Cloud Computing Techniques	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the concepts of virtualization and virtual machines	U
CO-02	Understand the various issues in cloud computing. Remember the concept and developing the model of cloud services and tools.	U, R
CO-03	Experiment with virtualization of hardware resources and Docker.	R, U
CO-04	Apply the cloud computing concept with suitable communication purpose.	A
CO-05	Understand the security issues in the cloud environment.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	L	M	S	S	L	N	N	N	N	N
CO-02	S	S	N	S	M	S	M	N	L	L	L	L
CO-03	S	M	N	S	L	S	N	N	L	L	L	L
CO-04	M	M	M	L	S	M	M	N	L	L	L	L
CO-05	S	S	N	L	L	L	S	N	L	L	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Cloud Architecture Models and Infrastructure 9

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models;

Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

Unit II: Virtualization Basics 9

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

Unit III: Virtualization Infrastructure and Docker 9

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

Unit IV: Programming Model 9

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack - Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster

Unit V: Cloud Security 9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. James Turnbull, “The Docker Book”, O’Reilly Publishers, 2014.

3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

REFERENCES

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

CS3215	Cyber Security	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The course gives an exposure to the different types of mechanisms to sanitize the cyberspace by adopting standardized operating procedures while transacting business/commerce online, and also to ensure security of information handled over the net.
- Introduction to the Cyber Laws and the IPC/Cr. PC equips the students with sufficient legal knowledge about deterrence in preventing cybercrimes.

Course Outcome – Cos		Cognitive Skill
CO-01	Remember and understand the principles of computer organization and communicate effectively to discuss about the OS and architectures.	R, U
CO-02	Understand and identify the information security fundamentals and apply them in E-commerce.	U, A
CO-03	Remember and understand the security threats and test the programming bugs in computing systems.	R, U
CO-04	Explain the basics of cyber security, cyber crime and cyber law	R, U
CO-05	Understand various cyber crimes and cyber security.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	N	L	M	L	M	S	L	N	N	N	N	N
CO-02	N	L	M	S	M	S	M	N	N	N	N	N
CO-03	S	L	M	L	L	M	S	N	N	N	N	N
CO-04	L	L	M	M	M	S	M	N	N	N	N	N
CO-05	S	S	M	M	L	L	M	N	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

Unit-I: Computer organization & Architecture and Operating Systems 9

Computer Organization, Architecture, Operating Systems, Process Management, CPU Scheduling, I/O Memory Management, file systems and deadlocks. LAN, MAN, WAN, ISO/OSI seven layer architecture.

Unit-II: Information Security fundamentals *9*

Background, Importance, statistics, national and international scenarios. Identification and authentication, confidentiality, privacy ,integrity, non-repudiation. Goals of security:prevention, detection and recovery. E-commerce security. Critical Infrastructure Protection.

Unit-III: Security Threats and vulnerabilities 9

Overview of security threats, various kinds of threats; Authentication-weak passwords. Insecure internet connection- internet cookies, viruses and other infections. Security of hard drives, security of laptops; sniffers, backdoors and Trojans. Buffer overflow and other programming bugs. Common attacks- DoS, man-in-the-middle, brute force attacks.

Unit-IV: Cyber security 9

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

Unit-V: Cyber crimes 9

Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Key loggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security

TOTAL: 45 HOURS

TEXT BOOKS

1. Thomas Calabres and Tom Calabrese, ”Information Security Intelligence:Cryptographic Principles & Application”, Thomson Delmar Learning,2004.
2. Bernadette H Schell, Clemens Martin, ”Cyber Crime”, ABC-CLIO Inc, California,2004.
3. Swiderski, Frank and Syndex, ”Threat Modeling”, Microsoft Press,2004.
4. William Stallings and Lawrie Brown, ”Computer Security: Principles andPractice”,
5. Prentice Hall,2008.
6. Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber
7. Security”, Notion Press, 2021.
8. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives”, First Edition, Wiley India, 2011.

REFERENCES:

1. Silberschatz A, Galvin P, Gagne G, ”Operating Systems Concepts”, John Wiley & Sons, Singapore,2006.
2. Principles and Practices of Information Security by Michael.E. Whiteman and Herbert
3. .J. Mattord.
4. Cyber Laws by AparnaViswanathan.
5. Joseph M Kizza, ”Computer Network Security”, Springer Verlag,2005.

CS3216	Big Data Analytics	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand big data.
- To learn Mapreduce analytics using Hadoop.
- To work with map reduce applications
- To understand the usage of Hadoop related tools for Big Data Analytics

Course Outcome – Cos		Cognitive Skill
CO-01	Identify the importance of Big Data and Hadoop	U
CO-02	Access and Process Data on Distributed File System	A
CO-03	Manage Job Execution in Hadoop Environment	A, An
CO-04	Develop Big Data Solutions by setting up Hadoop cluster	U
CO-05	Apply Big Data using Tools	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	S	N	N	M	S	S	N	N	N	N	N
CO-02	S	S	N	N	M	M	M	N	N	N	N	N
CO-03	S	S	N	N	M	S	S	N	N	N	N	N
CO-04	M	S	N	N	M	S	S	N	N	N	N	N
CO-05	S	S	N	N	L	S	S	N	N	N	N	N

S-Strong, M-Medium,L-Low,N-Not relevant

Unit- I: Introduction to Big Data and Hadoop **9**

Introduction to BigData Platform – Challenges of Conventional Systems – Intelligent data analysis - Nature of Data - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools.

Unit- II: HDFs **9**

Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications-Algorithms using map reduce.

Unit-III: Hadoop **9**

History of Hadoop - The Hadoop Distributed File System – Components of Hadoop Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS- Java interfaces to HDFS- How Map Reduce Works-Anatomy of a Map Reduce Job run Failures-Job Scheduling-Shuffle and Sort – Task execution – Map Reduce Features

Unit-IV: Hadoop Cluster **9**

Setting up a Hadoop Cluster - Cluster specification - Cluster Setup and Installation - Hadoop Configuration-Security in Hadoop - Administering Hadoop – HDFS - Monitoring-Maintenance

Unit V: Applications **9**

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – Hive QL – Querying Data in Hive - Fundamentals of H Base and Zoo Keeper.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tom White, “Hadoop: The Definitive Guide”, Third Edition, O’reilly Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

REFERENCES*:*

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis”, Springer, 2007.
2. Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications, CRC press,
3. 2013.
4. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”,
5. Cambridge University Press, 2012.
6. Tom Plunkett, Mark Hornick, “Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media 2013, Oracle press.

AI3205	**Internet of Things**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- Vision and Introduction to IoT.
- Understand IoT Market perspective.
- Understand State of the Art – IoT protocols.
- Build simple IoT Systems using Arduino and Raspberry Pi.
- Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Outcome – Cos		Cognitive Skill
CO-01	Remember and Understand the fundamentals of IoT.	R,U
CO-02	Analyze the market perspective for IoT.	An
CO-03	Evaluate the different IoT protocols.	E
CO-04	Understand and design a PoC of an IoT system using Rasperry Pi/Arduino	U,A
CO-05	Analyze applications of IoT in real time scenario	R,An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	L	M	S	L	M	M	L	N	N	N	N	N
CO-02	L	S	L	L	M	S	S	N	N	N	N	N
CO-03	M	L	S	M	L	L	M	N	N	N	N	N
CO-04	S	L	L	S	M	M	L	N	N	N	N	N
CO-05	S	S	L	L	M	S	L	N	N	N	N	N

S-Strong, M-Medium,L-Low,N-Not relevant

Unit- I: Fundamentals of IOT **9**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

Unit -II: M2M to IOT – A Market Perspective **9**

Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT,M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit -III: IOT Protocols **9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IPversions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods:

Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT.

Unit- IV: Building IOT with Raspberry Pi & Arduino 9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python- Other IoT Platforms - Arduino.

Unit -V: Case Studies and Real-World Applications 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL : 45 PERIODS

TEXT BOOKS

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", First Edition, Academic Press, 2014.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖,
2. Universities Press, 2015.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
4. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖,
5. CRC Press, 2012.
6. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012.
7. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", First Edition, VPT, 2014.
8. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", First Edition, A Press Publications, 2013.

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