DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

The Vision of the Department is to be a Centre of Excellence in Globalizing Power Engineering and Technology.

MISSION

The mission of the department is to Empower Youth by Imparting Technical Knowledge and Skills to Innovate, Transform and Globalize the Power Sector. It intended to equip the graduates with deftness to overcome challenges culminating in success in diverse competitive careers with societal impacts and values.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)	
PEO 1	Pursue a diverse range of careers in engineering, consultancy, and entrepreneurship. ***(Professional Effectiveness)***
PEO 2	Contribute to continuous professional development through higher studies and life-long learning. ***(Continuing Education)*****.**
PEO 3	Demonstrate their technical proficiency with ethical values and social responsibility. ***(Contribution to Society).***
PEO 4	Be adept in innovating solutions for ever-changing global environments with familiarity in computational platforms in power Sector. ***(Excellence in Career)***

PROGRAM OUTCOMES		
Engineering Graduates will be able to:		
PO 1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES	
PSO1	Apply appropriate techniques and modern Engineering hardware and software tools in power engineering adaptable to multi disciplinary environments
PSO2	Identify the optimal solutions for industrial and societal electrical energy requirements by applying suitable design and control strategies.

KUMARAGURU COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University Chennai)

COIMBATORE – 641 049

REGULATIONS 2015

BE ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM

SEMESTER – I

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	U15ENT101	Technical English	HS	3	3	0	0	3
2.	U15MAT101	Engineering Mathematics – I	BS	5	3	2	0	4
3.	U15PHT101	Engineering Physics	BS	3	3	0	0	3
4.	U15CHT101	Engineering Chemistry	BS	3	3	0	0	3
5.	U15EET101	Circuit Theory	PC	4	4	0	0	4
6.	U15CST101	Structured Programming using 'C'	ES	4	2	2	0	3
Practical								
7.	U15CHP101	Chemistry laboratory	BS	2	0	0	2	1
8.	U15EEP101	Basics of Electric Circuits lab	PC	4	0	0	4	2
9	U15CSP101	Structured Programming Laboratory using 'C'	ES	4	0	0	4	2
10.	U15GHP101	Personal Values	HS	2	0	0	2	1
TOTAL				34				26

SEMESTER – II

	Course Code	Course Title	Category	Contact Hours	Hrs/Week & Credits			
					L	T	P	C
Theory								
1.	U15ENP201	Business Communication and Presentation Skills	HS	4	2	0	2	2
2.	U15MAT201	Engineering Mathematics – II	BS	5	3	2	0	4
3.	U15PHT205	Applied Physics	BS	3	3	0	0	3
4.	U15CHT203	Chemistry for Circuit Engineering	BS	3	3	0	0	3
5.	U15MET201	Engineering Graphics	ES	6	2	4	0	4

6.	U15MET204	Thermal Engineering and Fluid Mechanics	ES	4	4	0	0	4
Practical								
7.	U15PHP201	Physics Laboratory	BS	2	0	0	2	1
8.	U15MEP201	Engineering Practices Laboratory	ES	4	0	0	4	2
9	U15MEP202	Thermal Engineering and Fluid Mechanics Lab	ES	4	0	0	4	2
10.	U15SIP201	Social Immersion Project	HS	2	0	0	2	2
TOTAL				37				27

SEMESTER - 3								
S. No.	**Course Code**	**Course Title**	**Category**	**Contact Hours**	**Hrs / Week & Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15MAT303	Partial Differential Equations and Transforms	BS	5	3	2	0	4
2.	U15EST001	Environmental Science and Engineering for Electrical Sciences	HS	3	3	0	0	3
3.	U15EET301	DC Machines and Transformers	PC	3	3	0	0	3
4.	U15EET302	Electromagnetic Fields	PC	3	3	0	0	3
5.	U15EET303	Networks and Systems	PC	4	2	2	0	3
6.	U15EET304	Analog Electronics	ES	3	3	0	0	3
Practical								
7.	U15EEP301	DC Machines and Transformers Laboratory	PC	2	0	0	2	1
8.	U15EEP302	Analog Electronics Laboratory	ES	2	0	0	2	1
9.	U15GHP301	Family Values	HS	1	1	0	0	1
Total				**26**				**22**

SEMESTER - 4								
S. No.	**Course Code**	**Course Title**	**Category**	**Contact Hours**	**Hrs / Week & Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15MAT402	Numerical Methods and Statistics	BS	5	3	2	0	4
2.	U15EET401	AC Machines	PC	3	3	0	0	3
3.	U15EET402	Transmission and Distribution	PC	3	3	0	0	3
4.	U15EET403	Control Systems	PC	4	2	2	0	3
5.	U15EET404	Measurements and Instrumentation	PC	3	3	0	0	3
6.	U15EET405	Digital Electronics	PC	3	3	0	0	3
Practical								
7.	U15EEP401	AC Machines and Controls Laboratory	PC	4	0	0	4	2
8.	U15EEP402	Digital Electronics Laboratory	PC	2	0	0	2	1
9.	U15CSP202	Problem Solving Techniques	ES	3	1	0	2	2
10.	U15GHP401	Professional Values	HS	1	1	0	0	1
Total				**31**				**25**

SEMESTER - 5								
S. No.	**Course Code**	**Course Title**	**Category**	**Contact Hours**	**Hrs / Week & Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15EET501	Electrical Machine Design	PC	3	3	0	0	3
2.	U15EET502	Power Electronics	PC	3	3	0	0	3
3.	U15EET503	Microprocessor and Micro controller	PC	3	3	0	0	3
4.	U15CST903	Data Structures and Algorithms	ES	3	3	0	0	3
5.	U15EEPE**	Professional Elective -I	PE	3	3	0	0	3
6.	U15	Open Elective -I	OE	3	3	0	0	3
Practicals								
7.	U15EEP501	Power Electronics Laboratory	PC	2	0	0	2	1
8.	U15CSP903	Data Structures and Algorithms Laboratory	ES	2	0	0	2	1
9.	U15EEP502	Industrial Training#	EEC	-	0	0	0	1
10.	U15ENP501	Communication Skills Laboratory	EEC	2	0	0	2	1
11.	U15GHP501	Social Values	HS	1	1	0	0	1
Total				**25**				**23**

Minimum one week training in Government / public sectors or two weeks in private organization during summer vacation at the end of fourth semester. To be evaluated during V semester by assessing the report and conducting seminar presentation.

SEMESTER - 6								
S. No.	**Course Code**	**Course Title**	**Category**	**Contact Hours**	**Hrs / Week & Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15GST005	Engineering Economics and Financial Management	HS	3	3	0	0	3
2.	U15EET601	Generation of Electrical Energy	PC	3	3	0	0	3
3.	U15EET602	Solid State Drives	PC	4	2	2	0	3
4.	U15EET603	Embedded Systems	ES	3	3	0	0	3
5.	U15EEPE**	Professional Elective -II	PE	3	3	0	0	3
6.	U15	Open Elective -II	OE	3	3	0	0	3
Practical								
7.	U15EEP601	Electrical Drives Laboratory	PC	2	0	0	2	1
8.	U15EEP602	Microprocessor and Embedded Systems Laboratory	ES	4	0	0	4	2
9.	U15EEP603	Creative Project Presentation	EEC	-	0	0	0	1
10.	U15GHP601	National Values	HS	1	1	0	0	1
Total				**26**				**23**

SEMESTER - 7								
S. No.	**Course Code**	**Course Title**	**Category**	**Contact Hours**	**Hrs / Week & Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15GST006	Product Design & Development	HS	3	3	0	0	3
2.	U15EET701	Electrical Energy Utilization and Conservation	PC	3	3	0	0	3
3.	U15EET702	Power System Analysis	PC	4	2	2	0	3
4.	U15EET703	Protection and Switch Gear	PC	3	3	0	0	3
5.	U15EEPE**	Professional Elective -III	PE	3	3	0	0	3
6.	U15	Open Elective -III	OE	3	3	0	0	3
Practical								
7.	U15EEP701	Power and Energy Laboratory	PC	2	0	0	2	1
8.	U15EEP702	Project Work Phase - I	EEC	4	0	0	4	2
9.	U15GHP701	Global Values	HS	1	1	0	0	1
Total				**26**				**22**

SEMESTER - 8								
S. No.	**Course Code**	**Course Title**	**Category**	**Contact Hours**	**Hrs / Week & Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15EEPE**	Professional Elective -IV	PE	3	3	0	0	3
2.	U15EEPE**	Professional Elective -V	PE	3	3	0	0	3
3.	U15EEPE**	Professional Elective -VI	PE	3	3	0	0	3
Practical								
4.	U15EEP801	Project Work Phase - II	EEC	20	0	0	20	10
Total				**29**				**19**

PROFESSIONAL ELECTIVES (PE)								
S. No.	**Course Code**	**Course Title**	**Category**	**Contact Hours**	**Hrs / Week & Credits**			
					L	**T**	**P**	**C**
Power System								
1.	U15EEPE01	High Voltage Engineering	PE	3	3	0	0	3
2.	U15EEPE02	Power Plant Engineering	PE	3	3	0	0	3
3.	U15EEPE03	Power System Operation and Control	PE	3	3	0	0	3
4.	U15EEPE04	Power Quality	PE	3	3	0	0	3
5.	U15EEPE05	Restructured Power System	PE	3	3	0	0	3
Power Electronics								
6.	U15EEPE06	Energy Storage Technology	PE	3	3	0	0	3
7.	U15EEPE07	Power Electronics For Renewable Energy Systems	PE	3	3	0	0	3
8.	U15EEPE08	Switched Mode Power Conversion	PE	3	3	0	0	3
9.	U15EEPE09	Advanced Power Electronics	PE	3	3	0	0	3
10.	U15EEPE10	PWM converters and Applications	PE	3	3	0	0	3
Control Systems								
11.	U15EEPE11	Adaptive Control	PE	3	3	0	0	3
12.	U15EEPE12	Modern Optimization Techniques	PE	3	3	0	0	3
13.	U15EEPE13	Modern Control Systems	PE	3	3	0	0	3
14.	U15EEPE14	Non linear Control systems	PE	3	3	0	0	3
15.	U15EEPE15	Soft computing	PE	3	3	0	0	3
Electrical Machines								
16.	U15EEPE16	Modeling and Analysis of Electrical Machines	PE	3	3	0	0	3
17.	U15EEPE17	CAD of Electrical Machines	PE	3	3	0	0	3

18.	U15EEPE18	Special Electrical Machines	PE	3	3	0	0	3
19.	U15EEPE19	Design of Energy Efficient Electrical Machines	PE	3	3	0	0	3
20.	U15EEPE20	Automotive Electronics	PE	3	3	0	0	3
Applied Electronics								
21.	U15EEPE21	Embedded System Design	PE	3	3	0	0	3
22.	U15EEPE22	Digital Signal Processing	PE	3	3	0	0	3
23.	U15EEPE23	Microcontroller Based System Design	PE	3	3	0	0	3
24.	U15EEPE24	Low Power VLSI Design	PE	3	3	0	0	3
25.	U15EEPE25	VLSI Design	PE	3	3	0	0	3
Emerging Technologies								
26.	U15EEPE26	FACTS	PE	3	3	0	0	3
27.	U15EEPE27	Smart Grid Engineering	PE	3	3	0	0	3
28.	U15EEPE28	Illumination Engineering	PE	3	3	0	0	3
29.	U15EEPE29	HVDC	PE	3	3	0	0	3
30.	U15EEPE30	Energy Auditing and Management	PE	3	3	0	0	3

OPEN ELECTIVES (OE)								
S. No.	**Course Code**	**Course Title**	**Category**	**Contact Hours**	**Hrs / Week & Credits**			
					L	**T**	**P**	**C**
Theory								
1.	U15EEOE01	Renewable Energy Resources	OE	3	3	0	0	3
2.	U15EEOE02	Control Engineering	OE	3	3	0	0	3
3.	U15EEOE03	Industrial Electronics	OE	3	3	0	0	3
4.	U15EEOE04	Power Electronics and Drives	OE	3	3	0	0	3
5.	U15EEOE05	Electrical Safety and Energy management	OE	3	3	0	0	3

ONE CREDIT COURSES

Code No.	Course Title	Industry that will offer the course
U15EEIN01	Electrical Systems in Automobile	Dept. of Automobile, KCT
U15EEIN02	Civil Construction for Power System	Dept. of Civil, KCT & TNEB
U15EIIN02	DCS Fundamentals And Industrial Communication Protocol	Dept. E & I, KCT, YOKOGAWA India Ltd.,
U15EEIN03	Siemens Course	Dept. E & I, KCT
U15EEIN04	Emerging Technologies in Solid State Drives	M/s Versa Drives, CBE
U15EEIN05	Automotive Electronics	TVS Motor Company, Hosur.

SEMESTER I

U15ENT101 - TECHNICAL ENGLISH (Common to all branches of Engineering and Technology)	L	T	P	C
	3	0	0	3

COURSE OUTCOMES

After the course the Student will be able to:

CO1: Use appropriate technical vocabulary when speaking and writing in English to express their understanding of technical concepts.

CO2: Write with greater felicity using the register suitable in the workplace.

CO3: Compose effective emails and write officials letters with greater clarity and precision.

CO4: Make effective oral presentations on topics related to science and technology and speak with clarity in interviews and group discussions.

COURSE OBJECTIVES

- To assist learners and enhance their technical vocabulary and thereby develop their communication skills in English both the written and the spoken mode.
- To familiarize learners with different rhetorical functions of technical syntax.
- To develop their writing skills with special reference to emails and official
- To help them improve their spoken communication in both formal and semi-formal contexts.
- To give them sufficient practice so that they develop their speaking, writing, reading and listening skills in English.

FOUNDATIONS OF TECHNICAL JARGON **9 Hours**

Parts of Speech – Word Formation – Affixing, Synonyms and Antonyms, Homonyms - Homophones and Homographs, One Word Substitutes, Nominal Compounds, Acronyms and Abbreviations, Definitions

TECHNICAL SYNTAX **9 Hours**

Tense, Voice, Kinds of Syntax, Gerund and Infinitives, Cause and effect expressions, Purpose and functional expressions, Conditional clauses, Reported speech

APPLICATIONS OF TECHNICAL SYNTAX **9 Hours**

Editing (Grammar – Concord, Articles, Parts of Speech, Modifiers – Dangling participles, Misplaced, Squinting and Punctuation), Instructions and Recommendations, Discourse markers – Process description, Writing a Paragraph – Descriptive, Narrative, Compare and Contrast, Argumentative, Evaluative, Persuasive, Sequencing of jumbled sentences

DRAFTING TECHNICAL DETAILS **9 Hours**

Note making – Linear, Report writing - Accident report, Project Proposals, Transcoding Graphics – Encoding and Decoding – Bar chart / Pie chart / Flow chart / Line graph / Tabulated data / Tree diagram or Organizational chart; Statement of Purpose

TECHNICAL CORRESPONDENCE **9 Hours**

Modules of a letter – Bank Loan applications, bona-fide Certificate Industrial Visit/ In-plant Training, Letter for Organizing functions, Letter of Application and Resume ,Notices and Circulars, Agenda, Basics of E-Mail writing and E-mail etiquette.

Total: 45 Hours.

Reference Books:

1. Rizvi Ashraf. M., Effective Technical Communciation, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2008.
2. Bhatnagar R.P. & Rahul Bhargava, “English for Competitive Examinations”, Macmillian Publishers, India, 1989, ISBN: 9780333925591
3. Aggarwal R.S., “A Modern Approach to Verbal & Non–Verbal Reasoning”, S.Chand Publishers, India, 2012, ISBN : 8121905516

U15MA*T*101/ ENGINEERING MATHEMATICS -I (Common to all branches of Engineering and Technology)	L	T	P	C
	3	2	0	4

COURSE OBJECTIVES

On completion of the course, the students are expected

- To know eigen values and eigen vectors and diagonalization of a matrix.
- To know about the geometrical aspects of curvature, evolute and envelope.
- To solve ordinary differential equations of certain types and its application.
- To understand the concepts of partial differentiation, maxima and minima.

MATRICES **9 Hours**

Rank of a matrix – Linearly dependent and independent vectors – Eigen values and eigenvectors of a real matrix – Properties of eigen values and eigenvectors – Cayley Hamilton theorem (excluding proof) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS **9 Hours**

Curvature – Radius, Centre and Circle of curvature in Cartesian, Parametric and Polar form – Evolute – Envelope of family of curves with one and two parameters – Evolute as the envelope of normals – properties of evolute and envelope.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS **9 Hours**

Leibnitz's equation – Bernoulli's equation – Equations of first order and higher degree - Clairauts form – Applications: Orthogonal trajectories and simple Electric circuit problems.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS **9 Hours**

Linear equations of second and higher order with constant coefficients – Euler's and Legendre's linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients - Application - Electrical circuit. (Differential equations and associated conditions need to be given).

FUNCTIONS OF SEVERAL VARIABLES **9 Hours**

Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

L: 45Hr; **T: 15Hr;** **TOTAL = 60 HOURS**

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition.
2. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
3. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics",S. Chand & Co., New Delhi, (Reprint) 2008.
4. Kreyzig E., "Advanced Engineering Mathematics", Eighth Edition, John Wiley and sons, 2010.
5. Arunachalam, T., Engineering Mathematics I, Sri Vignesh Publications, Coimbatore. (Revised) 2009.
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai,2003.
7. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Know eigen values and eigen vectors and its role in the system of equations.
CO2: Discover the radius, centre and circle of curvature of any curves.
CO3: Solve the ordinary differential equations of certain types and its applications.
CO4: Identify the maximum and minimum values of surfaces

.U15PH*T*101/ ENGINEERING PHYSICS **(Common to all branches of Engineering and Technology)**	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

At the end of the course the students would be exposed to fundamental knowledge in

- Various engineering subjects and applications.
- Structure identification of engineering materials.
- Non-destructive techniques.
- Interferometric techniques in metrology and electrical phenomena.
- Application of lasers in engineering and technology.
- Atomic and Nuclear related theories.

CRYSTAL PHYSICS **9 Hours**

Space lattice – unit cell – lattice planes – Bravais space lattices – Miller indices – calculation of interplanar distances – Atomic radius – co- ordination number – Packing factor for SC, BCC, FCC and HCP structures – crystal imperfections – point defects – line defects – surface defects – volume defects – effect of crystal imperfections.

APPLIED OPTICS **9 Hours**

Interference – airwedge and its applications - Lasers – spontaneous and stimulated emissions – Einsteins coefficients – Nd: YAG, Co_2 and semiconductor laser – Homojunction and Hetrojunction (only qualitative description) – applications – CD-ROM and holography (qualitative only) – optical fibre – principle and propagation of light in optcal fibers – Numerical aperture and acceptance angle – types of optical fibres – applications – fibre optic communication system – medical endoscopy.

QUANTUM PHYSICS **9 Hours**

Plancks quantum theory of black body radiation (derivation) – Photo electric effect – Compton effect (derivation) and experimental verification of Compton effect – De-broglies concept - Schrodinger wave equation – time independent and time dependent equations (derivations) – physical significance of wave function – particle in a box (one dimensional case) – Electron microscope – Scanning electron microscope – Transmission electron microscope.

ULTRASONICS AND NDT **9 Hours**

Introduction – production – magnetostriction effect – magnetostriction generator – piezoelectric effect – piezo electric generator –properties –detection – cavitation –acoustic grating – velocity measurement – applications –Sonar –velosity of blood flow – NDT –Liquid Penetrant method – Ultrasonic flaw detector – A scan, B scan, C scan – X- ray radiography and fluoroscopy – Thermography.

ATOMIC AND NUCLEAR PHYSICS **9 Hours**

Introduction – Atomic spectra – Molecular spectra – Applications – Raman effect – Stokes lines and anti stokes lines – Applications – Nuclear models – Liquid drop model –Nuclear fission – Theory – Energy released per fission – Chain reaction – Controlled chain reaction –

Nuclear reactors – Condition for sustained chain reaction – Types of Nuclear reactors – Nuclear fusion – Thermo nuclear reactions – Differences between fission and fusion

TOTAL: 45 HOURS

REFERENCES

1. Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.
3. Palinisamy P.K., Engineering Physics I, Scitech Publications, Chennai, 2011.
4. Avadhanulu M.N. andKshirsagar P.G., A textbook of Engineering Physics, S.Chand & Company Ltd, New Delhi,2005.
5. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2003.

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Analyze and identify the crystal structure in materials
CO2: Categorize and illustrate the optical materials and its application to engineering
CO3: Examine and compare samples at nano level
CO4: Apply the NDT techniques and modern engineering tools necessary for engineering practice.
CO5: Discuss the role of nulear physics in energy production

U15CHT101/ ENGINEERING CHEMISTRY (Common to all branches of Engineering and Technology)	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- To inculcate an understanding of the importance of chemistry by providing an overall perspective of theoretical and modern technological aspects of applied chemistry before beginning their more specialized courses.
- To embellish the usage of chemistry to exhibit engineering and technical concepts

ELECTROCHEMISTRY **9 Hours**

Introduction - Electrode potential – Nernst equation and problems - Electrochemical series - Application of EMF measurements & problems - Kohlrausch law of independent migration of ions & its application - Conductometric titrations (acid - base & precipitation titration)

Electrodes : Standard and reference electrode (Hydrogen & Calomel) – Types of electrodes (Metal – Metal ion; Metal – Metal insoluble salt, Redox electrode) - Ion selective (glass electrode) – determination of pH using glass electrode

Cells : Galvanic cell – Types of concentration cells

ENERGY STORING DEVICES **9 Hours**

Batteries : Primary Battery (Lechlanche & Alkaline battery) - Secondary Battery (Lead acid storage battery, Nickel - Cadmium battery & Lithium – Polymer battery) – Flow battery (Hydrogen and Oxygen Fuel Cell)

Solar Cells: Hybrid Solar cells

Nuclear Reactors: Light water nuclear power plant (nuclear fission) - ICF (nuclear fusion)

THERMODYNAMICS **9 Hours**

Introduction - Thermodynamic process (isothermic, isobaric, isochoric and adiabatic processes) - Internal energy – first law of thermodynamics (Mathematical derivation & limitation) - Enthalpy - Second law of thermodynamics - Entropy - Entropy change of an ideal gas & problems - Free energy - work function - Gibbs Helmholtz equation (derivation, applications & problems) - Van't Hoff isotherm (derivation & problems) - Van't Hoff isochore - (derivation & problems) - Third law and zeroeth law (Only statements)

SURFACE CHEMISTRY **9 Hours**

Introduction of adsorption - Types of Adsorption - Adsorption isotherm (Freundlich isotherm, Langmuir adsorption isotherm, BET isotherm) - Applications of adsorption : Role of adsorption in catalytic reactions, Ion exchange adsorption, adsorption chromatography (Column chromatography)

SPECTROSCOPY **9 Hours**

Introduction to spectroscopy - Beer Lambert's Law - Colorimetric analysis (principle, instrumentation (block diagram only) & application (Estimation of concentration of Ferrous and copper ions a solution by colorimetry) - UV – visible spectroscopy (principles, instrumentation (block diagram only) & simple Applications) - IR spectroscopy (principles, instrumentation (block diagram only) & simple applications) - Flame photometry (Principle, instrumentation (block diagram only) & simple Applications)

TOTAL: 45 HOURS

REFERENCES

1. Bahl B.S.,Tuli G.D. and ArunBahl., Essential of Physical Chemistry, S.Chand& Co. Ltd., New Delhi.
2. Somorjai G.A., Introduction to surface chemistry and Catalysis, John Wiley & Sons Inc., New York.
3. Shaw D.J., Introduction to colloidal and surface Chemistry, Butterworth – Heinemann Publishers
4. Syed Shabudeen, P.S. and Shoba U.S., Engineering Chemistry, Inder Publishers, Coimbatore.
5. Jain P.C. and Monika Jain, Engineering chemistry, Dhanpatrai Pub. Co. (P) Ltd., New Delhi.
6. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical chemistry, ShobanLal Nagin Chand & Co., New Delhi

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Assemble a battery and illustrate the phenomenon of production of electric current
CO2: Discuss the thermodynamic concepts and predict the feasibility of chemical reaction
CO3: Apply the theory of adsorption in real life situations
CO4: Outline the principles and instrumentation of spectroscopic techniques

U15EE*T*101/ CIRCUIT THEORY *(For Electrical and Electronics Engineering)*	L	T	P	C
	4	0	0	4

COURSE OBJECTIVES

- To understand the concept of electrical circuits, characteristics of circuit elements and power sources.
- To analyse A.C. circuits, the concept of active, reactive and apparent powers, power factor and resonance in series and parallel circuits.
- To solve electrical network problems using mesh and nodal analysis and by applying network theorems.
- To know the basic concepts of magnetic coupled circuits
- To know the fundamental relationships involved with three phase circuits and power measurement.

BASIC CIRCUIT CONCEPTS **9 Hours**

Introduction to Electrical Circuits: voltage, current, power and energy. Circuit elements : R,L,C parameters – Energy sources – Kirchhoff's laws –Series and parallel DC circuits-voltage division and current division-power in dc series and parallel circuits-network reduction techniques – Source transformation- star-to-delta and delta-to-star transformation.

AC CIRCUIT CONCEPTS **9 Hours**

The sine wave- Angular relation of a sine wave-The sine wave equation-Voltage and current Values of sine wave- Phase relation in Pure R, L and C . Complex impedance :impedance diagram– Phasor diagram- Analysis of series, parallel and Compound circuits. Power and power factor: Instantaneous Power - Average Power- Apparent Power and Power Factor-Reactive Power- Power Triangle. Series resonance and Parallel resonance – bandwidth and Q factor.

CIRCUIT ANALYSIS & NETWORK THEOREMS **9 Hours**

Nodal analysis and Mesh analysis for D.C and A.C circuits, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, maximum power transfer theorem, Duality in networks-problems.

MAGNETIC COUPLED CIRCUITS **9 Hours**

Self and mutual inductance-coefficient of coupling-dot convention-analysis of simple coupled circuits-ideal transformer-analysis of series and parallel connection of coupled coils- tuned circuits-analysis of magnetic circuits-comparisons of magnetic and electric circuits-magnetic leakage and fringing-parallel magnetic circuit.

THREE PHASE CIRCUITS **9 Hours**

Phase sequence-line and phase quantities-Three phase star and delta connections -analysis of three phase circuits with star and delta connected balanced and unbalanced loads- power measurement in three phase circuits using two wattmeter method-power factor of an unbalanced system.

L: 45Hr; T: 15Hr; TOTAL = 60 HOURS

REFERENCES

1. William H. Hayt Jr, Jack E. Kemmberly, and Steven M. Durbin, Engineering circuit analysis, Tata McGraw-Hill, New Delhi, 2002.
2. Joseph A. Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Series, Tata, McGraw-Hill, New Delhi, 2004.
3. Arumugam M. and Premkumar N., Electric Circuit Theory, Kanna Publishers, New Delhi, 1991.
4. Gupta B.R, Fundamentals of ElectruCircuits, S. Chand & Company (P) Ltd., New Delhi. 2002.
5. Paranjothi S.R., Electric Circuit Analysis, New Age International (P) Ltd., New Delhi, 2000.
6. Sudhakar A. and Shyammohan S.P., Circuits and Networks: Analysis and Synthesis, Tata McGraw-Hill, New Delhi, 2004.

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Determine the current and voltage magnitudes by applying laws. Students can also reduce the complex circuits to simple forms using reduction techniques and source transformations. Students will be able to draw the phase diagrams and can find the design parameters (Q factor and bandwidth) for series and parallel resonance circuits.

CO2: Reduce the complex circuits to simple circuits and apply mesh and nodal analysis to compute the current and voltage magnitudes in different branches of the given circuit.

CO3: Understand the concepts of magnetic circuits and can compute the effective inductance with respect to different parameters like number of turns, flux, area, direction of winding current and flux density. Students understand the 3 phase concepts and its types applicable for both balanced and unbalanced load.

U15CS*T*101/ U15CS*T*201 STRUCTURED PROGRAMMING USING C	L	T	P	C
	2	2	0	3
(Common to all branches of Engineering and Technology)				

COURSE OBJECTIVES

- To enable students to learn about the basics of computers and problem solving methods
- To learn the various features of C
- To learn how to program using C language

INTRODUCTION **9 Hours**

Programs and Programming- Programming languages and Their Classification - Compiler, Linker, Loader and Interpreter – Structured Programming Concept –Algorithm – Pseudo Code – Flow Chart.Number System – Binary – Decimal – Conversion Problems.

C LANGUAGE BASICS **9 Hours**

Introduction to C Programming – Fundamentals – Structure of a C Program – Compilation And Linking Processes – Constants, Variables – Data Types – Expressions Using Operators In C – Managing Input And Output Operations – Decision Making And Branching – Looping Statements – Solving Simple Scientific And Statistical Problems.

ARRAYS AND STRINGS **9 Hours**

Arrays – Initialization – Declaration – One Dimensional And Two Dimensional Arrays. String- String Operations – String Arrays. Simple Programs - Sorting- Searching – Matrix Operations.

FUNCTIONS, STORAGE CLASSES AND POINTERS **9 Hours**

Functions: Definition of function – Declaration of function – Pass by value – Pass by reference – Recursion.

Storage classes – auto, static, extern, register- scope rules.

Pointers: Definition – Initialization – Pointers arithmetic – Pointers and arrays - Dynamic memory allocation - Example Problems

STRUCTURES, UNIONS AND FILES **9 Hours**

Structures and Unions: Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions.

Files: Introduction – Using files in C - Working with text files.

L: 45Hr; T: 15Hr; TOTAL = 60 HOURS

REFERENCES

1. Pradip Dey and Manas Ghosh, “Programming in C”, Second Edition, Oxford University Press, 2011.

2. Rajasekaran S, "Numerical methods in Science and Engineering-A practical approach", S.Chand and Company, New Delhi-55, 2012.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
5. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Explain the basics of programs and programming
CO2: Select appropriate data types and control structures for solving a given problem.
CO3: Illustrate the representation of arrays, strings and usage of string operations.
CO4: Illustrate the importance of pointers and dynamic memory allocation.
CO5: Explain the basics of file handling mechanism.

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U15CH*P*101/ U15CH*P*201 CHEMISTRY LABORATORY (Common to all branches of Engineering and Technology)	L	T	P	C
	0	0	2	1

COURSE OBJECTIVES

- To apply the theoretical principles and perform experiments
- Experience the importance of theory by using analytical equipments and quantitative and qualitative procedures.

LIST OF EXPERIMENTS

PREPARATION OF SOLUTIONS (STANDARD)

1. Preparation of normal solutions of the following substances - oxalic acid, sodium carbonate, hydrochloric acid.
2. Preparation of phosphate buffer using Henderson equation.

WATER TESTING

3. Determination of total, temporary and permanent hardness by EDTA method.
4. Estimation of DO by Winkler's method.
5. Estimation of alkalinity by Indicator method.
6. Estimation of chloride by Argentometric method.

ELECTRO CHEMICAL ANALYSIS

7. Estimation of hydrochloric acid by pH metry.
8. Conductometric titration of mixture of acids and strong base
9. Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4.
10. Estimation of Iron by Potentiometry

PHOTOMETRY

11. Estimation of the Ferrous ions (Thiocyanate method) by Spectrophotometry.
12. Estimation of sodium and potassium by Flame photometry.

TOTAL: 45 HOURS

REFERENCES

1. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book ofQuantitative Chemical Analysis, Oxford, ELBS, London, 2002.
2. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, TataMcGraw-Hill Pub. Co., Ltd., London, 2003.
3. Shoba U.S., Sivahari R. and Mayildurai R., Practical Chemistry, Inder Publications, Coimbatore, 2009.

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Prepare normal solutions
CO2: Analyse the properties of water by applying the chemical concepts
CO3: Estimate the concentration of solutions by electrochemical methods and apply it in real life situations like blood testing etc

U15EEP101/ BASICS OF ELECTRIC CIRCUITS LABORATORY	L	T	P	C
(For Electrical and Electronics Engineering)	0	0	4	2

COURSE OBJECTIVES

- To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics and simulation of time response.

LIST OF EXPERIMENTS

1. Verifications of Ohm's Laws & Kirchhoff's Laws.
2. Verifications of Superposition theorem.
3. Verifications of Thevenin's theorem.
4. Verifications of Norton' s theorem.
5. Verifications of Reciprocity theorem.
6. Verifications of Maximum power transfer theorem.
7. Verifications of Mesh analysis.
8. Verifications of Nodal analysis.
9. Phasor relationships in RL & RC circuits.
10. Frequency response RL & RC Circuits
11. Frequency response of series resonance circuit.
12. Frequency response of parallel resonance circuit.

TOTAL: 45 HOURS

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Reduce the given complex circuit to simple circuit by applying theorems and can verify the theoretical and practical outputs
CO2: Find the impedance value of the given circuit at which the maximum power is transferred and also confirms with the practical results
CO3: Find the magnitudes of voltages and currents in the given circuit and verifies experimentally using mesh and nodal analysis
CO4: Demonstrate frequency response, Phasor relationships for the given RL, RC circuits and verify experimentally.
CO5: Design a circuit to accept or reject a particular frequency using resonance principle.

U15CS*P*101/ U15CSP201 STRUCTURED PROGRAMMING LABORATORY USING C (Common to all branches of Engineering and Technology)	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES

- To enable students to solve problems using C
- To apply the various features of C

LIST OF EXPERIMENTS

1. Simple programs
    - To find whether the given number is prime or not
    - Factorial of the given number
2. Programs involving Control and Looping Structures
    - Arithmetic Progression
    - Trigonometric series evaluation
3. Programs using Arrays
    - Sorting
    - Matrix addition and Multiplication
4. Calculation of median of a frequency distribution.
5. Evaluation of integrals
    - Trapezoidal Rule
6. String Processing
7. Program using Recursive function
8. Using pointers in C
9. Program using Functions, Structures and Files
    - Students Mark Analysis
10. Iterative method for finding Roots of the polynomials
    - Lagrange interpolation method

TOTAL: 45 HOURS

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Demonstrate code reusability using recursive and non-recursive functions.
CO2: Implement pointers, memory allocation techniques and files in 'C' language.
CO3: Apply and practice logical ability to solve simple problems.
CO4: Demonstrate 'C' programs for statistical and scientific problem solving.

U15GHP101/ PERSONAL VALUES (Common to all branches of Engineering and Technology)	L	T	P	C
	0	0	2	1

COURSE OBJECTIVES

- To inspire students to become best Humans.
- To know about self.
- To overcome evil temperaments.
- To live with sound health.
- To reach Intuition.

HUMAN LIFE & EXCELLENCE **4 Hours**

Human Excellence: Introduction – objective – personal values - importance.
Life : Self – Society – Nature – Yoga – purpose of life – philosophy of Human life.
Body, Soul, Mind & Their Functional Relationship : Panchboothas and it's association – Form of the body : physical body, astral body, causal body - Effect: Pain, Disease, Death; Soul – Life force – Bio magnetism – Genetic Centre – Mind : Origin & it's ten stages.

INTROSPECTION & THOUGHT ANALYSIS **4 Hours**

Introduction – Importance – Blemishes – Six evil temperaments & their maneuvering.
Thought analysis: Introduction - process of thought – Mind & Thought relationship – causes for origin of thoughts
Exercise: Training & Practice of Thought analysis

MORALIZATION OF DESIRE **2 Hours**

Desire : Introduction – Causes – Types – Contra qualities evolving out of desire – Effect of unfulfilled desire – Renunciation – Is attainment of desire in harmony with Law of Nature.
Training : Moralization of Desire.

NEUTRALIZATION OF ANGER **2 Hours**

Introduction – Origin of Anger – Alternative forms of Anger – A chain action – Consequence of anger on self & others – Neutralization of anger – the point where anger is won.
Training : Neutralizing anger.

ERADICATION OF WORRIES **2 Hours**

Worry: Causes - Effects – Types of problems – Solution to problems – Overcoming Worries.
Training – Eradication of Worries.

REALIZATION OF SELF **2 Hours**

Transformation Theory – Understating Self – Guru's role in guiding – Who am I? – Shaping One's destiny.
Training : Realization of self.

THEORY & PRACTICAL SESSION ON PHYSICAL EXERCISE: 9 Hours

Introduction – Hints & caution – Live in Health and harmony – Hand Exercise – Leg Exercise –Neuro muscular breathing Exercise – Kapalapathy – Magarasanas I & II – Massage – Acu-pressure – Body relaxation .

MEDITATION 5 Hours

Meditation: Agna Meditation – Shanthi Meditation.

TOTAL: 30 HOURS

1. Vethathiri's Maharishi's, ***"Manavalakalai part 1,2&3"*** 11th edition, The World Community Service Centre, Vethathiri Publications,1994.
2. Vethathiri Maharishi's, ***"Rejuvenating Life Force and Mind"*** – paper-III for M.A. Yoga for Human Excellence" 3rd edition, The World Community Service Centre, Vethathiri Publications, 2010.
3. Swami Vivekananda, "***Selections from the complete works"*** 23th edition , The Ramakirshna Mission Institute of Culture, 2007
4. Vethathiri's Maharishi's, ***"Yoga for Modern Age",*** The World Community Service Centre, Vethathiri Publications, 2009.
5. Vethathiri's Maharishi's, ***"Mind"*** The World Community Service Centre, Vethathiri Publications, 1999.
6. Russell Kelfer, "Self Control", Tyndale House Publishers, 1985.
7. Swami Vivekananda, "***Karma Yoga"*** 39th edition, The Ramakirshna Mission Institute of Culture, 2008.

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Acquire knowledge on the individual in relation to Nature and Society.
CO2: Analysis purity of Thoughts, Moralization of Desire
CO3: Learn about Neutralization of Anger.
CO4: Develop skills in Sky yoga and Kaya kalpa.

SEMESTER II

U15ENP201 – BUSINESS COMMUNICATION AND PRESENTATION SKILLS	L	T	P	C
	2	0	2	2
(Common to all branches of Engineering and Technology)				

COURSE OUTCOMES

After the course the Student will be able to:

CO1: Gain cognizance of Effective Business Environment

CO2: Practice and perceive the full repertoire of listening strategies.

CO3: Develop effective reading and writing skills and set goals for future growth.

CO4: Inculcate Spoken Communication Skills required for presentations and discussions.

COURSE OBJECTIVES

- Develop a milestone for leadership and group participation through communication skills
- Discover an understanding of the process of adept listening skills
- Formulate a significant training ground for the development of student's abilities in public speaking
- Create multiple opportunities for students to practice and share their reading skill development
- Improve critical thinking and analytical skills to facilitate effective writing skills

Fundamentals of Business Communication **12 Hours**

Introduction to Business Communication - Greetings, Formal and Informal Introduction of Self and Others, Giving encouragement: Phrases for Positive Feedback, Agreeing and disagreeing – Expressions indicating frequency, Reading to Understand – Facts, Inference, Main Idea, Author's Opinion/ tone, Short prepared compositions on current affairs

Listening and Comprehending Business Communication **12 Hours**

Listening to monologues, Listening for general content- Listening to dialogues- Listening to a telephonic conversation- Listening for specific information, numbers, time, duration- Listening to conversations among three or more people - Listening to a group discussion and providing factual information, Intensive listening

Oral Business Communication **12 Hours**

Establishing Business relationships and negotiating, Describe an object or event- Describing a working mechanism- Argumentative speech about a Public issue - Responding to situations and providing solutions, Seeking Permission, Introduction to Presentation Skills - Presenting information, Giving and Getting Product and Service Information, Perceiving Visual Information, Talking about People and Places

Reading and Comprehending Business Communication 12 Hours

Reading techniques, News Paper Reading, Reading brochures, leaflets, instruction manual- Cloze test- Reading Comprehension, Book review, Article review, Reading a Technical Report, Critical Reading (Editorial): Creative and Critical thinking

Written Business Communication 12 Hours

Product Review, Writing a proposal for conducting science exhibition, E-mail etiquette and correspondence, Business Itinerary, Business Letters – Calling for a quotation – Placing Order – Letter of Complaint – Letter seeking Clarification – Acknowledging prompt / quality service, Letter requesting information, Letter explaining a situation, Letter of acceptance and declining, Encoding and decoding advertisements

Total: 60 Hours

Reference Books:

1. Spoken English: A foundation course for speakers of Tamil. Part I & II: Kamalesh Sadanand, Susheela Punitha. Orient Longman Publications, 2008.
2. Life Skills and Leadership for Engineers: David Goldsberg, University of Ilinois, Tata Mcgraw Hill.2007.

U15MA*T*201/ ENGINEERING MATHEMATICS - II (Common to all branches of Engineering and Technology)	L	T	P	C
	3	2	0	4

COURSE OBJECTIVES

On completion of the course, the students are expected

- To understand double and triple integrations and enable them to find area and volume using multiple integrals.
- To know the basics of vector calculus comprising gradient, divergence and curl and line, surface and volume integrals.
- To understand analytic functions of complex variables and conformal mappings.
- To know the basics of residues, complex integration and contour integration.
- To understand Laplace transform and use it to represent system dynamic models and evaluate their time responses.

MULTIPLE INTEGRALS **9 Hours**

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variables between cartesian and polar coordinates - Triple integration in cartesian coordinates – Application : Area as double integral – Volume as triple integral .

VECTOR CALCULUS **9 Hours**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

ANALYTIC FUNCTION **9 Hours**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy-Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs) – Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping : $w = z + c$, cz , $1/z$ and bilinear transformation.

COMPLEX INTEGRATION **9 Hours**

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proofs) – Taylor's and Laurent's series expansions – Singularities – Residues – Cauchy's residue theorem (excluding proof) – Application of residue theorem to evaluate real integrals - Unit circle and semi-circular contours (excluding poles on real axis).

LAPLACE TRANSFORM **9 Hours**

Definition - Properties – Superposition - Shift in t - Shift in s - Time Derivatives - Time Integral – Initial and Final Value Theorems – Periodic functions: sine wave, saw-tooth, square and triangular waves - Inverse Laplace Transform – Simple system dynamic models – Transfer Functions – Poles and Zeroes - Response of First-Order Systems - Solution of RC Free, Step and Sinusoidal Responses; Response of Second-Order Systems - Free Response, step Response - Convolution theorem.

L: 45Hr; T: 15Hr; TOTAL = 60 HOURS

REFERENCES

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, Delhi, 42nd Edition, 2012.
2. Philip D. Cha, James J. Rosenberg, Clive L. Dym, Fundamentals of Modelling and Analyzing Engineering Systems, Cambridge University Press, United Kingdom, 2000.
3 Kreyzig E., Advanced Engineering Mathematics, John Wiley & Sons (Asia), Pvt, Ltd., Singapore, 10th Edition, 2010.
4 Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill, Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
5 Venkataraman M.K., Engineering Mathematics, Volume - II, The National Pub. Co., Chennai, 2003.
6 Kandasamy P., Thilagavathy K. and Gunavathy K., Engineering Mathematics, S. Chand & Co., New Delhi, 2008.
7 Arunachalam T. and Sumathi K., Engineering Mathematics II, Sri Vignesh Publications, Coimbatore, Third Edition, 2011.

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Evaluate double integral and triple integral to compute area, volume for two dimensional and three dimensional solid structure.

CO2: Know the gradient, divergence and curl, related theorems useful for engineering applications.

CO3: Test the analyticity and to construct the analytic function and transform complex functions from one plane to another plane graphically.

CO4: Evaluate real and complex integrals over suitable closed paths or contours.

CO5: Know the Applications of Laplace transform and its properties & to solve certain linear differential equations using Laplace transform technique.

U15PHT205 / APPLIED PHYSICS	L	T	P	C
(For Electrical and Electronics Engineering)	3	0	0	3

COURSE OBJECTIVES

At the end of the course the students would be exposed to fundamental knowledge in

- Design of acoustically good buildings
- Properties and applications of conducting materials, Superconducting materials, magnetic and dielectric materials.
- Preparation, properties and applications of Metallic glasses, Shape memory alloys and Nano materials.
- Plasma, types and its applications

ACOUSTICS **9 Hours**

Classification of sound – characteristics of musical sound –loudness –Weber-Fechner law – decibel, phon – Reverberation – reverberation time – derivation of Sabines formula for reverberation time (rate of growth and rate of decay) –Absorption coefficient and its determination – factors affecting acoustics of buildings –optimum reverberation time, loudness, focusing, echo, echelon effect, resonance and noise and their remedies.

CONDUCTING AND SUPERCONDUCTING MATERIALS **9 Hours**

Conducting Materials : Classical free electron theory of metals-Electrical conductivity – Thermal conductivity - expression – Wiedemann Franz law(derivation) – Lorentz number – drawbacks of classical theory – Fermi distribution function – density of energy states – effect of temperature on Fermi energy.

Superconducting Materials : Superconducting phenomena – properties of superconductors – Meissner effect, Isotope effect, Type I &Type II superconductors – High Tc superconductors - Applications – cryotron, magnetic levitation and squids.

SEMICONDUCTING & OPTICAL MATERIALS **9 Hours**

Origin of band gap in solids (Qualitative treatment only) - carrier concentration in an intrinsic semi conductor (derivation) – Fermi level – variation of Fermi level with temperature - Electrical conductivity – band gap semiconductor – carrier concentration in n-type and p-type semi conductors (derivation) – Variation of Fermi level with temperature and impurity concentration –

Optical Materials : Optical properties of semiconductors – Excitons- Traps – colour centre – Types of colour centres – luminescence – fluorescence and phosphorescence.

MAGNETIC & DIELECTRIC MATERIALS **9 Hours**

Magnetic Materials : Properties of dia, para, ferro, anti ferro and ferri magnetic materials - Langevin's theory of paramagnetism – Weiss theory of Ferromagnetism – Domain theory of ferromagnetism - hysteresis – soft and hard magnetic materials – Ferrites – Applications - magnetic recording and readout - Storage of magnetic data, Tapes, floppy,magnetic disc drives – Bubble memory.

Dielectric Materials : Electronic, ionic, orientation and space charge polarization - Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – different types of break down mechanism - Ferro electric materials - properties and applications.

PLASMA AND NANOTECHNOLOGY **9 Hours**

Plasma Technology : properties of plasma- types of plasma- thermal and non thermal plasma-Production of glow discharge plasma-Cold plasma- applications in textile and biomedical field.

Nano Materials - synthesis - plasma arcing – Chemical vapour deposition – sol-gel - Electro deposition – ball milling – properties of nanoparicles and applications. – Carbon nano tubes – fabrication - arc method – pulsed laser deposition - Chemical vapour deposition - structure, properties & applications.

TOTAL: 45 HOURS

REFERENCES

1. Gopal S., Materials Science, Inder Publications, Coimbatore, 2007.
2. Palanisamy P.K., Materials Science, 2nd edition, Scitech Pub. India (P) Ltd.
3. Pillai S.O., Solid State Physics, 5th edition, New Age Int. Publication, New Delhi, 2003.
4. Avadhanalu M.N. and Kshirsagar P.G., A textbook of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2004
5. Goldston R.J., Rutherford P.H., Introduction of Plasma Physics-I, CRC publication, New York, America, 2000
6. Rajendran V. and Marikani A., Materials Science, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Apply core concepts in Materials Science to solve engineering problems
CO2: Describe the impact of acoustic engineering solutions in a constructional environmental and societal context.
CO3: Determine the position of the acceptor or donor levels and the brand gap of an extrinsic semiconductor,
CO4: Classify & differentiate the structure and physical properties of conducting materials
CO5: Apply the concepts of nanomaterials and modern materials for explaining surface properties like adhesion etc. in engineering practice.

U15CHT203/ CHEMISTRY FOR CIRCUIT ENGINEERING *(Common For ECE, EEE, EIE, IT)*	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

To impart a sound knowledge on basics of

- Theoretical and modern technological aspects of modern polymeric materials technology for micro electrical, electronics, instrumentation and communication fields.

INTRODUCTION TO CONDUCTING POLYMERIC MATERIALS 9 Hours

Formation of polymers – Types of polymers - chain growth and step growth polymerization – Mechanisms - copolymerization - Thermoplastics and thermosets - Micro structures in polymers – polymer length - molecular weight - amorphous and crystalline - thermal transitions in plastics.

APPLIED CONDUCTING POLYMERS 9 Hours

Synthesis, structure, morphology, conductivity, doping theory and uses of Poly(sulfur nitride), Polyacetylene, Polyphenylene, Poly(phenylene vinylenes), Poly(phenylene sulfide), Polypyrrole and Polythiophene, Polyaniline - Polymers with transition metals in the side-group structure and their uses (includes Stacked Phthalocyanine polymers).

MANUFACTURING METHODS OF ORGANO ELCTRONICS MATERIALS 9Hours

Organo-electronic materials – classification – Production of substrates for organic electronics - Reel-to-reel Vacuum metallization - Organic vapor phase deposition – production of TFTs, OLED, organic photovoltaics - Micro and nanofabrication techniques – Solution based printing.

ORGANIC ELECTRONIC MATERIALS 9 Hours

Organic thin-film transistor (OTFT) – architecture, operating mode - fabrication techniques - structure-property relationship - methods of improving performance – structural perfection - device architecture - electrical and environmental stability – chemical effects on stability - Gate dielectrics on electrical functionality.

ADVANCED MATERIALS FOR ORGANIC ELECTRONICS 9 Hours

Pentacene transistors – performance - Engineered pentacenes – reversible functionalization – end - substituted derivatives - perifunctionalized pentacenes – Heteropentacenes - Semiconductors based on polythiophene and Indolo[3,2-*b*]carbazole – polydialkylterthiophenes – polydialkylquaterthiophenes - polythiophene nanoparticles - indocarbazole designs.

TOTAL: 45 HOURS

REFERENCES

1. Kiichi Takemoto, Raphael M. Ottenbrite, Mikiharu Kamachi, Functional Monomers and Polymers, CRC Press, New York.
2. Kaiser A.B., Electronic properties of conjugated polymers, Basics models and applications, Springer verlag, Berlin.
3. Chilton J.A. and Goosey M.T., Special polymers for electronics and optoelectronics, Kluwer Academic Pub., London.
4. Hagen Klauk, Organic Electronics: Materials, Manufacturing and Applications, Wiley – VCH, Weinheim
5. Hand book of Conducting Polymers, e-book
6. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, Polymer Science, New Age Int. Pvt. Ltd., New Delhi

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Analyse and determine the required conducting polymers in fabrication of organic electronic devices
CO2: Describe the mechanism of formation of conducting polymeric materials
CO3: Design an Organic Thin film transistor
CO4: Outline the performance of Pentacene transistors

U15ME*T*101/ U15ME*T*201 ENGINEERING GRAPHICS (Common to all branches of Engineering and Technology)	L	T	P	C
	2	4	0	4

COURSE OBJECTIVES

- To understand the principle of orthographic projection of points, lines, surfaces and solids.
- To understand the principle of section and development of solids.
- To understand the principle of Isometric and Perspective projections.
- To study the principle of free-hand sketching techniques.

PLANE CURVES, PROJECTION OF POINTS AND LINES 15 Hours

Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points.

Projections of straight lines located in first quadrant - determination of true length and true inclinations.

PROJECTIONS OF SURFACES AND SOLIDS 15 Hours

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined to one reference plane., Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 15 Hours

Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.

Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

PICTORIAL PROJECTIONS 15 Hours

Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms and pyramids when its base resting on the ground by vanishing point method.

FREE-HAND SKETCHING 15 Hours

Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning.

Sketching pictorial views from given orthographic views.

L: 30Hr; T: 45Hr; TOTAL = 75 HOURS

REFERENCES

1. Basant Agrawal and CM Agrawal, Engineering Drawing, McGraw-Hill, New Delhi, First Edition, 2008.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2008.
3. Nataraajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2005.
4. Warren J. Luzadder and Jon. M. Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., New Delhi, Eleventh Edition, 2005.
5. Gopalakirishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2001.

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Construct various plane curves and projection of lines and surfaces.
CO2: Develop projection of surfaces and solids.
CO3: Solve problems in sections of solids and development of surfaces.
CO4: Apply the concepts of isometric, and perspective projections
CO5: Apply free hand sketching in engineering practice.

U15ME*T*204/ THERMAL ENGINEERING AND FLUID MECHANICS *(For Electrical and Electronics Engineering)*	L	T	P	C
	4	0	0	4

COURSE OBJECTIVES

- To introduce principles of power generation utilizing various sources
- To introduce the basic concepts in various thermal applications like IC engines, gas, steam turbines and compressors.
- To gain knowledge regarding the fundamentals of fluid flow and their Applications.

POWER PLANT ENGINEERING **9 Hours**

Introduction, Classification of Power Plants – Working principles of thermal (coal, gas and diesel), Hydro-electric and Nuclear Power plants – Merits and Demerits – Non-conventional power generation methods- Solar and wind power – Boilers - construction and working principles of Cochran, Babcock and Wilcox boilers

PRIME MOVERS **9 Hours**

Steam turbines-Impulse (Delaval) and reaction turbines – Hydraulic prime movers- Pelton and Kaplan turbines- Internal combustion engines as automobile power plant – Working principles of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines.

REFRIGERATION AND AIR CONDITIONING **9 Hours**

Positive displacement compressors – Reciprocating compressors- Rotary positive displacement compressors - Construction and working principles of centrifugal and axial flow compressors. Refrigeration –Vapour compression and vapour absorption refrigeration – Air conditioning- Terminology- Classification as to season of the year - window room air conditioning- thermoelectric cooling-applications.

FLUID PROPERTIES AND FLOW CHARACTERISTICS **9 Hours**

Fluid properties – Viscosity – Surface Tension – Capillarity – Fluid Pressure and Pressure Head – Types of Fluid Flow – Flow Lines – Continuity Equation Euler's equations – Bernoulli's Equation and Applications – Viscous flow and turbulent flow

FLUID FLOW APPLICATIONS **9 Hours**

Energy losses due to fluid flow – Flow through Circular Pipes - Flow through pipes in series and parallel – Major and Minor Losses – Hydraulic Grade Line and Total Energy Line – Working principles of centrifugal pumps, reciprocating pumps (single acting and double acting).

TOTAL: 45 HOURS

REFERENCES

1. Domkundwar S., Kotandaraman C.P. and Domkundwar A.V., Thermal Engineering, Dhanpat Rai & Co, 2002.
2. Modi P.N. and Seth S.M., Hydraulic & Fluid Mechanics including Hydraulic Machines, Standard Book, 2006.

3. Venugopal K. and Prabhuraja V., Basic Mechanical Engineeering, Anuradha Publishers, 2005
4. Bansal R.K., Fluid Mechanics & Hydraulic Machines, Lakshmi Publications (P) Ltd., 2006

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Demonstrate understanding of basic concepts of thermodynamics and power plants
CO2: Explain the working of prime movers.
CO3: Understand the working of air conditioning systems.
CO4: Solve problems in fluid properties
CO5: Solve problems in flow dynamics.

U15PHP101/ U15PHP201 PHYSICS LABORATORY (Common to all branches of Engineering and Technology)	L	T	P	C
	0	0	2	1

COURSE OBJECTIVES

- The experiments are designed to illustrate phenomena in different areas of Physics and to expose you to measuring instruments.
- The laboratory provides a unique opportunity to validate physical theories in a quantitative manner.
- Laboratory experience demonstrates the limitations in the application of physical theories to real physical situations.
- In general, the purpose of these laboratory exercises is both to demonstrate some physical principle and to teach techniques of careful measurement

LIST OF EXPERIMENTS

Any Ten Experiments

1. Lee's disc - determination of thermal conductivity of a bad conductor
2. Air wedge - determination of thickness of agiven specimen.
3. Spectrometer - determination of wavelength of mercury source using grating
4. Compound pendulum - determination of accelaration due to gravity.
5. Carey foster bridge – determination of specific resistance of given coil of wire.
6. Viscosity - determination of co-efficient of viscosity of a liquid by poiseuille's flow method.
7. Non-uniform bending – determination of Young's modulus
8. Ultrasonic interferometer –determination of velocity of sound and compressibility of liquid.
9. Band gap determination of a semiconductor using post office box
10. Semiconductor laser:
    a. Determination of wavelength of laser using grating
    b. Particle size determination
    c. Acceptance angle of optical fibre
11. Torsional pendulum - determination of Rigidity modulus of the wire
12. Field along the axis of a coil – Determination of magnetic moment.

TOTAL: 45 HOURS

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Determine different physical properties of a material like the thermal conductivity thickness of the material, etc.

CO2: Perform experiments involving the physical phenomena like interference and diffraction.

CO3: Apply physical theories in real life situations by also taking into account its limitations

U15ME*P*101 / U15ME*P*201 ENGINEERING PRACTICES LABORATORY	L	T	P	C
(Common to all branches of Engineering and Technology)	0	0	4	2

LIST OF EXPERIMENTS

GROUP – I **21 Hours**

A. CIVIL ENGINEERING

1. Carpentry

- Study of carpentry tools
- Preparation of T joint
- Preparation of dovetail joint

2. Plumbing

- Study of pipeline joints

B. MECHANICAL ENGINEERING

1. Fitting

- Study of fitting tools
- Preparation of L joint
- Preparation of square joint

2. Sheet Metal Working

- Study of sheet metal working tools
- Preparation of cone and tray

3. Welding

- Study of arc welding tools and equipment
- Preparation of butt joint

GROUP - II (ELECTRICAL & ELECTRONICS ENGINEERING)

C. ELECTRICAL ENGINEERING PRACTICE **12 Hours**

- Basic household wiring using switches, fuse, indicator-lamp, etc.,
- Preparation of wiring diagrams.
- Stair case light wiring.
- Tube light wiring
- Study of iron-box, fan with regulator, emergency lamp and microwave oven.

D. ELECTRONIC ENGINEERING PRACTICE **12 Hours**

1. Assembling simple electronic component on a small PCB and Testing.
2. Soldering simple electronic circuits and checking continuity.

3. Measurements using digital multimeter.
    - DC and AC voltage measurement
    - DC and AC current measurements.
    - Resistance Measurement.
    - Continuity measurement.
4. Testing of Electronic components
    - Resistors
    - Inductors and capacitors
    - Diodes (resistance in forward bias and reverse bias)
    - Transistors
5. Study of CRO and Function generator
    - Study of Panel Controls
    - Measurement of Amplitude, Frequency, phase difference

TOTAL: 45 HOURS

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Select the various tools and equipments used in the fabrication workshop.
CO2: Develop various models in carpentry, fitting,
CO3: Make components using sheet metal work and welding.
CO4: Demonstrate and evaluate the parameters of basic electronic components (wires, resistors,
capacitors, diodes etc.) and test the components.
CO5: Estimate DC and AC Voltage and currents using appropriate measuring instruments.

U15ME*P*202/ THERMAL ENGINEERING & FLUID MECHANICS LABORATORY *(For Electrical and Electronics Engineering)*	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES

- Expected to gain knowledge regarding the working of IC engines and air compressors.
- Expected to gain knowledge regarding the fundamentals of fluid flow and their applications to flow through pipes and hydraulic machines.

LIST OF EXPERIMENTS

THERMODYNAMICS LAB

1. Study of a Petrol Engine
2. Study of a Diesel Engine
3. Study of a IC Engine
4. Performance evaluation of four stroke diesel engine using rope brake dynamometer
5. Test on reciprocating air compressor

FLUID MECHANICS LABORATORY

1. Flow measurements using venturi meter
2. Test to estimate frictional losses in pipe flow.
3. Test on positive displacement pump for obtaining its characteristics curves and design flow parameters.
4. Test on centrifugal pump for obtaining its characteristics curves and design flow parameters.
5. Test on jet pump for obtaining its characteristics curves and design flow parameters.
6. Test on reaction turbine for obtaining the characteristics curve and to design values of specific speed, discharge, output and efficiency.
7. Test on impulse turbine to obtain its characteristics curves and hydraulic design values.

TOTAL: 45 HOURS

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Conduct tests on engine performance.
CO2: Study petrol engine working principles.
CO3: Explain diesel engine working principles.
CO4: Examine the pump characteristics
CO5: Conduct test on turbines.

SEMESTER III

U15MAT303	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
		3	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Formulate partial differential equations and solve certain types of partial differential equations	**K_3**
CO2	Determine the Fourier Series and half range Fourier Series of a function given explicitly or to find Fourier Series of numerical data using harmonic analysis.	**K_4**
CO3	Solve one dimensional wave equation, one dimensional heat equation and two dimensional heat equation in steady state using Fourier Series (Cartesian co-ordinates only).	**K_6**
CO4	Apply the Fourier transform, Fourier sine and cosine transform to certain functions and use Parseval's identity to evaluate integrals.	**K_4**
CO5	Evaluate Z – transform for certain functions.	**K_5**
CO6	Estimate Inverse Z – transform of certain functions and to solve difference equations using them.	**K_4**

PRE-REQUISITE

Basic differentiation and integration concepts

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							M	M				
CO2	S	S							M	M				
CO3	S	S							M	M				
CO4	S	S							M	M				
CO5	S	S							M	M				
CO6	S	S							M	M				

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

PARTIAL DIFFERENTIAL EQUATIONS 9+3 Hours

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

FOURIER SERIES 9+3 Hours

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

BOUNDARY VALUE PROBLEMS 9+3 Hours

Classification of second order quasi linear partial differential equations –Solution of one dimensional wave equation – One dimensional heat equation (excluding insulated ends) – Steady state solution of two dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

FOURIER TRANSFORM 9+3 Hours

Infinite Fourier transform pair – Infinite Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

Z -TRANSFORM 9+3 Hours

Z-transform – Properties – Convolution theorem- Inverse Z -transform (by using partial fractions, residue methods and convolution theorem) - Solution of difference equations using Z - transform.

Theory: 45 Hours Tutorial: 15 Hours Total: 60 Hours

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.

REFERENCES

1. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, Wiley India, 2013.
3. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S. Chand & Company Ltd., New Delhi, 1996.
4. Ian Sneddon, "Elements of partial differential equations", McGraw – Hill New Delhi, 2003.
5. Arunachalam T., "Engineering Mathematics III", Sri Vignesh Publications, Coimbatore 2009.

U15EST001	ENVIRONMENTAL SCIENCE AND ENGINEERING FOR ELECTRICAL SCIENCES (COMMON TO EEE, ECE AND EIE)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Analyze the impact of engineering solutions in a global and societal context	**K4**
CO2	Discuss contemporary issues in the field of electrical, electronics and instrumentation that results in environmental degradation and would attempt to provide solutions to overcome those problems	**K3**
CO3	Highlight the importance of ecosystem and biodiversity	**K2**
CO4	Consider issues of environment and sustainable development in their personal and professional undertakings	**K3**
CO5	Paraphrase the importance of conservation of resources.	**K2**
CO6	Play an important role in transferring a healthy environment for future generations	**K3**

PRE-REQUISITE

NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					S	S		W	W				
CO2							S		W	W				
CO3							S		W	W				
CO4	W						S		W	W				
CO5	W						S	M	W	W		W		
CO6	W						S		W			W		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 14 Hours

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams benefits and problems - Water conservation, rain water harvesting, watershed management

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies

Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources - Case studies.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

ECOSYSTEMS AND BIODIVERSITY 9 Hours

ECOSYSTEM : Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids - Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

BIODIVERSITY : Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION 10 Hours

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution (e) light pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies - Solid waste Management: E-Waste management – Recycling of electrical components, Mobile phones, PCB, Servers – Radiation effects from electrical and electronic gadgets - Causes, effects and control measures of pollution due to electrical and electronic industrial emissions and wastes generation – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT 7 Hours

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues

involved in enforcement of environmental legislation – Human Rights

HUMAN POPULATION AND THE ENVIRONMENT 5 Hours

Population growth and explosion – Women and Child Welfare Programme - Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Field Work

Visit to local area to document environmental assets- river / grassland / hill / mountain, visit to local polluted site- urban / rural / industrial / agricultural, study of common plants, insects, birds, study of simple ecosystems-pond, river, hill slopes etc.,

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co., 2013
2. Syed Shabudeen, P.S., "Environmental chemistry", Inder Publishers, Coimbatore, 2013.

REFERENCES

1. Masters G.M. and Ela W.P., "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education Pvt., Ltd.
2. Bharucha Erach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., Ahmedabad India, 2002.
3. Trivedi R.K and Goel P.K., "Introduction to Air pollution" Techno-science Publications, 2003.
4. Trivedi R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 1996.
5. Cunningham, W.P., Cooper, T.H.., & Gorhani E., "Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.
6. Wager K.D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.
7. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell science Publishing Co., 2003.

U15EET301 DC MACHINES AND TRANSFORMERS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Explain the construction, principle of operation and characteristics of DC machines.	**K2**
CO2	Choose a suitable starter for the given DC machines.	**K2**
CO3	Analyze the performance of DC machines and Transformers.	**K3**
CO4	Identify the types and characteristics of transformers.	**K3**
CO5	Summarize the procedure for parallel operation of DC machines and Transformers.	**K3**
CO6	Classify the machines based on performance characteristics and identify their applications.	**K3**

PRE-REQUISITE

Electro Magnetic Fields

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		W											
CO2	S	W	W											
CO3	S	M		M										
CO4	S	W	W											
CO5	S	M		M										
CO6	S		M											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

DC GENERATORS 9 Hours

Constructional features of a DC machines – Principles of operation of DC generator – EMF equation – methods of excitation – no load and load characteristics of DC generators –armature reaction and commutation – parallel operation of DC generators.

DC MOTORS 9 Hours

Principle of operation - back EMF – torque equation –characteristics – starting – speed control - applications.

TESTING OF DC MACHINES 9 Hours

Losses and efficiency – Testing of DC machines - Brake test, Swinburne's and Hopkinson's tests.

TRANSFORMERS 9 Hours

Principle of operation – construction – types of single phase transformers – EMF equation – transformer on no load and load – effects of resistance and leakage reactance of the windings – phasor diagram – Auto transformer – comparison with two winding transformers – three phase transformer connections.

TESTING OF TRANSFORMERS 9 Hours

Equivalent circuit – regulation - losses and efficiency – all day efficiency – testing – polarity test – open circuit and short circuit tests – Sumpner's test – parallel operation of transformers.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. D.P.Kothari and I.J. Nagrath, "Electric Machines", 4th Edition, Tata McGraw Hill, 2010, New Delhi.
2. S.K.Bhattacharya, "Electrical Machines", 4th Edition, Tata McGraw Hill, 2014, New Delhi.

REFERENCES

1. A.E.Fitzgerald, Charles Kingsley, Stephen.D.Umans, "Electric Machinery", 7th Edition, Tata Mcgraw Hill, 2013, New Delhi.
2. J.B.Gupta, "Theory and Performance of Electrical Machines", 14th Edition, S.K.Kataria and Sons, 2010, New Delhi.
3. P.S.Bimbhra, "Electrical Machinery", 7th Edition, Khanna Publishers, 2011, New Delhi.

U15EET302	ELECTRO MAGNETIC FIELDS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	State and apply the laws of electromagnetic fields to practical circumstances and study the behavior of various geometrics of materials.	**K2**
CO2	Determine the electric field intensity resulting from various configurations of charge distribution.	**K3**
CO3	Apply the concept of magneto statics and its behavior using laws associated with it.	**K2**
CO4	Analyze and classify magnetic materials and solve magneto static field problems using laws associated with it.	**K2**
CO5	Apply the concept of electro dynamic fields and electromagnetic waves in determining wave parameters in different mediums.	**K3**
CO6	Outline the concept of electromagnetic fields and analyze the behavior of conductors using laws associated with it.	**K2**

PRE-REQUISITE

Engineering Mathematics – I, Engineering Mathematics – II, Applied Physics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M	W											
CO3	M	M												
CO4	M	S												
CO5	M	S												
CO6	S	M		W										

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal test – I 2. Internal test – II 3. Assignment 4. Seminar 5. End Semester Exam	1. Course Exit Survey

ELECTROSTATIC FIELDS 9 HOURS

Introduction to vector fields and co-ordinate systems - Types of charge distributions – Coulomb's law – electric field intensity of point, line and sheet of charges – electric flux density – Gauss's law and its applications – divergence theorem – Poisson's and Laplace equations – electric potential – potential gradient.

ELECTRIC FIELD IN MATERIALS 9 HOURS

Properties of Conductors - Current and current density – continuity of current – relaxation time - nature of dielectric materials – polarization in dielectrics - boundary conditions for perfect dielectric materials - electric dipole – Potential and field due to an electric dipole - capacitance – determination of capacitance for spherical, cylindrical and parallel plate configurations – electrostatic energy storage and energy density.

MAGNETOSTATIC FIELDS 9 HOURS

Lorentz' law of force- Biot Savart's law and its applications – Ampere's circuital law and its applications – Stoke's theorem – magnetic flux and flux density – scalar and vector magnetic potential - Relation between field theory and circuit theory.

MAGNETIC FORCE AND INDUCTANCE 9 HOURS

Force between different current elements - Torque on closed circuits - Magnetization - Magnetic boundary conditions – Inductance – Mutual Inductance – Magneto-static energy storage and energy density.

ELECTRODYNAMIC FIELDS AND ELECTROMAGNETIC WAVES 9 HOURS

Faraday's law – Stationary and motional EMFs - conduction and displacement current densities – Maxwell's equations in differential and integral forms. Electromagnetic waves: – wave parameters: velocity, intrinsic impedance - wave equation – waves in free space, conductors, lossy and lossless dielectrics – skin depth - Poynting vector and Poynting theorem.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. W. H. Hayt and John A. Buck, "Engineering Electromagnetics", 6th Edition, Tata McGraw Hill, New Delhi, 2014.
2. Gangadhar K.A. and Ramanathan P.M., "Electromagnetic Field Theory", 5th Edition, Khanna Publishers, New Delhi, 2013.

REFERENCES

1. J.A. Buck and W. H. Hayt, "Problems and Solutions in Electromagnetics", 1st Edition, Tata McGraw Hill, New Delhi, 2010.
2. John D. Kraus and Daniel A. Fleisch, "Electromagnetic with Applications", 5th Edition, Tata McGraw Hill, New Delhi, 2010.
3. Joseph A. Edminister, "Theory and Problems of Electromagnetic Schaum's Outline Series", 5th Edition, Tata McGraw Hill Inc., New Delhi, 2010.
4. Ashutosh Pramanik, "Electromagnetism – Theory and Applications", 2nd Edition, Prentice Hall of India, New Delhi, 2010.
5. N.N.Rao, "Elements of Engineering Electromagnetic", 6th Edition, Prentice Hall of India, New Delhi, 2010.
6. http://nptel.iitm.ac.in

U15EET303 **NETWORKS AND SYSTEMS**

L	T	P	C
2	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the basic concepts of graph theory applied to electrical networks.	**K1**
CO2	Analyze the transient behavior of DC and AC circuits.	**K2**
CO3	Model the networks in S-domain and determine their equivalent two port network parameters.	**K2**
CO4	Design various types of filters and observe their frequency response.	**K2**
CO5	Design various types of attenuators.	**K2**
CO6	Categorize the different types of signals and systems.	**K2**

PRE-REQUISITE

Circuit Theory, Engineering Mathematics – II

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M	W											
CO3	S	M												
CO4	M	M												
CO5	M	M												
CO6	M	W	W											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

NETWORK TOPOLOGY 9 Hours

Basic definitions of a network graph - planar graph and non-planar graph – tree and co-tree properties – Twigs and links – incidence matrix – Tie- set matrix and branch currents – cut-set and tree branch voltages - fundamental cut – sets – Formation of network equations: Node voltage equations – loop current equations -solving networks using Graph theory.

CIRCUIT TRANSIENTS 9 Hours

Steady state and Transient response in 'S' domain – DC response of RL, RC and RLC circuits and sinusoidal response of RL, RC and RLC circuits.

NETWORK FUNCTIONS AND TWO PORT NETWORKS 9 Hours

Concept of complex frequency – transform impedance and transform circuits - network functions for one port and two port networks — poles and zeros and their significance – time domain response from pole – zero plot-Two port networks - Z, Y, ABCD and h parameters – analysis of T and π networks.

FILTERS AND ATTENUATORS 9 Hours

Introduction – classification of filters – filter networks – equations of filter networks - low pass, high pass, band pass, and band elimination filters – limitations of constant k filters – m-derived filters- LPF and HPF. Attenuators: T network, π network, Lattice network and bridged T networks.

SIGNALS AND SYSTEMS 9 Hours

Classification of signals: continuous – discrete – periodic - energy and power signals; Classification of systems: Continuous – discrete – linear – causal – stable – dynamic - recursive and time variance.

Theory: 30 Hours Tutorial: 15 Hours Total: 45 Hours

TEXT BOOKS

1. Sudhakar A. and Shyammohan S.P., "Circuits and Networks: Analysis and Synthesis", 3rd Edition, Tata McGraw-Hill, New Delhi, 2006.
2. Ramesh Babu, "Digital Signal Processing", 4th Edition, SciTech Publications (India) Pvt. Ltd., 2012.

REFERENCES

1. D. Roy Choudhury, "Networks and Systems", 1st Edition, New Age Publications (Academic), New Delhi, 2005.
2. Gupta, B.R., "Network Analysis and Synthesis", 4th Revised Edition, S.Chand & Company (Pvt) Ltd., New Delhi, 2013.
3. Jagan N.C., and Lakshminarayana C., "Network Theory", 2nd Edition, BS Publications, Hyderabad, 2005.
4. Joseph A. Edminister and Mahmood Nahvi, "Electric Circuits Schaum's Outline Series", 6th Edition, Tata McGraw-Hill, New Delhi, 2014.
5. Umesh Sinha, "Network Analysis and Synthesis", 3rd Edition, Sathya Prakashan Publishers, New Delhi, 2013.
6. D.H. Hayes, "Digital Signal Processing Schaum's Outline Series", 2nd Edition, Tata McGraw Hill, New Delhi, 2011.

U15EET304	ANALOG ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the characteristics and applications of various semiconductor devices.	**K1**
CO2	Gain knowledge about BJT and FET amplifiers.	**K1**
CO3	Analyze and design amplifier and oscillator circuits.	**K2**
CO4	Analyze and design circuits using Op-amp.	**K3**
CO5	Familiarize with the concept of IC based voltage regulator and signal conversion circuits	**K2**
CO6	Apply the knowledge of semiconductor devices to design analog circuits for various applications.	**K3**

PRE-REQUISITE

Engineering Physics, Circuit Theory

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M											
CO2	M	M	W											
CO3			S	W							W			
CO4			S	W							W			
CO5	M	M												
CO6	W		M						M		M			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exist Survey

SEMICONDUCTOR DEVICES 9 Hours

PN junction Diode – Zener Diode – BJT – MOSFET- Structure, Operation and VI Characteristics - Applications of Diode: Half Wave & Full Wave Rectifier – Zener voltage regulator.

TRANSISTOR AND FET AMPLIFIERS 9 Hours

Biasing Circuits – Voltage divider bias, Self bias, CE, CB & CC Amplifiers – Cascade and Darlington Connection – FET amplifier-CS and Source Follower.

LARGE SIGNAL, FEEDBACK AMPLIFIERS AND OSCILLATORS 9 Hours

Classification of Amplifiers - Transformer coupled Class A, B & AB Amplifiers – Push-pull Amplifiers – Tuned Amplifiers - Single Tuned Amplifiers-Advantages of Negative Feedback – Voltage/Current - Series & Shunt Feedback Amplifiers – Positive Feedback – Barkhausen Criteria – Operation of RC phase shift, Wien Bridge, Crystal Oscillators.

OPAMP AND IT'S APPLICATIONS 9 Hours

Basic information of OPAMP, pin configuration, ideal OPAMP – internal circuit- Differential Amplifier – Common mode and Differential mode Analysis - Basic operations of OPAMP - inverting, Non inverting, Differentiator, Integrator- Instrumentation Amplifier - Op-Amp Based Instrumentation Amplifier – Comparator – Multi vibrators – Schmitt trigger – Precision rectifier.

SPECIAL ICs AND SIGNAL CONVERSION CIRCUITS 9 Hours

V/I and I/V conversion – V/F and F/V conversion - 555 Timer circuit – Functional block, characteristics & applications, 566 - voltage controlled oscillator circuit, 565-phase locked loop circuit functioning and applications, IC voltage regulators - LM317, 723 regulators.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS:

1. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", 3rd Edition, McGraw-Hill Education, 2012.
2. Thomas L. Floyd, "Electronic Devices (Conventional Current Version)", 9th Edition, Prentice Hall of India, 2012.
3. D. Roy Choudhary, Sheil B. Jani, "Linear Integrated Circuits", 4th Edition, New Age International, New Delhi, 2010.

REFERENCES

1. Jacob Millman, Christos C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", Tata McGraw Hill Publishing Limited, New Delhi, 2010.
2. B.P.Singh, Rekha Singh, "Electronic Devices and Circuits", 2nd Edition, Pearson Education, 2013.
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
4. J.B.Gupta, "Electronic Devices and Circuits", 2nd Edition, JPA Publications, 2009.
5. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, "Microelectronic Circuits", 6th Edition, Oxford University Press, 2013.
6. Donald A Neamen, "Microelectronics Circuit Analysis and Design", 4th Edition, Tata McGraw Hill Publishing Limited, 2009.
7. Ramakant A. Gayakward, "Op-amps and Linear Integrated Circuits", 4th Edition, Pearson Education, New Delhi, 2009.
8. Jacob Millman, Christos C. Halkias, "Integrated Electronics - Analog and Digital circuits system", 2nd Edition, Tata McGraw Hill, New Delhi, 2011.

U15EEP301	DC MACHINES AND TRANSFORMERS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Assess the performance of DC shunt, series and compound motors.	**K2**
CO2	Determine the efficiency of DC shunt, series and compound motors.	**K2**
CO3	Perform the speed control methods of DC shunt motor.	**K2**
CO4	Predetermine the efficiency of DC shunt motor	**K3**
CO5	Assess the performance of single phase transformer using various methods.	**K3**
CO6	Determine the performance characteristics of DC machines and transformers.	**K2**

PRE-REQUISITE

Electro Magnetic Fields

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M						W					
CO2	S	M	S						W					
CO3	M	W							W					
CO4	S	S	M						W					
CO5	S	S	M						W					
CO6	S	M	M						W					

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator with differential and cumulative connection
3. Load characteristics of DC shunt motor
4. Load characteristics of DC series motor
5. Load characteristics of DC compound motor

6. Swinburne’s test of DC shunt machine
7. Speed control of DC shunt motor
8. Hopkinson’s test on DC motor generator set
9. Load test on single-phase transformer
10. Open circuit and short circuit test on single phase transformer
11. Sumpner’s test
12. Scott connection of three phase transformer

Experiments beyond the syllabus should be conducted

Practical:24 Hours **Total: 24 Hours**

U15EEP302	ANALOG ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Gain hands on experience in studying the characteristics of semiconductor devices.	**K1**
CO2	Demonstrate simple application circuits using diode.	**K1**
CO3	Design amplifier and oscillator circuits using op-amp.	**K2**
CO4	Analyze the performance characteristics of linear IC's.	**K2**
CO5	Simulate simple analog circuits using PSPICE.	**K2**
CO6	Acquire experience in building and troubleshooting analog electronic circuits.	**K2**

PRE-REQUISITE

Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	W						W					
CO2	M		W						W					
CO3			M						W					
CO4			M						W					
CO5			W		M									
CO6									W			W		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

1. Characteristics of BJT - CE and CB configurations.
2. Characteristics of JFET.
3. Zener diode as a voltage regulator.
4. Frequency response of common emitter amplifier.
5. Half wave and full wave rectifiers.
6. Inverting, Non inverting and differential amplifiers using op-amp.

7. Comparator, Integrator and differentiator circuits using op-amp.
8. RC Phase shift oscillator.
9. Wien bridge oscillator.
10. Astable and Monostable operation using IC 555.
11. Schmitt trigger using op-amp.
12. Simulation of op-amp circuits using PSPICE.

Experiments beyond the syllabus should be conducted

Practical:24 Hours **Total: 24 Hours**

U15GHP301	FAMILY VALUES (Common to all branches of Engineering and Technology)	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the importance of a family	
CO2	Acquire skills in simplified Kundalini yoga for sound health.	
CO3	Learn about greatness of womanhood	
CO4	Learn about the importance of Blessings and relationship	
CO5	Know about simplified Kundalini yoga, its methodology and its benefits	

PRE-REQUISITE

Nil

Introduction to Family Life – An Overall Perspective **1 Period**

Personal & Spiritual development through good Family life **1 Period**

Importance of Relationships & Blessings **3 Periods**

Food as Medicine – Quantum Healing **3 Periods**

Greatness of womanhood **2 Periods**

Simplified Physical Exercises (Kundalini Exercises) **5 Periods**

Practical:15 Hours **Total: 15 Hours**

REFERENCES

1. Yoga for Modern Age ---- Vethathiri Maharishi
2. The Man making Messages ---- Swami Vivekananda
3. Manavalakalai Part- 1&2&3 ---- Vethathiri Maharishi
4. Only Love is Real ---- Brian L Weiss

SEMESTER IV

U15MAT402	NUMERICAL METHODS AND STATISTICS	L	T	P	C
		3	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the concepts of numerical techniques for solving system of equations.	**K_4**
CO2	Represent the experimental results numerically and to integrate (or differentiate) numerical data.	**K_3**
CO3	Predict the system dynamic behavior through solution of ordinary differential equations modeling the system.	**K_5**
CO4	Understand the concepts of statistical measures and to measure the relationship between two attributes.	**K_4**
CO5	Analyze random or unpredictable experiments and investigate important features of random experiments.	**K_5**
CO6	Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.	**K_6**

PRE-REQUISITE

Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							M	M				
CO2	S	S							M	M				
CO3	S	S							M	M				
CO4	S	S							M	M				
CO5	S	S							M	M				
CO6	S	S							M	M				

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9+3Hours

Linear interpolation method – Iteration method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordan methods - Iterative methods: Gauss Jacobi and Gauss - Seidel methods – Inverse of matrix by Gauss - Jordan method – Eigen values of a matrix by Power method.

INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3Hours

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's rules.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3Hours

Single step methods: Taylor's series method, Euler and Improved Euler methods for solving first order equations – Fourth order Runge- Kutta method for solving first and second order equations – Multistep method: Milne's predictor and corrector method.

STATISTICAL MEASURES 9+3Hours

Measures of central tendency: Mean, Median and Mode – Measures of variation : Range, Standard deviation, Mean deviation and coefficient of variation - Correlation and Regression: Karl Pearson's coefficient of correlation –Rank Correlation – Regression lines.

PROBABILITY, RANDOM VARIABLE AND DISTRIBUTIONS 9+3Hours

Axioms of probability – Conditional probability – Total probability – Baye's theorem – Random variable – Distribution function - Probability function – Probability density function – Expectation – Discrete and Continuous distributions: Binomial, Poisson and Normal distributions .

Theory: 45 Hours Tutorial: 15 Hours Total: 60 Hours

TEXT BOOKS

1. Grewal, B.S. and Grewal, J.S., "Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.
2. R.A. Johnson, Irwin Miller and John Freund, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2007.

REFERENCES

1. R.E. Walpole, R.H. Myers, S.L. Myers and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th edition, 2007.
2. Gupta S. P, "Statistical Methods", Sultan Chand & Sons Publishers, 2004.
3. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 7th Edition, Pearson Education Asia, New Delhi, 2007.
4. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.

U15EET401	AC MACHINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Explain the construction, principle of operation of synchronous machines and asynchronous machines.	**K2**
CO2	Determine the performance of synchronous machine under various excitation conditions.	**K2**
CO3	Choose a suitable starter for the given AC machines.	**K2**
CO4	Describe the speed control methods of induction motors.	**K2**
CO5	Analyze speed torque characteristics of induction motors.	**K3**
CO6	Explain the principle of operation and characteristics of special machines.	**K2**

PRE-REQUISITE

Electro Magnetic Fields

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		W											
CO2	S		W											
CO3	S	M		M	M									
CO4	S		W											
CO5	S	M		M	M									
CO6	S		M		M									

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

SYNCHRONOUS GENERATOR 9 Hours

Constructional details – Types of rotors – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF, ZPF and ASA methods – Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input - Operating characteristics – Capability curves.

Salient pole machines: Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test – phasor diagram using X_d and X_q.

SYNCHRONOUS MOTOR 9 Hours

Principle of operation – Torque equation – Operation on infinite bus bars – V and Inverted V curves – Power input and Power equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting.

THREE PHASE INDUCTION MOTOR 9 Hours

Constructional details – Types of rotors – Principle of operation – Slip – Equivalent circuit – Slip-torque characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor test - Circle diagram – Separation of no load losses – Cogging and Crawling-Double cage rotors – Induction generator – Synchronous induction motor.

STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9 Hours

Need for starters – Types of starters – Stator resistance and reactance, rotor resistance, autotransformer and star-delta starters – Speed control – Change of voltage, torque, frequency, V/f control, number of poles – Cascaded connection – Slip power recovery schemes.

SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9 Hours

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors - Special machines : Shaded pole induction motor, reluctance motor, repulsion motor, hysteresis motor, stepper motor and AC series motor.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. D.P.Kothari and I.J. Nagrath, “Electric Machines”, 4th Edition, Tata McGraw Hill, New Delhi, 2010.
2. A.E.Fitzgerald, Charles Kingsley, Stephen.D.Umans, “Electric Machinery”, 7th Edition, Tata Mcgraw Hill, New Delhi, 2013.

REFERENCES

1. P.S.Bimbhra, “Electrical Machinery”, 7th Edition, Khanna Publishers, New Delhi, 2011.
2. J.B.Gupta, “Theory and Performance of Electrical Machines”, 14th Edition, S.K. Kataria and Sons, New Delhi, 2013.
3. R.K.Rajput, “Electrical Machines”, 4th Edition, Laxmi publications Pvt.Ltd, New Delhi, 2006.
4. K. Murugesh Kumar, “Electrical Machines - II”, 1st Edition, Vikas publishing house Pvt Ltd, New Delhi, 2000.
5. B.L.Theraja, “A Text of Electrical Technology, Volume-II” S.Chand & Co Ltd, 2008.
6. H. Cotton, “Advanced Electrical Technology” Pitman London, 1967.

U15EET402	TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Calculate the parameters of transmission lines from the conductor configuration and physical characteristics of the lines.	**K2**
CO2	Model the transmission line and analyze their performance	**K2**
CO3	Calculate the number of insulators based on string efficiency and design the physical parameters of cables.	**K2**
CO4	Describe the components of substation and grounding.	**K2**
CO5	Compare the HVDC and AC systems and analyze the performance of AC distribution systems.	**K2**
CO6	Describe the essential components of transmission and distribution, model and analyze their performances.	**K2**

PRE-REQUISITE

Network Theory, Electro Magnetic Fields

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M												
CO3	S	M	M											
CO4		M	W											
CO5	M	M	M											
CO6	M	M	M											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

TRANSMISSION LINE PARAMETERS 9 Hours

Structure of electrical power system: various levels such as generation, transmission and distribution - 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 neighboring communication circuits - Typical configuration, conductor types and electrical parameters of 400, 220, 110, 66 and 33 kV lines.

MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9 Hours

Classification of lines: Short line, medium line and long line - equivalent circuits, attenuation constant, phase constant, surge impedance, transmission efficiency and voltage regulation - Sag tension calculation: Factors affecting sag, Support at same level, Effect of ice and wind, Total length of conductor, Equivalent span, Support at different levels - Ferranti effect, Phenomena of corona and its losses.

INSULATORS AND CABLES 9 Hours

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.

SUBSTATION AND GROUNDING SYSTEM 9 Hours

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 - Substation layout for 110/33/11 kV.

DISTRIBUTION SYSTEM AND HVDC SYSTEM 9 Hours

Classification of Distribution systems - AC distribution and DC Distribution - Connection Scheme of Distribution System - Radial system, Ring-main and Interconnected System. AC distribution - AC distributor with concentrated load - three-phase, four-wire distribution system. Sub-mains - Stepped and tapered mains. HVDC System - Types of HVDC system, advantages and limitations of HVDC - HVDC transmission system in India.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. S. N. Singh, “Electric Power Generation, Transmission and Distribution”, 2nd Edition, Prentice Hall of India, New Delhi, 2008.
2. B. R. Gupta, “Power System Analysis and Design”, 5th Edition, S. Chand, New Delhi, 2001.

REFERENCES

1. C.L. Wadhwa, “Electrical Power Systems”, 6th Edition, New Age International (P) Ltd., New Delhi, 2010.
2. D. P Kothari and I J Nagrath, “Modern Power System Analysis”, 4th Edition, Tata McGraw Hill, New Delhi, 2011.
3. Hadi Saadat, “Power System Analysis”, 2nd Edition, Tata McGraw Hill, New Delhi, 2002.
4. Central Electricity Authority (CEA), “Manual on Transmission Planning Criteria”, New Delhi, Jan 2013.
5. Tamil Nadu Electricity Board Handbook, 2003.

U15EET403	CONTROL SYSTEMS	L	T	P	C
		2	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Gain the basic knowledge about various control system components	**K1**
CO2	Derive the transfer function model and state space model of physical systems	**K2**
CO3	Determine the transient and steady state behavior of systems subjected to standard test signals	**K2**
CO4	Analyze the linear systems for steady state errors.	**K3**
CO5	Analyze the linear systems for absolute and relative stability in time and frequency domain.	**K3**
CO6	Familiarize with system properties like Controllability and Observability.	**K2**

PRE-REQUISITE

DC Machines and Transformers, AC Machines, Engineering Mathematics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M	W											
CO3	S	M	W											
CO4	S	M	W											
CO5	S	M	W											
CO6	S	M												

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

SYSTEMS AND THEIR REPRESENTATION 9Hours

Basic elements in control systems – Open and closed loop systems -Mathematical modeling of physical systems: Transfer function model of Mechanical and Electrical systems - Electrical analogue of mechanical systems - Transfer function of DC Servo motor and AC Servomotor-Block diagram reduction techniques – Signal flow graphs.

TIME RESPONSE ANALYSIS 9Hours

Time response – Types of test input-step, ramp, impulse and parabolic inputs – I order system response for step, ramp and impulse input and II order system Response for step input– Time domain specifications -Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

FREQUENCY RESPONSE ANALYSIS 9Hours

Frequency response – Frequency domain specifications- Correlation between frequency domain and time domain specifications– Polar plot – Bode plot- Introduction to Constant M and N circles.

STABILITY OF CONTROL SYSTEM 9Hours

Definition of Stability - Location of roots of Characteristics equation in S plane for stability – Routh Hurwitz criterion – Root locus Techniques – Effect of pole, zero addition – Gain margin and phase margin –Concepts of Nyquist stability criterion.

STATE VARIABLE ANALYSIS 9 Hours

State space formulation-state model of linear system-state diagram-state space representation using physical variable- state space representation using phase variable - state space representation using canonical variable-Solution of state equations using Laplace transform-Concepts of Controllability and Observability.

Theory:30 Hrs Tutorial: 15 Hrs Total: 45 Hrs

TEXT BOOKS

1. I.J. Nagrath & M. Gopal, "Control Systems Engineering", 5th Edition, New Age International Publishers, New Delhi, 2007.
2. M. Gopal, "Control Systems, Principles & Design", 4th Edition, Tata McGraw Hill, New Delhi, 2012.

REFERENCES

1. K. Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, New Delhi, 2010.
2. B.C. Kuo, "Automatic Control Systems", 7th Edition, Prentice Hall of India Ltd., New Delhi, 2003.
3. R. Anandha Natarajan and B. Ramesh Babu, "Control System Engineering", 3rd Edition, Scitech Publication, 2009.
4. Norman S. Nise, "Control Systems Engineering", 4th Edition, John Wiley & Sons, Inc., 2007.
5. M.N. Bandyopadhyay, "Control Engineering Theory & Practice", Prentice Hall of India, 2004.

U15EET404	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Explain the functional elements of instruments used for measuring electrical parameters.	**K2**
CO2	Determine the circuit parameters (R,L,C and frequency) using bridges	**K2**
CO3	Explain the function and working of various transducers for measuring physical quantities.	**K2**
CO4	Illustrate the concept of digital measurement system.	**K2**
CO5	Describe the role of intelligent sensors and data acquisition system for effective measurement and data storage.	**K2**
CO6	Select appropriate instruments for measuring electrical and non electrical parameters.	**K3**

PRE-REQUISITE

Applied Physics, Circuit Theory

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W												
CO2	M	M	W											
CO3	M	W	W								W			
CO4	M	W	W											
CO5	W	M	M	W	W									
CO6		M	M								W			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

CONCEPT OF MEASUREMENT SYSTEMS 9 Hours

Functional elements of an instrument – Static and dynamic characteristic – Errors in measurement – Standards and calibration – Construction, Principle of operation of MC & MI meters - Electro Dynamic moving type Wattmeter – Induction type Energy meter.

COMPARISON METHODS OF MEASUREMENTS 9 Hours

DC bridges – Kelvin double bridge, Wheat stone bridge, Mega Ohm Bridge, Megger – AC bridges - Schering bridge - Maxwell's inductance bridge - capacitance bridge – Anderson bridge - Wein bridge

DIGITAL MEASUREMENT 9 Hours

Digital Measurement of Electrical Quantities – Concept of digital measurement - Block diagram study of Digital voltmeter - frequency meter - Power Analyzer - Harmonics Analyzer - Electronic Multimeter.

ELECTRONIC TRANSDUCER AND APPLICATIONS 9 Hours

Transducer – Definition and Nature – Transducer functions – Characteristics of Transducer – Classification of Transducers – Technology Trend– Fibre optic Transducers – Displacement Transducer – LVDT-Temperature Transducer – Resistance Temperature Detector – Thermocouples – Thermistor – pyrometer, Pressure Transducer – Piezo Electric Transducer - Liquid level Transducer – Fluid pressure Transducer - Liquid flow Transducer – Pipe line flow Transducers – Open channel flow measurement, speed measurement using Encoder and hall sensor.

DATA ACQUISITION SYSTEM AND INTELLIGENT SENSORS 9 Hours

Data acquisition system – Introduction, objectives, single channel and multi channel. Block diagram study – compact data logger with basic operation (H.S.Kalsi, pp. 558-569), Microcomputer based data acquisition system (Ernest O. Doeblin pp. 911-921 or H.S.Kalsi pp. 569-576). Intelligent Sensors – On chip signal processing – MEMS sensors – Nano sensors.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Sons Publications, New Delhi, 2012.
2. H.S.Kalsi, "Electronic Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2010.

REFERENCES

1. Ernest O.Doeblin, "Measurement Systems – Applications and Design", 5th Edition, McGraw Hill, New Delhi, 2007.
2. A.D.Cooper and A.D.Helfrik, "Modern Electronic Instrumentation and Measurement Techniques", 2nd Edition, Prentice Hall of India, New Delhi, 2008.
3. S.Ramabhadran, "Electrical Measurements and Instruments", Khanna Publishers, New Delhi, 2009.
4. S.K.Singh, "Industrial Instrumentation and Control", 3rd Edition, Tata McGraw Hill Publishers, New Delhi, 2008.
5. E. W. Golding & F. C. Widdis, "Electrical Measurement & Measuring Instrument", 5th Edition, A.H.Wheeler & co., India, 2011.

U15EET405	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Translate the number systems and apply the basic postulates of Boolean algebra.	**K2**
CO2	Design and analyze combinational logic circuits	**K2**
CO3	Design and analyze simple sequential logic circuits	**K2**
CO4	Apply state reduction techniques for sequential circuit design	**K2**
CO5	Explain the digital logic families and implement combinational circuits using programmable logic devices	**K2**
CO6	Design digital logic circuits for various applications	**K3**

PRE-REQUISITE

Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	W											
CO2		M	S	W										
CO3		M	S	W										
CO4			M	W										
CO5	S		M											
CO6	W	W	M	W					W		W	W		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

NUMBER SYSTEM AND BASIC LOGIC 9 Hours

Number systems-Binary, Octal, Hexadecimal, Number base conversions , Binary codes: Weighted codes-BCD - 8421-2421, Non Weighted codes - Gray code – Excess 3 code Binary arithmetic,1’s complements , 2’s complements, and Code conversions. Boolean algebra - Boolean theorems – DeMorgan’s Theorem- Principle of Duality – Logic gates – Minterm – Maxterm - Canonical forms - Conversion between canonical forms, sum of product and product of sum forms, Karnaugh map Minimization – Don’t care conditions, Tabulation method.

COMBINATIONAL CIRCUITS 9 Hours

Problem formulation and design of combinational circuits - adder , subtractor – Serial adder / Subtractor – Parallel adder / Subtractor – Carry look ahead adder – BCD adder – Magnitude Comparator – parity checker – Encoder/Decoder – Multiplexer / Demultiplexer – code converters – Function realization using gates and multiplexers.

SEQUENTIAL CIRCUIT 9 Hours

Flip flops SR, D, JK, T and Master slave – Characteristic table and equation – Excitation table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – Synchronous Binary counters – Modulo-N counter - Decade counters.

DESIGN OF SEQUENTIAL CIRCUITS 9 Hours

Classification of sequential circuits – Moore and Mealy - Design of Asynchronous counters - state diagram - State table – State minimization – State assignment - Register – shift registers - Universal shift register – Ring counters - Hazards.

DIGITAL LOGIC FAMILIES AND PLD 9 Hours

Memories – ROM, PROM, EEPROM, RAM – Programmable Logic Devices: Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Implementation of combinational logic using PROM and PLA - Introduction to FPGA - Digital logic Families: TTL, ECL and CMOS.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. M. Morris Mano, “Digital Design”, 5th Edition, Prentice Hall of India, New Delhi, 2012.
2. John M. Yarbrough, “Digital Logic Applications and Design”, Vikas Publishing House, New Delhi, 2002.

REFERENCES

1. S. Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, 3rd Edition, Vikas Publishing House, New Delhi, 2009.
2. Charles H.Roth. “Fundamentals of Logic Design”, 7th Edition, Thomson West, 2011.
3. R.P.Jain, “Modern Digital Electronics”, 4th Edition, Tata McGraw Hill, New Delhi, 2010.
4. Donald D.Givone, “Digital Principles and Design”, 4th Edition, Tata McGraw Hill, New Delhi, 2010.
5. M. Morris Mano, Michael D. Ciletti, “Digital Design with an Introduction to the VHDL”, 5th Edition, Pearson Education India, New Delhi, 2013.

U15EEP401	AC MACHINES AND CONTROLS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Determine the regulation of alternator using different methods.	**K2**
CO2	Estimate the performance characteristics of Induction motors using various methods.	**K2**
CO3	Examine the excitation characteristics of Three phase Synchronous motors.	**K2**
CO4	Determine the time response of AC and DC servo motor.	**K2**
CO5	Determine the performance of first and second order systems in time domain and frequency Domain.	**K2**
CO6	Measure the electrical parameters using various bridges and learn to calibrate the single phase energy meter.	**K2**

PRE-REQUISITE

Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	M						W					
CO2	S	M	S						W					
CO3	S	W							W					
CO4	S	W							W					
CO5	S	W			W				W					
CO6	S	W							W					

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

a) Machines Laboratory:

1. Regulation of three phase alternator by MMF method.
2. Regulation of three phase alternator by ZPF method.
3. Regulation of three phase salient pole alternator by slip test.

4. V and Inverted V curves of Three Phase Synchronous Motor.
5. Load test on three-phase induction motor.
6. Construction of Circle diagram in a three-phase induction motor by No load and blocked rotor tests.
7. Load test on single-phase induction motor.
8. Measurements of negative sequence and zero sequence impedance of alternators.
9. No load and blocked rotor tests on three-phase induction motor.
10. No load and blocked rotor tests on single-phase induction motor.

b) <u>Controls Laboratory</u>

1. Transfer function of DC servo motor.
2. Transfer function of AC servo motor.
3. Analog simulation of type-0 and type-1 system.
4. Design and implementation of P, PI and PID controllers.
5. Stability analysis of linear systems.
6. Digital Simulation of first order system with standard input signals
7. Measurement of Medium and Low resistance using Wheatstone and Kelvin bridges
8. Capacitance and Inductance using Schering and Anderson bridges
9. Calibration of single phase energy meter
10. A/D and D/A converters
11. Instrumentation amplifier

Experiments beyond the syllabus should be conducted

Theory: 48 Hrs **Total: 48 Hrs**

U15EEP402	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Acquire hands on experience in working with basic digital IC's.	**K1**
CO2	Design and implement combinational circuits using logic gates.	**K2**
CO3	Design and implement sequential circuits using logic gates.	**K2**
CO4	Design and implement shift register circuits.	**K2**
CO5	Simulate digital circuits using Xilinx tool.	**K2**
CO6	Build, test and troubleshoot simple digital circuits.	**K2**

PRE-REQUISITE

Electronic Devices and Circuits

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M								W					
CO2		W	M	W					W					
CO3		W	M	W					W					
CO4			W	W					W					
CO5				M	S				W			W		
CO6				W					W			W		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

1. Verification of truth table for Logic Gates and Flip flops.
2. Implementation of Boolean Functions, Parity checker circuits.
3. Implementation of Adder / Subtractor circuits.
4. Design of Code converters: Gray to Binary, Binary to Gray.
5. Design and implementation of encoder and decoder using logic gates.

6. Design and implementation of Multiplexer and De-multiplexer using logic gates.
7. Design and implementation of 4 – bit synchronous counter.
8. Design and implementation of 4 – bit asynchronous counter.
9. Design and implementation of 4 – bit shift registers.
10. Design of combinational circuit using VHDL.
11. Design of sequential circuit using VHDL.

Experiments beyond the syllabus should be conducted

Theory: 24 Hrs **Total: 24 Hrs**

U15CSP202 PROBLEM SOLVING TECHNIQUES

L	T	P	C
1	0	2	2

COURSE OBJECTIVES:

To introduce students to the foundations of computing, programming and problem-solving.

To develop basic programming skills necessary for engineering education.

COURSE OUTCOMES (CO):

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

CO1	Write a pseudo code for the identified problem	S
CO2	Translate the pseudo code into an executable program	S
CO3	Validate the program for all the possible inputs.	S
CO4	Identify an appropriate approach to solve the problem	S
CO5	Use different data structures	S

PRE-REQUISITE: NIL

CO/PO Mapping
(S/M/L indicates strength of correlation) S-Strong, M-Medium, L- Low

COs	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M		M					L						
CO2	S	M		M	S				L						
CO3	S	M		M					L						
CO4	S	M		M					L						
CO5	S	M		M					L						

COURSE ASSESSMENT METHODS:

Direct	Indirect
• Model Lab Exam • End Semester Practical Exam	• Course Exit Survey

COURSE CONTENT:

Problem solving

General problem solving concepts, approaches and challenges, problem solving with computers, data structures

Approaches

Solve by analogy, Decompose the task into smaller subtasks, Building block approach, merging solutions, Algorithmic thinking, Choice of appropriate data structures, Implementation of the Pseudo-code, implementing the code, testing the solution

Introduction to program structure

Variables and constants, local and global variables, expressions, control structures, selection structures, arithmetic, relational and logical operators, Conditional and looping statements, programming in manageable pieces: program modules, subprograms, functions and recursion

Problem to code approach

Problem statement, problem analysis, program design, program code, program test

Sorting (Numbers and Strings)

Bubble sort, Insertion sort, Selection Sort

Searching (Numbers and Strings)

Binary search, Random search, Search for Max-Min

REFERENCES:

1. R. J. Dromey, How to solve it by Computer, Prentice Hall International, New Jersey, 2007
2. Harold Abelson and Gerald Sussman, Structure and Interpretation of Computer Programs, MIT Press, 1996.
3. Subhasis Banerjee, S. Arun Kumar, D. Dubhashi, Introduction to Computer Science, McGraw Hill India.

LIST OF EXPERIMENTS:

I **Problems based on Numbers:**

1) Write a program to compute the factorial of a given number.

Test Case	1	2	3	4
Input	8	1	0	-5
Output	40320	1	1	Invalid

2) Write a program to find all numbers between 2000 and 3000 (both inclusive) which are divisible by 7 but not a multiple of 5. All such numbers are to be printed in a comma separated sequence on a single line.
Output: 2002, 2009, 2016, … 3199

II **Problems based on Data Processing:**

1) Write a program that takes an IP address of the form P.Q.R.S as input, where P, Q, R and S are decimal numbers in the range 0 to 255, and prints the class of the address as indicated in the table below.

Value of P	Class
1 – 126	A
128 – 191	B
192 – 223	C
224 – 239	D
240 – 254	E

Test Case	1	2	3	4	5
Input	224.220.206.91	126.220.206.91	127.0.0.1	0.100.100.100	255.255.255.255
Output	Class D	Class A	Invalid	Invalid	Invalid

2) Write a program to check if a given number is a stepping number or not.
Note: A number is called a stepping number if every adjacent digit, except those separated by commas, differs by 1. A stepping number can't be a 1-digit number; it must be at least a 2-digit number. For example 45 and 43,545 are valid stepping numbers, but 890,098 is not a stepping number because the difference between numbers 9 and 0 cannot be considered as 1.

Test Case	**1**	**2**	**3**	**4**	**5**
Input	567	89,432	780,023	7	49
Output	Valid	Valid	Invalid	Invalid	Invalid

3) Write a program that takes a large English text file as input and counts the number of occurrences of each alphabet in the text.
(i) Display the alphabet with maximum and minimum number of occurrences.
(ii) Swap the alphabets with maximum and minimum occurrences to obtain a modified text file.
(iii)Take the output of (ii) as input and get back the original text file.

Test case:
Input: A text file with 3000 characters - in which 500 are e and 5 are z.
Output: (i) Maximum occurrence – e and Minimum occurrence – z
(ii) The characters e and z in the text file are swapped to get a modified text
(iii) The original text file

4) The property of Exclusive OR operation (i) Any X ⊕ X is 0 (ii) Any X ⊕ 0 is X. An Encryption and Decryption scheme using this property is given below:
Encryption Algorithm: Cipher Text (C) = Plain Text (P) ⊕ Key (K)
Decryption Algorithm: Plaint Text (P) = Cipher Text (C) ⊕ Key (K)
Answer the following questions:
(i) For any given P and the corresponding C, find K [K = P ⊕ C]
(ii) For any given C and the corresponding key K, find P [P = C ⊕ K]

Test Case		**1**	**2**	**3**
Input	P	1 1 0 0 1 1 0 0	0 0 1 1 1 1 0 0	1 1 1 1 1 1 1 1
	C	0 0 1 1 0 0 1 1	1 0 1 0 1 0 1 1	1 1 1 1 1 1 1 1
Output	Key	1 1 1 1 1 1 1 1	1 0 0 1 0 1 1 1	0 0 0 0 0 0 0 0
	New cipher text	0 0 0 0 0 0 0 0	1 1 0 0 1 1 1 1	11 11 1 1 1 1
	Plaintext (New cipher text ⊕Key)	1 1 1 1 1 1 1	0 1 0 1 1 0 0 0	1 1 1 1 1 1 1 1

5) Write a function num_atoms( ) that takes the weight of the element in grams and its atomic weight as parameters and calculates the number of atoms in n grams of an element.

Note: Atomic weight of gold (Au) 196.97 with units in grams/mole.
Atomic weight of carbon=12.001, Atomic weight of hydrogen=1.008
Avogadro's number is a constant, 6.022×10^{23}

Test Case 1:

Amount of gold =4.5grams, n = 0.45/197 = 2.28×10^{-3} , 1 mol = 6.022×10^{23} atoms

Total number of atoms =$6.022 \times 10^{23} \times 2.28 \times 10^{-3} = 13.756 \times 10^{20}$

6) Define a procedure histogram() that takes a list of integers and prints a histogram to the screen.

Test Case	**1**	**2**	**3**
Input	histogram([4])	histogram([-3, 6, 12])	histogram([2, 0, 3])
Output	****	****** **********	** ***

7) Write a program to solve this classic ancient Chinese puzzle: We count 35 heads and 94 legs among the chickens and rabbits in a farm. How many rabbits and how many chickens do we have?

8) In cryptography, a Caesar Cipher is a very simple encryption technique in which each letter in the plain text is replaced by a letter some fixed number of positions down the alphabet. For example, with a shift of 3, A would be replaced by D, B would become E, and so on. ROT-13 ("rotate by 13 places") is a widely used example of a Caesar cipher where the shift is 13. Write a program to implement an encoder/decoder of ROT-13.

Test Case	**1**	**2**
Input	Roy eats	Deer stays back
Output	Ebl rngf	Qrre fgnlf onpx

9) Newton's Second Law of motion is expressed as $F = m \times a$, where F is force, m is mass and a is acceleration. Write a program to calculate the acceleration if mass of an object and the force on that object are given as input. Display the result to the user.

Test Case	**1**	**2**
Input	Mass=5, Force =1050	Mass =3, Force=564
Output	210	188

III **Problems based on Strings and Functions:**

1) Write a program (using functions) that takes a long sentence with multiple words as input and rearranges the words in the sentence in the reverse order.

Test Case	**1**	**2**	**3**
Input	My name is python	Kumaraguru College of Technology	Problem based on Strings
Output	python is name My	Technology of College Kumaraguru	Strings on based Problem

2) Write a program that accepts a sequence of 4 digit binary numbers as its input,

which are comma separated and prints as output, only the binary numbers that are divisible by 5 in the same format.

Test Case	1	2	3
Input	0100,0011,1010,1001,1100,1001,0101	0010, 1111, 1100	1110, 1000, 1110
Output	1010, 0101	1111	Not divisible by 5

3) Write a program that accepts a sentence as input and calculates the number of letters, digits and special characters.

Test Case		1	2
Input sentence		hello world! @$ 123	There is a laptop with #CS123…
Output	Letters	10	20
	Digits	3	3
	Special Characters	3	4

4) Write a String tokenizer program that accepts a file as input and counts the number of lines and words and prints the same as output. (Note: You can use wc command also)

Test Case	Input Sentences	No. of lines	No. of words
1	Correctness and efficiency issues in programming, time and space measures Basics of imperative style programming Assertions and loop invariants	3	19
2	greedy algorithms are not always the optimal process, even after adjusting the order of their processing	2	16

5) Write a "space_correction()" function that takes a string (sentence) as input and examines it for space characters. If there are two or more continuous space characters in the sentence then they are deleted, so as to have only one space character between words. It also examines the end of sentences; if the period (full stop) is directly then followed by a letter it inserts a space after the period.

Test case I	Input	space_correction(“This is very funny and cool.Indeed!")
	Output	"This is very funny and cool. Indeed!"
Test case II	Input	space_correction(“A flow chart provides appropriate steps to be followed.it is a program design tool”)
	Output	A flow chart provides appropriate steps to be followed. it is a program design tool

6) Write a function printValue() that can accept two strings as input and prints the

longer of the two. If two strings have the same length, then the function should print both the strings.

Test case	**1**	**2**	**3**
Input	printValue(“one”,”three”)	printValue(“laptop”,”lapto p”)	printValue(“ten”,”s o”)
Output	three	laptop laptop	ten

7) An anagram is a type of word play, the result of rearranging the letters of a word, using all the letters in the original word exactly once; e.g., uleb = blue. Write a program that accepts the jumbled characters from user and choose the correct word from the given list by rearranging the characters in the word. Display the word, if it is available in the given list of word. Assume that the list of words is set of colors like {brown, blue, green etc}

Test case	**1**	**2**	**3**
Input	onwbr	reegn	etihw
Output	brown	green	white

8) Assuming that we have some email address of the form "username@companyname.com". Write a program to print the user name of a given email address. Both user names and company names consists of letters only.

Test case	**1**	**2**
Input	inboxcse@gmail.com	csedeptgroups#yahoomail.com
Output	inboxcse	Invalid email address

9) Write a program that takes a string as input and prints the number of occurrences of each character in the string.

Test case	**1**	**2**
Input	abbaca	icici
No. of occurrences	a=3,b=2,c=1	i-3 , c-2

10) Write a recursive function and an iterative function to compute the Fibonacci sequence. Compare the performance of both functions.

11) Write a version of a palindrome recognizer that also accepts phrase palindromes such as "Go hang a salami I'm a lasagna hog.". (Note: punctuation, capitalization and spacing are ignored)

Test case	**1**	**2**
Input	i am tired	was it a rat i saw
Output	Not a palindrome	Palindrome

12) In English, a sentence using present continuous is formed by adding the suffix -*ing* to the verb.(example: go→ going).

A simple set of heuristic rules can be given as follows:

1. If the verb ends in *e*, drop the *e* and add *ing* (if not exception: be, see, knee, etc.)

2. If the verb ends in *ie*, change *ie* to *y* and add *ing*
3. For words consisting of consonant-vowel-consonant, double the final letter before adding *ing*
4. By default, just add *ing*

Write a function "make_ing_form()" which converts a given verb to present continuous form. Test your function with words such as lie, see, move and hug.

Test case	**1**	**2**	**3**	**4**
Input	believe	tie	sit	walk
Output	believing	tying	sitting	walking

13) A pangram is a sentence that contains all the letters of the English alphabet at least once. Write a function to check if a given sentence is a pangram or not. If the given sentence is not a pangram print the missing letters.

Test case	**1**	**2**
Input	*The quick brown fox jumps over the lazy dog*	*The quick brown rat jumps over the lazy cat*
Output	Pangram	Not a Pangram Missing letters*:f,x,d,g*

14) Write a function "calc_weight_ on_ planet()" that takes two arguments - weight on Earth and the surface gravity of the other planet and calculates the equivalent weight on the other planet. (Note: The surface gravity of Jupiter is 23.1 m/s^2 (approx) and that of Earth is 9.8 m/s^2(approx), Weight = Mass x Surface gravity)

Test case	**1**	**2**
Weight on Earth(lb)	*127.2*	*-100*
Weight on Jupiter	297.6	*Invalid*

15) Write a program to check the validity of passwords entered by users.

Following are the criteria for a valid password:

1. At least 1 letter between [a-z]
2. At least 1 letter between [A-Z]
3. At least 1 number between [0-9]
4. At least 1 character from [$#@]
5. Minimum length of password: 6
6. Maximum length of password: 12

Your program should accept a sequence of passwords that are comma separated and check them for validity based on the criteria given above and print the valid passwords only in the comma separated form.

Test case	**1**	**2**	**3**
Input	ABd1234@1, a F1#,2w3E*,2We3345	HFd1244@1, a F1#,2w3E*,2We334#5	ABd12342, a F1#,2w2B*,2We3345

Output	ABd1234@1	HFd1244@1, 2We334#5	Invalid

V **Problems based on Data Structures:**

1) Write a program that maps a list of words to a list of integers (representing the lengths of the corresponding words). Write it in three different ways: 1) using a for-loop, 2) using the higher order function map (), and 3) using list comprehensions
2) Write a program that prompts the user to enter the name of the fruit and its weight. The program should then display the information in the same form but in the alphabetical order.

Test case	**1**	**2**	**3**
Input	Kiwi, 4 kg, Apple, 6 kg, Banana, 11 kg	Gowva, 4 kg, Apple, 6 kg, Banana, 11 kg	Carrot, 4 kg, Kiwi, 6 kg, Banana, 11 kg
Output	Apple, 6 kg, Banana, 11 kg, Kiwi, 4 kg	Apple, 6 kg, Banana, 11 kg, Gowva, 4 kg	Banana, 11 kg, Carrot, 4 kg, Kiwi, 6 kg

3) Write a program that prompts the user to enter a list of words and stores them in a list. Create a new list that retrieves words from the first list such that first letter occurs again within the word. The program should display the resulting list.

Test case	**1**	**2**
Input	Baboon, List, Duplicate	Frog, Snake, Lizard
Output	Baboon	No Such word exist in list

4) List Overlap Solution:
Consider the following lists, A = [1,1,2,3,5,8,13,21,34,55,89] &
B = [1,2,3,4,5,6,7,8,9,10,11,12,13]
Write a program that returns a list that contains only the elements that are common between the lists (without duplicates). Make sure your program works on two lists of different sizes.
Hint: (A intersection B)

Test cases:
Input the following lists,
A = [1,1,2,3,5,8,13,21,34,55,89] B = [1,2,3,4,5,6,7,8,9,10,11,12,13]
Output: A ∩ B= [1,2,3,5,8,13]

VI **Problems based on Sorting:**

1) Write a program to sort the (name, age, score) tuples in ascending order where name is string, age and score are numbers. The tuples are input using the console. The sort criteria are:
    a. Sort based on name
    b. Then sort based on age;
    c. Then sort by score
    d.

Test case	1	2
Input	Tom,19,80 John,20,90 Jony,17,91	Jony,17,91 Jony,17,93 Json,21,85
Output	[('John', '20', '90'), ('Jony', '17', '91'), ('Jony', '17', '93'),('Tom', '19', '80')]	[('Jony', '17', '91'), ('Jony', '17', '93'), ('Json', '21', '85')]

2) Write a program that accepts a sequence of words that are hyphen separated as input and prints the words in a hyphen-separated sequence after sorting them alphabetically.

Test case	1	2	3
Input	green-red-yellow-black-white	red-yellow-black	green-yellow-white
Output	black-green-red-white-yellow	black -red-yellow	green-white-yellow

VII **Problems based on Divide and Conquer:**

1) Write a program for binary search using arrays

Test case	1	2
Input	4, 7,8,11,21	4, 7,8,11,21
Enter the number to be search	11	18
Output	The number is present	The number is not present

VIII **Problem Solving by Backtracking:**

1) Write a program to solve the 4-Queen's Problem.

Total Hours:24

U15GHP401	PROFESSIONAL VALUES (Common to all branches of Engineering and Technology)	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Acquire knowledge on the Clarity, courage, confidence, commitment, compassion this required for a good professional	
CO2	Understand the concept of Karma Yoga and lead his/her life accordingly	
CO3	Understand the importance of ethics in ones profession and practice it	
CO4	Get acquainted with leadership theories and use them in his/her profession appropriately	
CO5	Learn how to be an empowered professional and how to empower colleagues	

PRE-REQUISITE

Nil

Introduction to Professional Values **1 Periods**

Concept of Integral Karma Yoga **3 Periods**

Professional Ethics **3 Periods**

Eastern and Western Leadership Theories **2 Periods**

Empowerment of a Professional **4 Periods**

Advanced Contemplative Practices with Demonstrations **2 Periods**

Practical:15 Hours **Total: 15 Hours**

REFERENCES

- Integral Yoga of Sri Aurobindo ---- Rishabhchand
- Engineering Ethics : Concepts and Cases ---- Charles E Harris
- Spirituality at Work ---- Devdas Menon
- Karma Yoga : Perfection in Work ---- Ameetha Mehta
- The Bhagavad Gita ---- Winthrop Sargeant
- Professional Ethics& Human Values ---- D.R Kiran & S. Bhaskar
- Extraordinary performance from ordinary peopl ---- Keith Ward & Cliff Bowman
- Organization Behaviour ---- Stephen Robbins

SEMESTER V

U15EET501	ELECTRICAL MACHINE DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Calculate the magnetic circuit parameters of electrical machines.	**K2**
CO2	Design main dimension of DC machines, AC machines and transformer based on power ratings	**K3**
CO3	Design the internal dimensions of various electrical machines.	**K3**
CO4	Evaluate the thermal ratings of electrical machines.	**K3**
CO5	Design the cooling system of electrical machines.	**K3**
CO6	Classify the machine duties and power ratings.	**K2**

PRE-REQUISITE

DC Machines and Transformers, AC Machines

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M											
CO2	S	M												
CO3	S	M												
CO4	M	S	M											
CO5	M	M												
CO6	S	M	M											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

MAGNETIC CIRCUITS AND COOLING OF ELECTICAL MACHINES 9 Hours

Concept of magnetic circuit – MMF calculation for various types of electrical machines – real and apparent flux density of rotating machines – leakage reactance calculation for induction and synchronous machine - thermal rating: continuous, short time and intermittent short time rating of electrical machines-direct and indirect cooling methods – cooling of turbo alternators.

D.C. MACHINES 9 Hours

Constructional details – output equation – main dimensions - choice of specific loadings – choice of number of poles – armature design – design of field poles and field coil – design of commutator and brushes – losses and efficiency calculations.

TRANSFORMERS 9 Hours

Constructional details of core and shell type transformers – output rating of single phase and three phase transformers – optimum design of transformers – design of core, yoke and windings for core and shell type transformers – equivalent circuit parameters from designed data – losses and efficiency calculations – design of tank and cooling tubes of transformers.

THREE PHASE INDUCTION MOTORS 9 Hours

Constructional details of squirrel cage and slip ring induction motors – output equation – main dimensions – choice of specific loadings – design of stator – design of squirrel cage and slip ring rotor – equivalent circuit parameters from designed data – losses and efficiency calculations.

SYNCHRONOUS MACHINES 9 Hours

Constructional details of cylindrical pole and salient pole alternators – output equation – choice of specific loadings – main dimensions – short circuit ratio – design of stator and rotor of cylindrical pole and salient pole machines - design of field coil.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, New Delhi, 2011.
2. S.K. Sen, "Principles of Electrical Machine Design with Computer Programmes", 2nd Edition, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi, 2006.

REFERENCES

1. R.K. Agarwal, "Principles of Electrical Machine Design", 5th Edition, S.K.Kataria and Sons, New Delhi, 2014.
2. V.N. Mittle and A. Mittle, "Design of Electrical Machines", 5th Edition, Standard Publications and Distributors, New Delhi, 2014.
3. A. Shanmugasundaram, G. Gangadharan, R. Palani, "Electrical Machine Design Data Book", 1st Edition, New Age International Pvt. Ltd., 2007.

U15EET502	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Describe the structure, operation and characteristics of power semi conductor devices.	**K1**
CO2	Choose the protection and drives circuit for power electronic devices.	**K2**
CO3	Illustrate the circuit and modes of operation of power converters.	**K2**
CO4	Analyze the performance parameters of power converters.	**K3**
CO5	Describe the voltage control and harmonic control strategies for power converters.	**K2**
CO6	Select the power converter for specific applications.	**K3**

PRE-REQUISITE

Partial Differential Equations and Transforms, Electronic Devices and Circuits

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W												
CO2		W	S											
CO3		M			W									
CO4		S		W										
CO5			S		W							W		
CO6			M			W	W					W		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

POWER SEMI-CONDUCTOR DEVICES 9 Hours

Power diode, power BJT, Thyristors, Power MOSFET and IGBT – Structure and operation – Static and switching characteristics – Driver and snubber circuits.

AC TO DC CONVERTERS 9 Hours

Single phase half controlled and fully controlled converters - Three phase half controlled and fully controlled converters – Analysis of converters with R and RL loads - Performance parameters - Effect of source inductance - Dual converters.

DC TO DC CONVERTERS 9 Hours

Step-down chopper - Time ratio control and current limit control – Step-up chopper - Two quadrant and four quadrant choppers - Switching mode regulator - Buck, boost, buck-boost converters - DC-DC Converters for PV systems.

DC TO AC CONVERTERS 9 Hours

Single phase and three phase voltage source bridge inverters –Voltage control and harmonic reduction (waveform improvement) - Current source inverter- Inverters application for Induction Heating and UPS.

AC TO AC CONVERTERS 9 Hours

Single phase and Three phase AC voltage controllers – Phase control – PWM control – single phase and three phase cyclo converters – On load Transformer Tap Changers.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, Pearson Education, New Delhi, 2014.
2. M.D. Singh, K.B.Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill, New Delhi, 2008.

REFERENCES

1. P.S. Bimbra, "Power Electronics", 5th Edition, Khanna Publishers, New Delhi, 2012.
2. Ned Mohan Tore. M. Undeland, William. P. Robbins, "Power Electronics: Converters, Applications and Design", 3rd Edition, Wiley, India, 2010.
3. Vidhyathil Joseph, "Power Electronics Principles and Applications", McGraw Hill Education (India), 2010.
4. Williams, B. W., "Power Electronics: Devices, Drivers, Applications, and Passive Components" 3rd Edition, McGraw Hill, 2006.
5. Andrzej M. Trzynadlowski, "Introduction to Modern Power Electronics", 2nd Edition, Wiley India Pvt. Ltd., 2011.

U15EET503	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the fundamentals of Microprocessors and Microcontrollers	**K2**
CO2	Understand the internals of Microprocessors and Microcontrollers with timing diagram.	**K2**
CO3	Interface the peripheral devices with Microprocessors and Microcontrollers	**K3**
CO4	Write ALP for Microprocessors And Microcontrollers to perform a task.	**K3**
CO5	Analyze the interfacing modules using Embedded C programs.	**K4**
CO6	Apply the techniques to control the electrical and electronics applications.	**K3**

PRE-REQUISITE

Digital Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	W										M		
CO3		S	M	W										
CO4			S	S					W		M			
CO5				S	S						M			
CO6				S	S	W						M		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION TO MICROPROCESSOR AND MICROCONTROLLER — 9 Hours

Evolution of Microprocessor and Microcontrollers-Von Neumann-Harvard architecture - Overview of microprocessor and microcontroller-technology improvements-comparison of 8085/8086/8051/Intel Pentium dual core processor - vendors in microprocessors and microcontrollers.

8085 MICROPROCESSOR — 9 Hours

8085 architecture-pin diagram-interrupts-memory and I/O interfacing-addressing modes-instruction set-timing diagrams-simple assembly language programming-interrupt programming.

8051 MICROCONTROLLER 9 Hours

8051 architecture-I/O pins-ports-timers and counters-serial data communication-memory organization-instruction set-addressing modes-assembly language programming.

INTRODUCTION TO EMBEDDED 'C' PROGRAM 9 Hours

Port initialization-data types-time delay-logic operations-data conversion-data serialization-programming to interface: relay-timer-serial communication-LED-7 segment display-LCD.

MICROCONTROLLER BASED SYSTEM DESIGN-CASE STUDY 9 Hours

Generation of PWM pulses for DC chopper and three phase inverter -Stepper motor control - closed loop temperature control of an air conditioning system- control of robotic vehicle.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. Ramesh S Gaonkar, "Microprocessor architecture programming and application with 8085", 6th Edition, Penram International publication, New Delhi, 2011.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.Mckinlay, "The 8051 microcontroller and embedded systems using assembly and C", 2nd Edition, Pearson Education, 2011.

REFERENCES

1. N.Senthilkumar, M.Saravanan, S.Jeevananthan, S.KShah "Microprocessor and interfacing 8086, 8051, 8096 and advanced processors", Oxford university publications, 2012.
2. N. Senthil Kumar, M. Saravanan, S. Jeevananthan," Microprocessors and Microcontrollers" Oxford university publications, 2010
3. Kenneth J Ayala, "The 8051 microcontroller architecture programming and application", Penram International publication, New Delhi, 2004.

U15CST903	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Develop simple algorithms for solving problems	
CO2	Explain the basic data structures and its operations.	
CO3	Explain basics of hashing and solve problems using trees	
CO4	Summarize various searching and sorting algorithms.	
CO5	Make use of graph based algorithms to solve problems.	
CO6	Explain the concept of time complexity and space complexity.	

PRE-REQUISITE

Basic Knowledge in C Programming

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M	W											
CO2	M									W				
CO3		M	W							W				
CO4		M												
CO5	S	M	W							W				
CO6		M												

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

PROBLEM SOLVING **9 Hours**

Problem solving – Top-down Design – Implementation – Verification – Efficiency – Analysis – Sample algorithms.

LISTS, STACKS AND QUEUES **9 Hours**

Abstract Data Type (ADT) – The List ADT – The Stack ADT – The Queue ADT

TREES **9 Hours**

Preliminaries – Binary Trees – The Search Tree ADT – Binary Search Trees – AVL Trees – Tree Traversals – Hashing – General Idea – Hash Function – Separate Chaining – Open Addressing – Linear Probing – Priority Queues (Heaps) – Model – Simple implementations –

Binary Heap

SORTING **9 Hours**

Preliminaries – Insertion Sort – Shell sort – Heap sort – Merge sort – Quick sort – External Sorting

GRAPHS **9 Hours**

Definitions – Topological Sort – Shortest-Path Algorithms – Unweighted Shortest Paths – Dijkstra's Algorithm – Minimum Spanning Tree – Prim's Algorithm – Applications of Depth-First Search – Undirected Graphs – Biconnectivity – Introduction to NP-Completeness

Theory: 45 Hours **Tutorial: 00 Hours** **Total: 45 Hours**

TEXT BOOK

1. R. G. Dromey, "How to Solve it by Computer" (Chaps 1-2), Prentice-Hall of India, 2002.

REFERENCES

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", 3rd edition, Pearson Education Asia, 2007. (chaps 3, 4.1-4.4 (except 4.3.6), 5.1-5.4.1, 6.1-6.3.3, 7.1-7.7 (except 7.2.2, 7.4.1, 7.5.1, 7.6.1, 7.7.5, 7.7.6), 7.11, 9.1-9.3.2, 9.5-9.5.1, 9.6-9.6.2, 9.7)

U15EEP501	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Analyze the operation and characteristics of power electronic devices.	**K2**
CO2	Construct gate firing circuit for SCR.	**K3**
CO3	Construct the various power electronic converters.	**K2**
CO4	Perform voltage control on power electronic converters.	**K3**
CO5	Perform frequency control on inverters and cyclo converters.	**K3**
CO6	Choose and employ the power converter for specific application.	**K3**

PRE-REQUISITE

Power Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M			M					W					
CO2	W			M					M					
CO3	W			M					W					
CO4	W	W		S					M					
CO5	W	W	W	S					M					
CO6			M	W					W					

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

1. SCR firing circuit and phase control.
2. VI characteristic of SCR.
3. Single phase AC-DC half controlled converter.
4. Three phase fully controlled converter.
5. SCR based DC chopper.
6. MOSFET based step up and step down choppers.

7. Resonant DC - DC converter.
8. Single phase PWM inverter.
9. TRIAC based voltage controller.
10. Cyclo converter.
11. Series inverter.
12. Harmonic analysis in power converters.

Experiments beyond the syllabus should be conducted

Practical:24 Hours **Total: 24 Hours**

U15CSP903	DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Implement various basic data structures and its operations.	
CO2	Implement various sorting and searching algorithms.	
CO3	Implement various tree operations	
CO4	Implement various graphs algorithms	
CO5	Develop simple applications using various data structures.	

PRE-REQUISITE

Basic Knowledge in C Programming

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S			W										
CO2	S			M										
CO3	M			M										
CO4	M			M										
CO5	S	W	M											
CO6	S	W	M											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

1. Array implementation of stack
2. Linked implementation stack
3. Implementation of singly linked List
4. Implementation of doubly linked List
5. Implementation of circular Queue
6. Implement the application for checking 'Balanced Parenthesis' using array implementation of Stack ADT.
7. Implement the application for 'Evaluating Postfix Expressions' using linked list

implementations of Stack ADT.

8. Implement Search Tree - Binary Search Tree
9. Implement Heap Sort
10. Implement Quick Sort

Experiments beyond the syllabus should be conducted

Practical:24 Hours **Total: 24 Hours**

U15ENP501	COMMUNICATION SKILLS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Imparting the role of communicative ability as one of the soft skills needed for placement
CO2	Developing communicative ability and soft skills needed for placement
CO3	Making students Industry-Ready through inculcating team-playing capacity

PRE-REQUISITE

Technical English, Business Communication and Presentation Skills

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M			S	S	M			
CO2				W		M			S	S	M	M		
CO3							M		S	S	M	M		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Presentation, Role Play, Mock interview, GD etc.	1. Course Exit Survey

Grammar and Usage – Building Blocks, Homonyms, Subject and Verb Agreement , Giving Seminars and Presentations
Error Correction - Grammar Application , Nuances of Addressing a Gathering - one to one/ one to a few/ one to many
Framing Questions – Question words, Verbal Questions, Tags, Communication Process, Visual Aids and their Preparation
Giving Replies –Types of Sentences , Accent Neutralization
Listening Comprehension –Listening and Ear training , Analyzing the Audience
Listening Comprehension in Cross–Cultural Ambience , Nonverbal Communication
Telephonic Conversations/Etiquette , Importance of Body Language –Gestures
Role Play Activities - Postures and Proxemics
Dramatizing Situations – Idioms and Phrases , Extempore
Video Sensitizing , Facing the Interview Panel
Communicative Courtesy – Interactions , Interview FAQs
Situational Conversations , Psychometric Tests

Time Management, Stress Management Techniques , Stress Interviews
Verbal Reasoning , Introduction to GD
Current Affairs – E Mail Communication / Etiquette , Mock GD Practices

Practical: 45 Hours **Total: 45 Hours**

REFERENCES

4. Bhatnagar, R.P., Rahul Bhargava, “English for Competitive Examinations”, Macmillan Publishers, India, 1989.
5. Devadoss, K., Malathy, P., “Career Skills for Engineers”, National Book Publishers, Chennai, 2013.
6. Aggarwal, R.S., “A Modern Approach to Verbal & Non–Verbal Reasoning”, S.Chand Publishers, India, 2012.

U15GHP501	SOCIAL VALUES (Common to all branches of Engineering and Technology)	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Acquire knowledge about how societies are formed and social values are created	
CO2	Understand and empathize various social issues and contribute towards finding a solution	
CO3	Understand the causes of disparity among human beings	
CO4	Know about social welfare organizations and to use social media effectively	
CO5	Understand various social parameters that influences individual and society at large	

PRE-REQUISITE

Nil

Introduction to Social Values – Society **2 Periods**

Development of Science, Education, Politics & Economics **3 Periods**

Disparity among human beings **3 Periods**

Social Issues & Welfare **3 Periods**

Social Welfare Organizations **2 Periods**

Yogasanas & Meditation **2 Periods**

Practical:15 Hours **Total: 15 Hours**

REFERENCES

1. Prosperous India ---- Swami Vivekananda
2. Small is Beautiful ---- Fritz Schumacher
3. Samudhaya chikkalukkana nala Aaivugal ---- Vethathiri Maharishi
4. The Source Book on Indian Philosophy ----Sarvepalli Radhakrishnan
5. Religion, Science and Culture ----Sarvepalli Radhakrishnan
6. World Community Life ---- Vethathiriyam

SEMESTER VI

U15GST005	ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Evaluate the economic theories, Cost concepts and pricing policies	
CO2	Analyze the market structures and integration concepts	
CO3	Apply the concepts of national income and understand the functions of banks and concepts of globalization	
CO4	Apply the concepts of financial management for project appraisal and working capital management	
CO5	Understand accounting systems	
CO6	Analyze financial statements using ratio analysis	

PRE-REQUISITE

NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M				M					M			
CO2				M		M					M			
CO3						M					M			
CO4				M							S			
CO5											S			
CO6		M		M							S			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

ECONOMICS, COST AND PRICING CONCEPTS 9 Hours

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of break even chart – Interpretation of break even chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing Policies – Pricing methods.

CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES 9 Hours

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration.

NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT 9 Hours

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

CONCEPTS OF FINANCIAL MANAGEMENT 9 Hours

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS 9 Hours

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. Prasanna Chandra, "Financial Management (Theory & Practice) 7th Edition, TMH, New Delhi, 2008.
2. J. Fred Weston, E.F. Brigham, "Essentials of Managerial Finance" 10th Edition, Dryden Press Series in Finance, 1996.

REFERENCES

1. Pandey, I. M., "Financial Management"
2. Fundamentals of Financial Management- James C. Van Horne.
3. Bhaskar S. "Engineering Economics and Financial Accounting", Anuradha Agencies, Chennai, 2003.
4. Financial Management & Policy -James C. Van Horne.
5. Management Accounting & Financial Management- M. Y. Khan & P. K. Jain.
6. Management Accounting Principles & Practice -P. Saravanavel.
7. Ramachandra Aryasri.A., and Ramana Murthy V.V., "Engineering Economics & Financial Accounting"-Tata McGraw Hill, New Delhi, 2006.
8. Varshney R.L., and Maheswari K.L., "Managerial Economics" – Sultan Chand & Sons, New Delhi, 2001.
9. Samvelson and Nordhaus, "Economics"-Tata McGraw Hill, New Delhi, 2002.

U15EET601	GENERATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the economics of various power generation systems.	**K2**
CO2	Explain and demonstrate the technological basis for various conventional energy sources.	**K2**
CO3	Understand the techniques for harnessing solar energy.	**K2**
CO4	Have the knowledge of Micro Grid and Distributed Generation.	**K2**
CO5	Apply the knowledge of wind energy conversion system and selection criteria.	**K3**
CO6	Extend the basic idea and importance of environmental issues to conventional and non conventional energy sources.	**K2**

PRE-REQUISITE

NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					W								
CO2	M	M												
CO3	S					W	M							
CO4	M					W	M							
CO5	S					W	M							
CO6						M	S							

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

ECONOMICS OF POWER GENERATION 9 Hours

Terms and definitions – Significance of load factor and diversity factor – Base load, Peak load – Load sharing between base load and peak load plants – selection of size and number generating units – economics in plant selection – factors affecting economics of generation.

CONVENTIONAL SOURCES OF ELECTRIC ENERGY 9 Hours

Introduction – Thermal power stations – Nuclear power plant – Hydro Power plant – MHD generation – Geothermal Energy – Environmental aspects of electrical energy generation.

SOLAR ENERGY 9 Hours

Solar Radiation and its measurements – Solar constant – Solar radiation at the earth's surface – Solar radiation geometry – Solar radiation measurements – Solar radiation Data – Solar Energy collectors – Physical properties –Flat plate collectors,Concentrating collectors- Comparison of flat plate and concentrating collectors- Solar Electric power generation: Solar Photovoltaics – Principle of photovoltaic conversion of solar energy – types of SPV cells.

WIND ENERGY 9 Hours

Introduction – Basic principles of wind energy conversion system – Power in Wind - Forces on blades and thrust on turbines – TSR- site selection considerations - Basic components of WECS – Classification.

MICROGRID 9 Hours

Microgrid Concept - Distributed Generation - Microgrid Control Architecture - Forecasting - Centralized and Decentralized Control -State Estimation.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. R.K.Rajput, "Utilisation of Electrical Power", 1st Edition, Laxmi Publications Ltd, New Delhi, 2006.
2. D.P.Kothari, I.J.Nagrath, "Power System Engineering", 2nd Edition, Tata McGraw - Hill Education Pvt. Ltd, New Delhi, 2008.
3. G. D. Rai, "Non Conventional Energy Sources", 1st Edition, Khanna Publishers, 2010.
4. Nikos Hatziargyriou, "Microgrids: Architectures and Control", Wiley-IEEE Press, 2013.

REFERENCES

1. B. H. Khan, "Non-conventional Energy Resources", 2nd Edition, Tata McGraw Hill, New Delhi, 2009.
2. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata McGraw Hill, New Delhi, 2008.
3. Bent Sorensen, "Renewable Energy – Conversion, Transmission and Storage", 2nd Edition, Academic Press, New York, 2000.
4. Godfrey Boyle, "Renewable Energy: Power for a sustainable future", 3rd Edition, Oxford University Press, 2012.

U15EET602	SOLID STATE DRIVES	L	T	P	C
		2	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Compare various types of loads and characteristics of motors.	**K2**
CO2	Choose the braking scheme for motor drives.	**K2**
CO3	Construct the power converter circuit for DC motor drives.	**K3**
CO4	Design the power converter circuit for AC motor drives.	**K3**
CO5	Describe the speed control schemes for DC and AC motor drives.	**K2**
CO6	Select the motor for specific application.	**K3**

PRE-REQUISITES

DC Machines and Transformers, AC Machines, Power Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W	M												
CO2		W	M											
CO3			M		W									
CO4			M		W									
CO5			S		W							W		
CO6			M			W						W		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

DRIVE CHARACTERISTICS 9 Hours

Elements of electric drive system- speed torque characteristics of various types of loads - Steady state stability: joint speed characteristics - Selection of power rating for drive motors: classes of duty, heating and cooling - Starting, types of braking & reversing operations.

CONVERTER FED DC DRIVES 9 Hours

Single phase half controlled and fully controlled converter fed DC motor drive - Three phase half controlled and fully controlled converter fed DC motor drive - Performance parameters - Dual converter fed separately excited DC motor drive.

CHOPPER FED DC DRIVES 9 Hours

Single quadrant chopper fed DC motor drive - Analysis of performance parameters of step down chopper fed separately excited DC motor drive – Two quadrant and four quadrant chopper fed DC drive

INDUCTION MOTOR DRIVES 9 Hours

Stator voltage controller fed induction motor drive – VSI and CSI fed induction motor drive - static rotor resistance control - Slip power recovery scheme - Introduction to vector control of induction motor drive.

SYNCHRONOUS MOTOR DRIVE AND DRIVE APPLICATIONS 9 Hours

Synchronous motor drive: V/F control- self-control – Permanent Magnet Synchronous motor drive.

Drive applications: steel rolling mil l– paper mill – traction – cranes and lifts.

Theory: 30 Hours Tutorial: 15 Hours Total: 45 Hours

TEXT BOOKS

1. Gopal K. Dubey, “Fundamentals of Electric Drives”, 2nd Edition, Narosa Publishing House, New Delhi, 2015.
2. S.K. Pillai, “A First Course on Electrical Drives”, 3rd Edition, New Age International Publishers, New Delhi, 2014.

REFERENCES

1. Bimal K. Bose. “Modern Power Electronics and AC Drives”, 2nd Edition, Prentice Hall of India, 2005.
2. R. Krishnan, “Electric Motor & Drives Modeling, Analysis and Control”, 1st Edition, Prentice Hall of India, 2001.
3. M.D. Singh, K.B. Khanchandani, “Power Electronics”, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
4. Vedam Subramanium, “Electric Drives Concepts and Applications”, 2nd Edition, Tata McGraw Hill, New Delhi, 2011.
5. P.C.Sen, “Thyristor DC Drives”, John Wiley & sons, New York, 2008.

U15EET603	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Differentiate Embedded Systems from general purpose systems	**K1**
CO2	Gain the knowledge on fundamentals of communication protocols	**K2**
CO3	Understand the architecture and features of microcontrollers	**K2**
CO4	Interface the peripheral devices with microcontroller	**K3**
CO5	Realize the basic concepts of RTOS in accessing shared resources for optimized CPU performance	**K2**
CO6	Understand the critical real – time issues involved in end product design with solutions using case studies	**K2**

PRE-REQUISITE

Microprocessors and Microcontrollers

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M										W		
CO2	S	M	M											
CO3		S	M											
CO4			S	S	M									
CO5			S		S									
CO6		S			M				M		W			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

OVERVIEW OF EMBEDDED SYSTEMS 9 Hours

Basics of Embedded Systems – Embedded System Initialization- I/O Devices : Types and Examples – Synchronous, iso-synchronous and Asynchronous Communication – Serial Communication Devices – Parallel Device Ports- Reset Circuitry – Serial Communication Protocols : I2C, CAN,USB – Parallel Bus device Protocols: ISA, PCI, ARM bus.

CPU ARCHITECTURE OF PIC MICROCONTROLLER 9 Hours

PIC Microcontroller – Architecture of PIC 16F8xx – FSR – Reset action – Oscillator Circuit – Program Memory organization- Register File Structure and Addressing Modes – Instruction Set- Simple Assembly Language Programming.

PIC PROGRAMMING USING EMBEDDED 'C' 9 Hours

Interrupts: Constraints – Interrupt Servicing – Interrupt Programming – External Interrupts – Internal structure and Programming: Timers – capture/compare/PWM module- I/O ports – LCD– ADC – Programming Tools: MPLABORATORY IDE – Hex file format.

CASE STUDIES OF PIC MICROCONTROLLER 9 Hours

Washing Machine control: actuators and sensor interfacing-Closed loop control of DC motor-Electronic voting machine.

REAL-TIME OPERATING SYSTEM CONCEPTS 9 Hours

Architecture of the Kernel – Task and Task Scheduler – Interrupt Service Routines – Semaphore – Mutex – Mailbox – Message Queue – Other Kernel Objects – Memory Management – Priority Inversion Problem

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. Raj Kamal, "Embedded Systems Architecture Programming and Design", 2nd Edition, Tata McGraw Hill, New Delhi, 2013.
2. K. V. K. K. Prasad, "Embedded /Real-Time Systems: Concepts, Design and Programming", Dream tech Press, 2009.

REFERENCES

1. Ajay V Deshmukh, "Microcontroller Theory and Applications", 1st Edition, Tata McGraw Hill, New Delhi, 2007.
2. David E Simon, "An Embedded Software Primer", Indian reprint twelve, Pearson Education, 2005.
3. Daniel .W Lewis, "Fundamentals of Embedded Software", reprint twelve, Pearson Education, 2005.
4. John B Peatman, "Designing with PIC Micro Controller", reprint twenty, Pearson, 2011.
5. C. M. Krishna, Kang. G. Shin, "Real-time systems", 1st Edition, Tata McGraw Hill, New Delhi, 2009.
6. Steve Yeath, "Embedded system design", 2nd Edition, Elsevier, 2008.

U15EEP601	ELECTRICAL DRIVES LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Construct power converter circuits for motor drives.	**K2**
CO2	Employ various control strategies for motor drives.	**K3**
CO3	Perform speed control of various motor drives.	**K3**
CO4	Construct and simulate various motor drives.	**K3**

PRE-REQUISITE

DC Machines and Transformers, AC Machines, Power Electronics, Solid State Drives

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W		M		W									
CO2	W		S		W				M			W		
CO3		W		S					M			W		
CO4			M	W								W		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

1. Speed control of DC motor using single phase AC-DC converter.
2. Speed control of DC motor using three phase AC-DC converter.
3. Four quadrant chopper based DC motor drive.
4. V/F control of Induction motor.
5. Control of Induction motor using AC voltage controller.
6. Regenerative braking of DC motor drive by simulation.
7. Speed control of synchronous motor drive by simulation.
8. Simulation of slip power recovery scheme.
9. Simulation of CSI fed Induction motor drive.
10. Simulation of cyclo converter fed AC motor drive.

Experiments beyond the syllabus should be conducted

Practical:24 Hrs **Total: 24 Hrs**

U15EEP602	MICROPROCESSOR AND EMBEDDED SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Write simple 8/16- bit processor controller programs using ALP	**K2**
CO2	Interface input/output devices to the microcontroller/processor using ALP	**K3**
CO3	Program on-board peripherals using Embedded C for 8/16 bit controllers	**K2**
CO4	Interface control and monitor simple hardware modules using firmware programming	**K3**
CO5	Visualize and analyze the internals of hardware using IDE	**K4**
CO6	Design and develop interactive systems using microcontroller and open source electronics platform.	**K4**

PRE-REQUISITE

Microprocessor, Embedded Systems

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M							W					
CO2	M	S	W						M					
CO3	M				S				W					
CO4	M	S	W		M									
CO5			S	W								M		
CO6			S		S				M	W	W	M		

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

a) MICROPROCESSOR LABORATORY

8-bit Microprocessor – 8085

1. Programs for 8/16 bit arithmetic operations using 8085 processor.
   Programs using arithmetic and control instructions.
2. A/D interfacing and D/A interfacing.

b) EMBEDDED SYSTEMS LABORATORY

8-bit Microcontroller – 8051

3. Programs for 8/16 bit arithmetic operations using 8051 Microcontroller
    - Addition & subtraction of 8-bit data
    - Multi-byte addition & Array addition
    - Multiplication & Division

4. Programs with control instructions & bit manipulation instructions
    - Search for the largest and smallest numbers in an array
    - Ascending and Descending order
5. Stepper motor interfacing

8051 Program using Embedded C

6. LED interface to 8051 and timer programming.
7. Rolling display using LCD interface
8. Serial communication to PC- hyper link terminal
9. PWM generation
10. Temperature monitoring system.

PIC16F877 program using Embedded C

11. PWM generation of 3 phase inverter
12. Speed sensing and monitoring from PC.

Experiments beyond the syllabus should be conducted

Practical:48 Hours **Total: 48 Hours**

U15GHP601	NATIONAL VALUES (Common to all branches of Engineering and Technology)	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Acquire knowledge on the Enlightened Citizenship.	
CO2	Know skills the greatness of India and Indian Culture.	
CO3	Aware of the messages of India to the world	
CO4	Aware of the uniqueness of India	
CO5	Know about the inspiring Indian personalities and emulate them	

PRE-REQUISITE

1. Nil

Enlightened Citizenship **2 Periods**

Greatness of India & Indian Culture **2 Periods**

Uniqueness of India **2 Periods**

Famous Indian Personalities **2 Periods**

India's messages to the world **3 Periods**

Meditation & Yogasanas **4 Periods**

Practical:15 Hours **Total: 15 Hours**

REFERENCES

1. India Grows at Night ---- Gurcharan Das
2. Prosperous India ---- Swami Vivekananda
3. The Source Book on Indian Philosophy ---- Sarvepalli Radhakrishnan
4. The Argumentative Indian ---- Amartya Sen

SEMESTER VII

U15GST006	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply concepts of product development and outline product planning process	
CO2	Apply relative importance of customer needs in establishing product specifications	
CO3	Identify concept generation activities and summarize the methodology involved in concept selection and testing	
CO4	Outline supply chain considerations in product architecture and understand the industrial design process	
CO5	Apply design for manufacturing concepts in estimating manufacturing costs	
CO6	Apply principles of prototyping in product development economics and highlight importance of managing projects	

PRE-REQUISITE

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M		M					W				
CO2			M											
CO3	M		M											
CO4			S			W				M	M			
CO5			S		M	M								
CO6					M				M		S			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION - DEVELOPMENT PROCESSES AND ORGANIZATIONS – PRODUCT PLANNING **9 Hours**

Characteristics of successful product development to Design and develop products – duration and cost of product development – the challenges of product development. A generic development process – concept development: the front-end process, adapting the generic product development process, the AMF development process – product development organizations, the AMF organization. The product planning process – identify opportunities. Evaluate and prioritize projects – allocate resources and plan timing – complete pre project planning – reflect all the results and the process.

IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATIONS — 9 Hours

Gathering raw data from customers – interpreting raw data in terms of customer needs, organizing the needs into a hierarchy – establishing the relative importance of the needs and reflecting on the results and the process. Specifications – establish specifications, establishing target specifications setting the final specifications.

CONCEPT GENERATION - CONCEPT SELECTION - CONCEPT TESTING — 9 Hours

The activities of concept generation clarify the problem search externally, search internally, explore systematically – reflect on the results and the process – Overview of methodology – concept screening, concept scoring, caveats. Purpose of concept test – choosing a survey population and a survey format – communicate the concept – measuring customer response – interpreting the result – reflecting on the results and the process.

PRODUCT ARCHITECTURE - INDUSTRIAL DESIGN - DESIGN FOR MANUFACTURING — 9 Hours

Meaning of product architecture – implications of the architecture – establishing the architecture – variety and supply chain considerations – platform planning – related system level design issues. Assessing the need for industrial design – the impact of industrial design – industrial design process – managing the industrial design process, is assessing the quality of industrial design – Definition – estimation of manufacturing cost – reducing the cost of components – assembly – supporting production – impact of DFM on other factors.

PROTOTYPING - PRODUCT DEVELOPMENT ECONOMICS – MANAGING PROJECTS — 9 Hours

Prototyping basics – principles of prototyping – technologies – planning for prototypes – Elements of economic analysis – base case financial mode. Sensitive analysis – project trade-offs – influence of qualitative factors on project success – qualitative analysis. Understanding and representing task – baseline project planning – accelerating projects – project execution, and post-mortem project evaluation.

Theory: 45 Hours **Tutorial: 00 Hours** **Total: 45 Hours**

TEXT BOOKS

1. Karl. T. Ulrich, Steven D. Eppinger, “Product Design and Development”, Irwin McGraw Hill.
2. A. C. Chitale and R. C. Gupta, “Product Design and Manufacturing”, Prentice Hall of India.

REFERENCES

1. Timjones. Butterworth Heinmann, “New Product Development”, Oxford. UCI.
2. Geoffery Boothroyd, Peter Dewhurst and Winston Knight, “Product Design for Manufacture and Assembly”,

U15EET701	ELECTRICAL ENERGY UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Design illumination systems.	**K2**
CO2	Understand the concepts of electric heating, welding, electric traction and breaking system.	**K2**
CO3	Design of heating element depending on the requirements.	**K2**
CO4	Understand the concepts of electro chemical processes.	**K1**
CO5	Estimate the different types of tariff structures, impact of tariff and methods of optimizing the tariff by energy conservation.	**K3**
CO6	Understand the concepts of energy management and audit.	**K2**

PRE-REQUISITE

NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S						W							
CO3	S	M	W											
CO4	S													
CO5	S					M	M							
CO6				W		M	M							

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

ILLUMINATION, HEATING AND WELDING 9 Hours

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 efficient lamps. Methods of heating, requirement of heating material – design of heating element – furnaces – welding generator – welding transformer and its characteristics.

ELECTRIC TRACTION 9 Hours

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

ELECTRO CHEMICAL PROCESS 9 Hours

Electrolysis – electro plating – electro deposition – extraction of metals – current – efficiency – batteries types – charging methods.

CONSERVATION 9 Hours

LT and HT tariff structure – impact of tariff – power factor improvement methods – impact of power quality on HT billing- introduction to electrical energy conservation – Green building concept.

ENERGY MANAGEMENT AND AUDIT 9 Hours

Need of Energy Audit - Types of energy audit- Energy audit approach- understanding energy costs- Bench marking- Energy performance- Matching energy use to requirement-Maximizing system efficiencies- optimizing the input energy requirements- Fuel and energy substitution- Energy Audit instruments.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. E. Openshaw Taylor, "Utilization of Electrical Energy in SI Units", 1st Edition, Orient Longman Pvt. Ltd., New Delhi, 2006.
2. General Aspect of Energy Management and Energy Audit, 2nd Edition, By Bureau of Energy Efficiency, Ministry of Power, India, 2005.

REFERENCES

1. H. Partab, "Art and Science of Utilization of Electrical Energy", 1st Edition, Dhanpat Rai and Co., New Delhi, 2015.
2. Gopal. K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosa Publishing House, New Delhi, 2014.
3. C.L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", 2nd Edition, New Age International, 2006.
4. J.B. Gupta, "Utilization of Electric Power and Electric Traction", 10th Edition, S.K. Kattaria and Sons, 2014.
5. M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, "A Text Book on Power System Engineering", 2nd Edition, Dhanpat Rai & Co., 2014
6. Donald R Wulfinghoff, "Energy Efficiency Manual", Energy Institute Press, USA, 1999.

U15EET702	POWER SYSTEM ANALYSIS	L	T	P	C
		2	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Represent the power system components in per unit quantities.	**K2**
CO2	Apply and analyze the load flow of power system network.	**K2**
CO3	Model the sequence networks in terms of symmetrical components.	**K2**
CO4	Calculate the fault currents, voltages when symmetrical and unsymmetrical faults occur.	**K2**
CO5	Calculate the stability limits of power system network using various methods.	**K2**
CO6	Analyze load flow, fault and stability of power system network using simulation tool.	**K3**

PRE-REQUISITE

Partial Differential Equations and Transforms, Transmission and Distribution, AC Machines

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M	M											
CO3	S	M	M											
CO4	S	M	M											
CO5	S	M	M	M										
CO6	M	M	M	W	S									

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

PER UNIT REPRESENTATION OF POWER SYSTEM 9 Hours

Basic components of a power system – Representation of Power System Components- Synchronous machines, Transformers, Transmission lines - Single line diagram- impedance and reactance diagrams, per unit quantities, changing the base of per unit quantities, advantages of per unit system.

POWER FLOW ANALYSIS 9 Hours

Introduction – Bus Classification – Bus admittance matrix – Solution of load flow equations: Gauss Seidal method – Newton Raphson method – Fast decoupled Method – Load flow Computations in large systems.

SYMMETRICAL FAULT ANALYSIS 9 Hours

Symmetrical components- Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks -Types of faults: Symmetrical faults -Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions.

UNSYMMETRICAL FAULT ANALYSIS 9 Hours

Unsymmetrical faults-Analysis of single line to ground fault, line-to-line fault and double Line to ground fault on an unloaded generators and power system network with and without fault impedance - Formation of Z_{bus} using building algorithm.

POWER SYSTEM STABILITY 9 Hours

Steady state stability in power system – swing equation – stability limits – methods of improving stability limits – Solution of swing equation by Euler's method and Runge – Kutta methods-power angle equations – Equal area criterion-critical clearing angle and time.

Theory: 30 Hours Tutorial: 15 Hours Total: 45 Hours

TEXT BOOKS

1. P. Kundur, "Power System Stability and Control", 1st Edition, McGraw Hill Publishing, 2006.
2. B. R. Gupta "Power System Analysis and Design", 5th Edition, S.Chand & Company, 2005.

REFERENCES

1. Hadi Saadat "Power system analysis", Tata McGraw Hill, New Delhi, 2010.
2. William D. Stevenson Jr, "Elements of Power System Analysis", 4th Edition, McGraw Hill Education, New Delhi, 2014.
3. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill, New Delhi, 2011.
4. M.A. Pai, "Computer Techniques in power system Analysis", 3rd Edition, McGraw Hill, New Delhi, 2014.
5. C.L.Wadhwa, "Electric Power Systems", 6th Edition, New Age International Publisher, 2014.
6. Chowdhuri and Pritindra, "Electromagnetic Transients in Power systems", 2nd Edition, Prentice Hall of India, 2009.

U15EET703	PROTECTION AND SWITCH GEAR	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Describe the operating principles of various relays and their construction	**K2**
CO2	Compare the various protection systems for power system apparatus.	**K2**
CO3	Have the knowledge of the phenomena of circuit interruptions	**K2**
CO4	Classify the various types of circuit breakers and their working	**K2**
CO5	Know the Protective methods of Power system against over voltages	**K1**
CO6	Gain the basic idea about integrated protection.	**K1**

PRE-REQUISITES

Transmission and Distribution, Electrical Machines

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					W								
CO2	M					W								
CO3	M	M												
CO4	M					W								
CO5	S					W								
CO6	M				W									

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

OPERATING PRINCIPLES AND RELAY CONSTRUCTIONS — 9 Hours

Need for protective system- Components of protection system- Classification of protection schemes- Basic relay circuit- Classification of relays- Electromechanical relays – Static relays – Numerical relays.

APPARATUS PROTECTION — 9 Hours

Protective methods for transformer, generator and motor – protection of bus bars, transmission lines – CTs and PTs and their applications in protection schemes.

THEORY OF CIRCUIT INTERRUPTION 9 Hours

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

CIRCUIT BREAKERS 9 Hours

Circuit breakers – types – air blast, air break, oil, SF6 and vacuum circuit breakers – comparison of circuit breakers – Testing of circuit breakers- Gas Insulated Substation/ Switch gear (GIS).

PROTECTION AGAINST OVER VOLTAGES 9 Hours

Causes of over voltages – Lightening, switching surges and temporary over voltage methods of protection against over voltages – ground wires, Peterson coil, surge absorbers, diverters – Insulation co – ordination – Introduction to Integrated protection and control using PLC and SCADA.

Theory: 45 Hours Tutorial: 00 Hours Total: 45 Hours

TEXT BOOKS

1. Badri Ram, Vishwakarma, "Power System Protection and Switchgear", 2nd Edition, Tata McGraw Hill, New Delhi, 2012.
2. Sunil S. Rao, "Switchgear and Protection and Power System", 13th Edition, Khanna publishers, New Delhi, 2008.

REFERENCES

1. M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, "A Text Book on Power System Engineering", 2nd Edition, Dhanpat Rai & Co., 2009.
2. Y.G. Paithankar and S.R. Bhide, "Fundamentals of Power System Protection", 2nd Edition, Prentice Hall of India, New Delhi, 2010.
3. B. Ravindranath, and M. Chander, "Power System Protection & Switchgear", 2nd Edition, New Age International, 2005.
4. S L Uppal, "Electrical Power", 13th Edition, Khanna Publishers, New Delhi, 2006.

U15EEP701 POWER AND ENERGY LABORATORY

L	T	P	C
0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Simulate and analyze the load flow of power system network	**K2**
CO2	Simulate and analyze the faults of power system network	**K2**
CO3	Simulate and analyze the stability of power system network	**K2**
CO4	Simulate the performance of wind mill and PV module	**K2**
CO5	Calculate the electrical Tariff structure	**K2**

PRE-REQUISITE

Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M			S									
CO2	M	M			S									
CO3	M	M			S									
CO4		M	W		S									
CO5	S				S									
CO6														

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Laboratory Exercise 2. Model Exam 3. End Semester Exam	1. Course Exit Survey

LIST OF EXPERIMENTS

1. Formation of Bus Admittance Matrices
2. Formation of Bus Impedance Matrices and Solution of Networks
3. Load Flow Analysis: Solution of Load Flow and Related Problems Using Gauss-Seidel Method
4. Load Flow Analysis: Solution of Load Flow and Related Problems Using Newton-Raphson method
5. Load Flow Analysis: Solution of Load Flow and Related Problems Using Fast-Decoupled Method
6. Load Flow, Fault analysis and transient stability analysis of 5 bus system using ETAP

7. Simulation of Swing Equation using Euler's Method.
8. Tariff calculations.
9. Development of Simulink model for a PV module.
10. Performance analysis of Wind mill using Simulink.
11. Stability analysis of hybrid power system network using ETAP.

Experiments beyond the syllabus should be conducted

Practical:24 Hrs **Total: 24 Hrs**

U15GHP701	GLOBAL VALUES (Common to all branches of Engineering and Technology)	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand importance of ecology and its preservations	
CO2	Understand the various global issues and their causes and solutions	
CO3	Approach any problem holistically as against giving a reductionist solution	
CO4	Learn impact of globalization on various factors such as environment, local population etc	
CO5	Learn to integrate and understand how an Individual peace impacts world peace	

PRE-REQUISITE

1. Nil

Introduction to Global Values **1 Period**

Introduction to Systems Thinking **1 Period**

Ecology, ecological imbalances and its solution **3 Periods**

Globalisation Vs Localisation – an economic and Spiritual Perspective **3 Periods**

Global Issues & Solutions **3 Periods**

Advanced Contemplative Practices **4 Periods**

Practical:15 Hours **Total: 15 Hours**

REFERENCES

1. World peace plan ---- Vedhathiri Maharishi
2. Small is Beautiful ---- Fritz Schumacher
3. Profit over People ---- Noam Chomsky
4. Atomic Poison ---- Vedhathiri Maharishi

PROFESSIONAL ELECTIVES

U15EEPE01	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the causes and effects of over voltages and protection of power system against over voltages.	**K1**
CO2	Classify the different breakdown mechanisms in Gases, liquids and solids.	**K2**
CO3	Describe the principle of generation of high DC, AC and impulse voltages.	**K2**
CO4	Explain the various measurement techniques of high voltages and high currents.	**K2**
CO5	Summarize the testing of high voltage electrical power apparatus.	**K2**
CO6	Perform calculations in Generation and Measurement of High AC , DC and Impulse Voltages and Currents	**K2**

PRE-REQUISITE

NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S					W	W							
CO2	S	M												
CO3	S	M												
CO4	S	M												
CO5	S					W								
CO6	S	M	W											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9 Hours

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – protection against over voltages – Bewley's lattice diagram.

ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS 9 Hours

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids – Breakdown mechanisms in solid and composite dielectrics.

GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9 Hours

Generation of High DC, AC, impulse voltages and currents – Tripping and control of impulse generators.

MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9 Hours

Measurement of High voltages and High currents – Digital techniques in high voltage measurement.

HIGH VOLTAGE TESTING OF ELECTRICAL POWER APPARATUS 9 Hours

Testing of Insulator - Bushings - Isolators, Circuit breakers – Cables – Transformers -Surge Arresters – Tan Delta measurement – Partial Discharge measurement – Radio interference measurement – International and Indian Standards.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", 5th Edition, Tata McGraw Hill, New Delhi, 2013.
2. E. Kuffel and M. Abdullah, "High Voltage Engineering", 2nd Edition, Pergamon Press, 2000.

REFERENCES

1. E. Kuffel, W. S. Zaengl and J.Kuffel, "High Voltage Engineering Fundamentals", 2nd Edition, Butterworth – Heinmann Publisher, 2000.
2. L. L. Alston, 'High Voltage Technology', 1st Edition, Oxford University Press, 1968.
3. T.J.Gallagher and A.J Pearmain, "High Voltage Measurement, Testing and Design", 2nd Edition, Wiley, New York, 2007.
4. C.L Wadwa, "High Voltage Engineering", 3rd Edition, New Age International, New Delhi, 2012.
5. R.D. Begamudre, "High Voltage Engineering (Problems and Solution)", 1st Edition, New Age International, New Delhi, 2010.

U15EEPE02	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Describe the different types of Power Plant and Boilers.	**K1**
CO2	Explain the function of various equipments in steam, Gas and Diesel power plant.	**K1**
CO3	Understand the concepts of different types of reactors used in nuclear power plant.	**K1**
CO4	Know the significance of waste disposal and safety measures in nuclear power plant.	**K2**
CO5	Select the appropriate power plant and its components based on requirement and Environmental aspects.	**K2**
CO6	Analyse economic related issues in Power Plant.	**K2**

PRE-REQUISITE

NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	S						W							
CO3	M					W	W							
CO4	M					M	S	W						
CO5	M					M	M							
CO6	M	M				M	W							

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION TO POWER PLANTS & BOILERS 9 Hours

Layout of Hydel power plants – Types – Standalone – Pumped Storage. Steam Boilers and cycles – High pressure and low pressure boilers – Fluidized bed boilers –Power plant cycles - Combined power cycles – comparison and selection-Indian boilers Act.

STEAM POWER PLANT 9 Hours

Layout and types of Steam Power Plants - Fuel and Ash handling systems – combustion equipment for steam boilers – Mechanical stokers – Pulverizers – Electrostatic precipitator – Draughts – Steam condensers-Cooling Ponds and Cooling Towers-Pollution Controls.

NUCLEAR POWER PLANTS 9 Hours

Nuclear energy - Fission, Fusion reaction - Layout of nuclear power plants - Types of reactors, pressurized water reactor - Boiling water reactor - Gas cooled reactor – CANDU reactor- Breeder reactor - Waste disposal and safety.

DIESEL AND GAS TURBINE POWER PLANTS 9 Hours

Layout and types of Diesel power plants and components, selection of engine – types - applications. Gas Turbine power plant – Classifications - Layout – Merits – Gas Turbine Fuels – Combination of gas Turbine cycles.

POWER PLANT ECONOMICS 9 Hours

Economics of power plant – Actual load curves-cost analysis – Selection of generation and plant equipments – Economics of load sharing – Tariff – Types of Tariff - Independent Power Producers and their Tariff Structure- Wheeling Prices.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. El-Wakil M.M., “Power Plant Technology”, 2nd Edition, Tata McGraw Hill, New Delhi, 2010.
2. Arora S.C. and Domkundwar.S, “A Course in Power Plant Engineering”, 3rd Edition, Dhanpat Rai & Sons, New Delhi, 1988.

REFERENCES

1. Nag P.K., “Power Plant Engineering”, 4th Edition, Tata-McGraw Hill Education, New Delhi, 2014.
2. Frederick T. Morse, “Power Plant Engineering”, 3rd Edition, Litton Educational Publishing Inc, 1953.
3. R.K. Rajput, “A Text Book of Power Plant Engineering”, 4th Edition, Laxmi Publications, 2013.
4. G.D. Rai, “Introduction to Power Plant Technology”, 3rd Edition, Khanna Publishers, New Delhi, 2013.
5. G.R. Nagpal, “Power Plant Engineering”, 16th Edition, Khanna Publishers, New Delhi, 2012.
6. Frank D.Graham, Charlie Buffington, “Power Plant Engineers Guide”, 3rd Edition, Prentice Hall & IBD, 1983.
7. http://www.uneptie.org/energy

U15EEPE03	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Know the power system operation and control.	**K1**
CO2	Understand and model the speed governing mechanism for real-power frequency control.	**K2**
CO3	Model the load frequency control for single and multi area system.	**K2**
CO4	Model different types of reactive power control	**K2**
CO5	Determine the solution for economic dispatch and unit commitment problems.	**K2**
CO6	Know the different control strategies of power system.	**K1**

PRE-REQUISITE

Power System Analysis and Stability

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	S	M												
CO3	S	M	W											
CO4	S	M												
CO5	S	M												
CO6	S													

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

FORECASTING AND CONTROL 9 Hours

System load variation: System load characteristics, load curves - daily, weekly and annual, load-duration curve - load factor - diversity factor. Reserve requirements: Installed reserves - spinning reserves - cold reserves - hot reserves. Overview of system operation: Load forecasting - unit commitment - load dispatching. Overview of system control: Governor Control - LFC – EDC – AVR - system voltage control - security control.

REAL POWER - FREQUENCY CONTROL 9 Hours

Fundamentals of speed governing mechanism and modeling: Speed-load characteristics – Load sharing between two synchronous machines in parallel; concept of control area - LFC control of a single - area system: Static and dynamic analysis of uncontrolled and controlled cases - Multi-area systems: Two-area system modeling; static analysis - uncontrolled case; tie line with frequency bias control of two-area system derivation - state variable model.

REACTIVE POWER–VOLTAGE CONTROL 9 Hours

Typical excitation system – modeling - static and dynamic analysis - stability compensation; generation and absorption of reactive power: Relation between voltage - power and reactive power at a node; method of voltage control: Injection of reactive power - Tap-changing transformer - numerical problems - System level control using generator voltage magnitude setting - tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

UNIT COMMITMENT AND ECONOMIC DISPATCH 9 Hours

UNIT COMMITMENT: Statement of Unit Commitment (UC); constraints in UC: spinning reserve - thermal unit constraints - hydro constraints, fuel constraints and other constraints; UC solution methods: Priority - list methods - numerical problems.

ECONOMIC DISPATCH: Incremental cost curve - co-ordination equations without loss and with loss - solution by λ-iteration method - Numerical problems (No derivation of loss coefficients) and Computational intelligent method (Algorithm and Flowchart only) - Base point and participation factors -Numerical problems.

COMPUTER CONTROL OF POWER SYSTEMS 9 Hours

Energy control centre: Functions – Monitoring, data acquisition and control. System hardware configuration – SCADA and EMS functions: Network topology determination - state estimation - security analysis and control - Various operating states: Normal, alert, emergency, in extremis and restorative - State transition diagram showing various state transitions and control strategies.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", 2nd Edition, Tata McGraw Hill, New Delhi, 2008.
2. Allen. J. Wood and Bruce F. Wollenberg, "Power Generation, Operation and Control", 3rd Edition, John Wiley & Sons, Inc., 2014.

REFERENCES

1. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill, New Delhi, 2011.
2. P. Kundur, "Power System Stability & Control", 1st Edition, McGraw Hill, USA, 2006.
3. PSR Murthy, "Operation & Control in Power System", 1st Edition, CRC Press, 2011.
4. S. Sivanagaraju, G. Sreenivasan, "Power System Operation and Control", 1st Edition, Pearson Education, 2010.
5. Robert H. Miller, James H. Malinowski, "Power System Operation", 3rd Edition, McGraw Hill, 2009.

U15EEPE04	POWER QUALITY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Explain power quality disturbances and typical problems associated with it.	**K1**
CO2	Describe the causes of transient over voltages and its mitigation methods.	**K2**
CO3	Explain the sources of current and voltage harmonics.	**K2**
CO4	Understand the concepts of harmonic distortion and controlling methods.	**K2**
CO5	Know the different standards used in harmonic evaluation.	**K1**
CO6	Describe the different types of analyzer used in power quality monitoring.	**K2**

PRE-REQUISITE

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	S				W									
CO3	S													
CO4	S													
CO5	S													
CO6	M													

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION, VOLTAGE SAGS AND INTERRUPTIONS — 9 Hours

Terms and definitions: Overloading, under voltage - sustained interruption; sags and swells; waveform distortion - Total Harmonic Distortion (THD) - Computer Business Equipment Manufacturers Associations (CBEMA) curve - Sources of sags and interruptions - estimating voltage sag performance - fundamental principles of protection - motor starting sags.

TRANSIENT OVERVOLTAGES 9 Hours

Sources of transient over voltages: Capacitor switching - magnification of capacitor switching transients – lightning - ferro resonance and other switching transients; Devices for over voltage protection: Surge arresters and transient voltage surge suppressors - isolation transformers - low pass filters - low impedance power conditioners - -utility surge arresters, utility system Lightning protection : shielding, line arresters - low side surges - cable protection and scout arrester scheme.

FUNDAMENTALS OF HARMONICS 9 Hours

Harmonic distortion: Voltage and current distortion - harmonic indices - harmonic sources from commercial and industrial loads - locating harmonic sources - system response characteristics: resonance.

APPLIED HARMONINCS, WIRING AND GROUNDING 9 Hours

Effects of harmonic distortion - harmonic distortion evaluation, principles for controlling harmonics - devices for controlling harmonic distortion – inter harmonics caused by induction furnaces - IEEE standard 519-1992 – over view of IEC standards on harmonics – reasons for grounding – typical wiring and grounding problems – isolated ground – summary of wiring and grounding solutions.

POWER QUALITY MONITORING 9 Hours

Monitoring considerations: Disturbance analyzer - harmonic / spectrum analyzer – combination - Disturbance harmonic analyzer - flicker meters - smart power quality monitors - transducers requirements - applications of expert system - power quality monitoring and the internet – EMI - Electromagnetic compatibility.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Roger.C.Dugan, Mark.F. Mc Granagham, “Electrical Power Systems Quality” 3rd Edition, McGraw Hill, 2012.
2. Ewald F. Fuchs, Mohammad A. S. Masoum, “Power Quality in Power Systems and Electrical Machines”, 2nd Edition, Academic Press, 2011.

REFERENCES

1. Francisco C. De La Rosa, “Harmonics and Power Systems”, 1st Edition, CRC Press, 2006.
2. Angelo Baggiri, “Handbook of Power Quality”, 1st Edition, John Wiley & Sons, 2008.
3. C. Sankaran, “Power Quality”, 1st Edition, CRC Press, 2002.
4. P.S. Satnam P.S. Kang, “Power Capacitor for Reactive Compensation”, 1st Edition, Dhanpat Rai & Sons Publications, *2008*.

U15EEPE05	RESTRUCTURED POWER SYSTEM	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Explain and differentiate the key issues involved in the regulated and de-regulated power markets.	K2
CO2	Explain the congestion management methods.	K2
CO3	Understand transmission open access pricing issues, classification of transmission pricing methods and loss allocation.	K2
CO4	Distinguish perfectly competitive market and imperfect competitive market.	K2
CO5	Know about power marketing and bidding.	K2
CO6	Review the reforms in Indian power sector.	K2

PRE-REQUISITE

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S					W								
CO2	S	M				W								
CO3	S	M				W		W						
CO4	M					W		W						
CO5	M					W		W						
CO6	S					W								

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9 Hours

Reasons for restructuring / deregulation of power industry - Understanding the restructuring process - Reasons and objectives of deregulation of various power systems across the world: The US, The UK, The Nordic Pool, The developing countries - Fundamentals of Economics -

Consumer behaviour - Supplier behaviour - Market equilibrium - Short-run and Long-run costs - Various costs of production - Total cost (TC), Average fixed cost (AFC), Average variable cost (AVC), Average cost (AC), Marginal cost (MC)- The Philosophy of Market Models - Market models based on contractual arrangements - Market architecture: Timeline for various energy markets, Bilateral / forward contracts, The spot market - Models for trading arrangements - ISO or TSO model

TRANSMISSION CONGESTION MANAGEMENT 9 Hours

Definition of congestion - Reasons for transfer capability limitation - Importance of congestion management in deregulated environment - Effects of congestion - Desired features of congestion management schemes - Classification of congestion management methods - Calculation of ATC using PTDF and LODF based on DC model - Calculation of ATC using AC model Non-market methods : Capacity allocation on first come first served basis, Capacity allocation based on pro-rata methods, Capacity allocation based on type of contract Market based methods: Explicit auctioning, Coordinated auctioning Nodal pricing and its implications - Inter-zonal Intra-zonal congestion management - Price area congestion management - Capacity alleviation method

PRICING OF TRANSMISSION NETWORK USAGE AND LOSS ALLOCATION 9 Hours

Power wheeling - Issues involved- Principles of transmission pricing - Classification of transmission pricing methods - Rolled-in transmission pricing methods: Postage stamp method, Incremental postage stamp method, Contract path method, MW-Mile method, Distance based - Power flow based - Power flow tracing - Marginal transmission pricing paradigm - Composite pricing paradigm - Introduction to loss allocation - Classification of loss allocation methods

MARKET POWER AND GENERATORS BIDDING 9 Hours

Attributes of a perfectly competitive market -The firm's supply decision under perfect competition - Imperfect competition: Monopoly, Oligopoly - Electricity markets under imperfect competition - Market power: Sources of market power, Effect of market power, Identifying market power, Market power mitigation - Introduction to optimal bidding by a generator company - Bidding in real markets - Optimal bidding methods

REFORMS IN INDIAN POWER SECTOR 9 Hours

Framework of Indian power sector : Historical Developments - The Institutional Framework - Operational Demarcation of the Power System - National and Transnational Grids - Reform initiatives during 1990-1995: The Independent Power Plants - Orissa Reform Model - Accelerated Power Development and Reforms Program (APDRP) - Public-Private Partnership - The availability based tariff (ABT)

The Electricity Act 2003 - Provisions in the generation sector - the transmission sector - the distribution sector - Power trading - Open Access issues - Power exchange - Reforms in near future

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen, "Operation of restructured power systems", 1st Edition, Kluwer Academic Publisher, 2001.
2. Daniel Kirschen and GoranStrbac, "Fundamentals of Power System economics", 1st Edition, John Wiley & Sons, 2004.

REFERENCES

1. http://nptelonlinecourses.iitm.ac.in
2. Sally Hunt, "Making competition work in electricity", 1st Edition, John Wiley & Sons, 2002.
3. MarjiaIlic, Francisco Galiana and Lester Fink, "Power systems restructuring engineering and economics", 1st Edition, Kluwer Academic Publishers, 1998.
4. Zaccour G, "Deregulation of Electric Utilities", 1st Edition, Kluwar Academic Publisher, 1998.
5. Mohammad Shahidehpour, M. Alomoush, "Restructured Electrical Power Systems: Operation: Trading, and Volatility", 1st Edition, CRC Press, 2001.
6. S. A. Khaparde, A.R. Abhyankar, "Restructured Power Systems", 1st Edition, Alpha Science International Publications, 2006.

U15EEPE06	ENERGY STORAGE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Describe the basic components of a battery and the fundamental principles.	**K2**
CO2	Identify the materials used in modern lithium-ion batteries and their respective operational characteristics.	**K2**
CO3	Summarize the factors that control battery performance and the primary mechanisms.	**K2**
CO4	Classify applications currently utilizing energy.	**K3**
CO5	Describe the need for storage of hybrid energy.	**K2**
CO6	Compare various energy storage methods based on different parameters.	**K3**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M			W									
CO2	S		M			W								
CO3		M												
CO4		M				W	W							
CO5		M				W								
CO6		M			W	W								

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES — 9 Hours

Storage Needs-Variations in Energy Demand-Variations in Energy Supply-Interruptions in Energy Supply-Transmission Congestion -Demand for Portable Energy -Demand and scale -requirements -Environmental and sustainability issues.

TECHNICAL METHODS OF STORAGE — 9 Hours

Introduction: Energy and Energy Transformations - Potential energy (pumped hydro, compressed air, springs) - Kinetic energy (mechanical flywheels) -Thermal energy without phase change passive (adobe) and active (water)-Thermal energy with phase change (ice,

molten salts, steam) - Chemical energy (hydrogen, methane, gasoline, coal, oil)- Electrochemical energy (batteries, fuel cells) - Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets) - Different Types of Energy Storage Systems.

PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS 9 Hours

Energy capture rate and efficiency -discharge rate and efficiency-dispatch ability and load flow characteristics -Scale flexibility, durability-cycle lifetime, mass and safety – risks of fire, explosion, toxicity-ease of materials recycling and recovery -Environmental consideration and recycling-Merits and demerits of different types of Storage.

HYDROGEN FUEL CELLS AND HYBRID ENERGY 9 Hours

Hydrogen Economy - Generation Techniques - Storage of Hydrogen - Hybrid Energy generation. Applications: Storage for Hybrid Electric Vehicles -Regenerative Power and capturing methods.

FLOW BATTERIES AND SUPER CAPACITORS 9 Hours

Flow battery operation -Super Capacitors : power calculation -operation and design

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Detlef Stolten, “Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications”, Wiley, 2010.
2. Jiujun Zhang, LeiZhang,Hansan Liu, Andy Sun, Ru-Shi Liu, “Electrochemical Technologies for Energy Storage and Conversion”, John Wiley and Sons, 2010.

REFERENCES

1. Francois Beguin and Elzbieta Frackowiak, “Super capacitors”, Wiley, 2013.

U15EEPE07	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Gain knowledge on various renewable energy sources and their impacts	K2
CO2	Basic concepts of wind and solar energy conversion systems.	K2
CO3	Understand the concepts of grid connected solar and wind energy systems.	K2
CO4	Gain the knowledge on different types of hybrid systems.	K2
CO5	Choose a power converter for the control of wind and solar energy systems.	K2
CO6	Understand the concepts of maximum power point tracking algorithms.	K2

PRE-REQUISITE

Power Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M													
CO2	M											W		
CO3	M					W								
CO4	M					W						W		
CO5	M													
CO6	M													

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION 9 Hours

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

PHOTOVOLTAIC ENERGY CONVERSION 9 Hours

Solar radiation and measurements - Solar cells – Panels and their characteristics – Influence of insulation and temperature – PV arrays –Maximum power point tracking – Applications – Water pumping – Street lighting – DC-DC converters for solar PV systems.

WIND ENERGY SYSTEMS 9 Hours

Basic principle of Wind Energy Conversion System – Nature of Wind –Components of Wind Energy Conversion System – Generators for WECS- Classifications of WECS – Self excited induction generator - synchronous generator - Power conditioning schemes.

GRID CONNECTED WECS AND SECS 9 Hours

Grid connectors – Wind farm and its accessories – Grid related problems – Generator control – Performance improvements - Different schemes – Matrix converters -Line commutated inverters- Multilevel inverters-Power converters for Grid connected WECS-Grid connected solar energy converter systems.

HYBRID RENEWABLE ENERGY SYSTEMS 9 Hours

Need for Hybrid Systems- Range and types of Hybrid systems- Wind-PV, Wind-Diesel, and Wind -Mini-hydro Systems.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Mukund R. Patel, "Wind and Solar Power Systems: Design, Analysis, and Operation", 2nd Edition, CRC Press, London, 2005.
2. G.D.Rai, "Non - Conventional Energy Sources", 5th Edition, Khanna publishers, 2010.

REFERENCES

1. Ned Mohan Tore. M. Undeland, William. P. Robbins, "Power Electronics converters, Applications and design", 3rd Edition, John Wiley and Sons, 2006.
2. M.H. Rashid, "Power Electronics Circuits, Devices and Applications", 3rd Edition, Prentice Hall of India, New Delhi, 2004.
3. D. P. Kothari, K.C. Singal and Rakesh Ranjan, "Renewable Energy Sources And Emerging Technologies", 2nd Edition, Prentice Hall of India, New Delhi, 2011.
4. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications", IEEE, Wiley, 2014.

U15EEPE08	SWITCHED MODE POWER CONVERSION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand isolated and non-isolated DC-DC converters and their operation in continuous conduction mode and discontinuous conduction mode.	K1
CO2	Calculate minimum inductance, capacitance in single switch DC-DC converters.	K3
CO3	Apply current control and voltage control methods to regulate the output power.	K3
CO4	Design DC-DC converters and evaluate the stability of the system.	K3
CO5	Analyze and design current fed topologies.	K4
CO6	Understand dynamic AC modeling of converters using transfer functions.	K2

PRE-REQUISITE

Power Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		M						W					
CO2		S	S			M								
CO3	S	M			M									
CO4	S		M			W								
CO5	S		S		M									
CO6	S	S				W								

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

DC/DC CONVERTERS 9 Hours

Basic topologies of buck, boost converters, buck-boost converters and cuk converter - isolated DC/DC converter topologies—forward and fly-back converters - half and full bridge topologies - modeling of switching converters.

CURRENT MODE AND CURRENT FED TOPOLOGIES 9 Hours

Voltage mode and current mode control of converters - peak and average current mode control - its advantages and limitations - voltage and current fed converters.

RESONANT CONVERTERS 9 Hours

Need for resonant converters - types of resonant converters - methods of control - phase-modulation technique with ZVS in full-bridge topology - series resonant converter and resonant transition converter.

CONVERTER TRANSFER FUNCTIONS 9 Hours

Application of state-space averaging to switching converters - derivation of converter transfer functions for buck, boost and fly-back topologies.

POWER CONVERTER DESIGN 9 Hours

Design of filter inductor & capacitor - and power transformer - Ratings for switching devices, current transformer for current sensing - design of drive circuits for switching devices - considerations for PCB layout.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Ned Mohan Tore M. Undeland, "Power Electronics: Converters, Applications, and Design", 3rd Edition, John Wiley & Sons, 2007.
2. Abraham I. Pressman, "Switching Power Supply Design", 2nd Edition, Mc Graw Hill International, 1999.

REFERENCES

1. P.C. Sen, "Modern Power Electronics", 2nd Revised Edition, S. Chand-Company, 2005.
2. Andrzej M. Trzynadlowski, "Introduction to Modern Power Electronics", 2nd Edition, Wiley India Pvt Ltd, 2011.
3. Muhammad H. Rashid, "Power Electronics hand book", ISBN: 81 8147 367 1.

U15EEPE09 ADVANCED POWER ELECTRONICS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Describe the basic concepts of various types of resonant converters.	**K2**
CO2	Discuss the basic concepts of various types of matrix converters.	**K2**
CO3	Distinguish the types and concepts of multilevel inverters.	**K2**
CO4	Illustrate power quality issues and various utility interfacing techniques.	**K2**
CO5	Apply the knowledge of contemporary technical issues in Power electronics field and new semiconductor materials currently used in modern industries.	**K3**
CO6	Design a circuit for specific applications using suitable converters.	**K3**

PRE-REQUISITE

Power Electronics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S													
CO3	S		W											
CO4	M	S		W										
CO5		M	W											
CO6		M	S											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

RESONANT CONVERTERS 10 Hours

Zero voltage and Zero current switching – Classification of resonant converters - Basic resonant circuit concepts - Load resonant converters - Resonant switch converters - Zero voltage switching, clamped voltage topologies -Resonant DC link Inverters and Zero voltage switching - High frequency link integral half cycle converters - Applications in SMPS and lighting.

MATRIX CONVERTER 10 Hours

Fundamentals of matrix converter – working principle – topology-single phase to three phase, three phase to single phase, three phase to three phase-switching pattern – bidirectional switch realization and commutation.

MULTILEVEL CONVERTER 8 Hours

Multilevel inverter concept – diode clamped – flying capacitor – cascade type multilevel inverters - comparison of multilevel inverters.

IMPROVED UTILITY INTERFACE 9 Hours

Generation of current harmonics – Current harmonics and power factor – Harmonic standards and recommended practices - Need for improved utility interface - Improved single phase utility interface - Improved three phase utility interface - Electromagnetic interference.

EMERGING DEVICES AND CIRCUITS 8 Hours

Power Junction Field Effect Transistors - Field Controlled Thyristors - JFET based devices Vs other power devices - MOS controlled thyristors, IGCT - Power integrated circuits - New semiconductor materials for power devices – GaAs, SiC.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Ned Mohan, Tore. M. Undeland, William. P. Robbins, "Power Electronics: Converters, Applications and Design", 3rd Edition, Wiley, India, 2010.
2. M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, Pearson Education, New Delhi, 2014.

REFERENCES

1. Andrzej M. Trzynadlowski, "Introduction to Modern Power Electronics", 2nd Edition, Wiley India Pvt Ltd, New Delhi, 2011.
2. Roger C Dugan, Mark F F Mcgranaghan, Surya Santoso & H.Wayne Beaty, "Electrical Power System Quality", 3rd Edition, McGraw Hill, 2012.
3. Bimal K Bose, "Modern Power Electronics–Evolution, Technology and Application", 1st Edition, IEEE Press, 1992.

U15EEPE10	PWM CONVERTERS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Distinguish the types of power conversion using different power modulation scheme.	**K2**
CO2	Analyze the steady-state and transient behavior of power converters with various advanced PWM techniques.	**K3**
CO3	Model and describe the characteristics of PWM and multilevel converter.	**K3**
CO4	Analyze the controller for PWM converter for applications.	**K3**
CO5	Choose the PWM converter to improve power quality.	**K2**
CO6	Identify and design a converter for specific applications.	**K2**

PRE-REQUISITE

Power Electronics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	W	M	S											
CO3	M	S	S											
CO4		M		W										
CO5	W	M		W										
CO6		M	S	M					W					

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

OVERVIEW OF CONVERTERS AND MODULATION 9 Hours

AC/DC and DC/AC power conversion - overview of applications of voltage source converters - pulse modulation techniques for bridge converters.

PWM TECHNIQUES 9 Hours

Bus clamping PWM - space vector based PWM - advanced PWM techniques - practical devices in converter; calculation of switching and conduction losses.

PWM INVERTERS 9 Hours

Compensation for dead time and DC voltage regulation - dynamic model of a PWM converter - multilevel converters - constant V/F induction motor drives.

PWM APPLICATIONS 9 Hours

Estimation of current ripple and torque ripple in inverter fed drives; line – side converters with power factor compensation.

POWER QUALITY IMPROVEMENT 9 Hours

Active power filtering - reactive power compensation - harmonic current compensation.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Ned Mohan, Tore M.Undeland and P.William Robbins, "Power Electronics; Converters, Applications and Design", John Wiley and Sons, 2006.
2. Marian P. Kazmierkowski, R. Krishnan and Frede Blaabjerg, "Control in Power Electronics", Academic Press Series, 2002.

REFERENCES

1. Erickson R W, D.Maksimovic, "Fundamentals of Power Electronics", Springer science & business media, 2001.
2. Joseph Vithyathil J, "Power Electronics: Principles and Applications", Tata McGraw Hill, 2010.

U15EEPE11 **ADAPTIVE CONTROL**

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Gain knowledge in parametric method by learning non parametric methods.	**K2**
CO2	Know linear regression method, prediction error method and instrumental variable methods in parametric methods.	**K2**
CO3	Understand recursive identification method and different approaches.	**K2**
CO4	Gain basic knowledge in adaptive control schemes and different approaches.	**K2**
CO5	Understand stability issues in adaptive control and its application.	**K2**
CO6	Apply the knowledge in parametric methods and adaptive control.	**K3**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M												
CO2	M	M	W											
CO3	M	M	W											
CO4	M	M												
CO5	M	M	W									W		
CO6	M	M												

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal test 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

NON PARAMETRIC METHODS 9 Hours

Nonparametric methods: Transient analysis-frequency analysis-Correlation analysis- Spectral analysis.

PARAMETRIC METHODS 9 Hours

Linear Regression: The Lease square estimate-best liner unbiased estimation under linear constraints- updating the Parameter estimates for linear regression models-Prediction error methods: Description of Prediction error methods-Optimal Prediction – relationships between Prediction error methods and other identification methods-theoretical analysis. Instrumental variable methods: description of Instrumental variable methods-theoretical analysis covariance matrix of IV estimates- Comparison of optimal IV prediction error methods.

RECURSIVE IDENTIFICATION METHODS 9 Hours

The recursive lest squares method-the recursive Instrument variable method-the recursive prediction error method-model validation and model structure determination. Identification of systems operating in closed loop: Identifiability considerations-direct identification- Indirect identification-joint input – output identification.

ADAPTIVE CONTROL SCHEMES 9 Hours

Introduction – users- Definitions-auto tuning-types of adaptive control-gain scheduling controller model reference adaptive control schemes – self tuning controller. MRAC and STC: Approaches – The Gradient approach – Lyapunov functions – Passivity theory – pole placement method Minimum variance control – Predictive control.

ISSUES IN ADAPTIVE CONTROL AND APPLICATION 9 Hours

Stability – Convergence – Robustness – Application of adaptive control.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Soderstorm.T and Petre stioca, “System Identification”, Prentice Hall International (UK) Ltd. 1989.
2. Karl J.Astrom and Bjorn Wittenmark, “Adaptive Control”, Pearson Education, 2nd Edition, 2001.

REFERENCES

1. Ljung, L., “System Identification: Theory for the user”, Prentice Hall, Englewood cliffs, 1987.
2. Sastry S. and Bodson M., “Adaptive control – stability, Convergence ad Robustness”, Prentice Hall inc., New Jersey, 1989.

U15EEPE12	MODERN OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Gain knowledge in different optimization techniques.	**K2**
CO2	Understand the fundamentals of evolutionary and genetic algorithms.	**K2**
CO3	Know hybrid approaches of different optimization techniques and understand PSO.	**K2**
CO4	Gain knowledge in SA, TS AND ACO.	**K2**
CO5	Understand the concept of multi objective optimization problem.	**K2**
CO6	Know different optimization techniques used in power systems.	**K2**

PRE-REQUISITE

Fundamentals of electrical power system

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W												
CO2	M	W			W									
CO3	M	W			W									
CO4	M	W			M									
CO5	M	W												
CO6	M	M	W											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

TRADITIONAL OPTIMIZATION TECHNIQUES 9 Hours

Definition-Classification of optimization problems-Unconstrained and Constrained optimization-Optimality conditions-Classical Optimization techniques (Linear and nonlinear programming, Quadratic programming, Mixed integer programming).

EVOLUTIONARY OPTIMIZATION TECHNIQUES 9 Hours

Evolution in nature-Fundamentals of Evolutionary algorithms-Working Principles of Genetic Algorithm- Evolutionary Strategy and Evolutionary Programming-Genetic Operators-Selection, Crossover and Mutation-Issues in GA implementation- GA based optimization: unit commitment problem, Selective Harmonic Elimination.

HYBRID OPTIMIZATION TECHNIQUES 9 Hours

PSO - Fundamental principle-Velocity Updating-Advanced operators-Parameter selection-Hybrid approaches (Hybrid GA - PSO, Hybrid EP - PSO) -Binary, discrete and combinatorial PSO-Implementation issues-Convergence issues- PSO based optimization techniques applied in tuning PI and PID controllers.

ADVANCED OPTIMIZATION ALGORITHMS 9 Hours

Simulated annealing algorithm-Tabu search algorithm- Ant colony optimization- Bacteria Foraging optimization- Teaching Learning based Optimization – Biogeography Based Optimization.

MULTI OBJECTIVE OPTIMIZATION 9 Hours

Concept of pareto optimality-Conventional approaches for MOOP-Multi objective GA-Fitness assignment-Sharing function- Applications in power electronics to minimize losses in power converters.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Soliman Abdel Hady, Abdel Aal Hassan Mantawy, “Modern optimization techniques with applications in Electric Power Systems”, Springer, 2012.
2. Kalyanmoy Deb, “Multi objective optimization using Evolutionary Algorithms”, John Wiley and Sons, 2008.

REFERENCES

1. Kalyanmoy Deb, “Optimization for Engineering Design”, Prentice Hall of India, 1st Edition, 1988.

U15EEPE13	MODERN CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand basic concepts of state space system and to know state variable feedback.	**K2**
CO2	Know different types of non linear system and its describing function.	**K2**
CO3	Find the stability of non linear system.	**K3**
CO4	Understand the concept of pole placement technique by state feedback and state observer.	**K2**
CO5	Know different control techniques and distributed control system.	**K2**
CO6	Understand the concepts of modern control theory.	**K2**

PRE-REQUISITE

Basic control systems, Linear algebra

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M												
CO2	M		W											
CO3	M	M		W										
CO4	M	M												
CO5	M	W												
CO6	M	W												

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

STATE SPACE ANALYSIS 9 Hours

State variable systems - controllability and Observability - State variable feedback and its effect on controllability and Observability-elements of observer theory.

NON LINEAR SYSTEMS 9 Hours

Common types of non- linear phenomena – linearization -singular points- phase plane method -construction of phase trajectories- describing functions.

STABILITY ANALYSIS 9 Hours

Basic concepts-derivation of describing functions-stability of non- linear systems by describing function method- Liapunov's method of stability studies- Popov's criterion.

STATE SPACE DESIGN 9 Hours

Pole placement technique by state feedback for linear SISO time invariant system–Design of state observers and servo system.

ADVANCES IN CONTROL SYSTEMS 9 Hours

Optimal control - adaptive control - robust control and intelligent control methods- Introduction to distributed control systems.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Chi-Tsong Chen, "Linear System Theory and Design", Oxford University Press, 4th Edition, 2012.
2. Khalil H.D., "Nonlinear Systems", Prentice Hall Publications, 3rd Edition, 2003.

REFERENCES

1. Stanley M. Shiners, "Modern Control System theory and Design", John Wiley and Sons Publications, 2nd Edition, 1998.
2. Ogata K., "Modern Control Engineering", Prentice Hall Publications, 5th Edition, 2010.

U15EEPE14	NON LINEAR CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Know about different sets, functions and space concepts of non linear systems.	**K2**
CO2	Model the electrical and mechanical non linear systems.	**K3**
CO3	Analyze the stability of non linear systems.	**K2**
CO4	Understand feedback linearization and design of stepping controllers.	**K2**
CO5	Design the sliding mode controller and energy based controller.	**K4**
CO6	Understand the basic concepts of non linear system and able to design different non linear controller.	**K3**

PRE-REQUISITE

Linear Electrical Control systems

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M													
CO2	M	M												
CO3	M	M												
CO4	M													
CO5	M	M	W											
CO6	M	M	W											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION TO SETS AND VECTORS 9 Hours

Open and closed sets - compact set, dense set -Continuity of functions - Lipschitz condition- smooth functions - Vector space - norm of a vector - normed linear space - inner product space.

MATHEMATICAL MODELING OF SYSTEMS 9 Hours

Mathematical modeling of simple mechanical and electrical systems - concept of equilibrium points - isolated equilibrium points and limit cycles.

STABILITY ANALYSIS 9 Hours

Stability analysis of nonlinear systems – Lyapunov stability, asymptotic stability, relative stability, finite - time stability and exponential stability- Lasalles invariance principle

FEEDBACK LINEARIZATION 9 Hours

Feedback linearization- dynamic feedback linearization - flatness and back stepping controllers design

LYAPUNOV-BASED DESIGN 9 Hours

Sliding mode controller design - Lyapunov redesign and energy based controller design

Theory: 45 Hours **Tutorial: 0 Hours** **Total: 45 Hours**

TEXT BOOKS

1. Khalil H.K., "Nonlinear Systems", Prentice Hall, 3rd Edition, 2001.
2. Vidyasagar M., "Nonlinear System Analysis", Prentice Hall, 2nd Edition, 2002.

REFERENCES

1. J.J.E. Slotine and W.Li, "Applied Nonlinear Control", Prentice Hall, Englewood Cliffs, NJ, 1991.
2. Zhihua Qu, "Robust Control of Nonlinear Uncertain Systems", John Wiley & Sons, Inter science Division, New York, 1998.
3. A.Isidori, "Nonlinear Control Systems", Communications and Control Engineering, Springer-Verlag, 3rd Edition, 1995.
4. H. Nijmeijer and A. J. vander Schaft, "Nonlinear Dynamical Control Systems", Springer-Verlag, New York, 1990.

U15EEPE15	SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Know about different learning process in ANN.	**K2**
CO2	Gain knowledge in concepts of ANN.	**K2**
CO3	Understand the basics of Fuzzy logic.	**K2**
CO4	Gain the basic concepts of Genetic Algorithm.	**K2**
CO5	Know about different engineering applications of Artificial intelligence techniques.	**K2**
CO6	Understand different soft computing techniques.	**K2**

PRE-REQUISITE

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M													
CO2	M													
CO3	M													
CO4	M													
CO5	W											W		
CO6	M													

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

ARTIFICIAL NEURAL NETWORKS 9 Hours

Introduction, Models of Neuron Network-Architectures –Knowledge representation, Artificial Intelligence and Neural networks–Learning process-Error correction learning, Hebbian learning –Competitive learning-Boltzman learning, supervised learning-Unsupervised learning–Reinforcement learning-Learning tasks.

ANN PARADIGMS 9 Hours

Multi-layer perceptron using Back propagation Algorithm (BPA), Self – Organizing Map (SOM) – Radial Basis Function Network-Functional Link Network (FLN), Hopfield Network.

FUZZY LOGIC 9 Hours

Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy Cartesian Product, Operations on Fuzzy relations –Fuzzy logic –Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods

GENETIC ALGORITHMS 9 Hours

Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling – Genetic operators-Cross over-Single site cross over, Two point cross over –Multi point cross over-Uniform cross over, Matrix cross over-Cross over Rate-Inversion & Deletion, Mutation operator –Mutation –Mutation Rate-Bit-wise operators, Generational cycle-convergence of Genetic Algorithm.

APPLICATIONS OF AI TECHNIQUES 9 Hours

Load forecasting, Load flow studies - Economic load dispatch - Load frequency control - Single area system and two area system - Small Signal Stability (Dynamic stability) - Reactive power control - Speed control of DC and AC Motors.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. S.Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms”, PHI, New Delhi, 2003.

REFERENCES

1. Rober J. Schalkoff, “Artificial Neural Networks”, Tata McGraw Hill Edition, 2011.
2. P.D.Wasserman, “Neural Computing Theory & Practice”, Van Nostrand Reinhold, New York, 1989.
3. Bart Kosko, “Neural Network & Fuzzy System”, Prentice Hall, 1992.
4. D.E.Goldberg, “Genetic Algorithms”, Addison-Wesley, 1999.

U15EEPE16	MODELLING AND ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand about the magnetic circuits and characteristics of the electrical machines.	**K1**
CO2	Understand generalized machine theory and forms the basics of machine modeling.	**K2**
CO3	Outline the Concept of transformation of variables to develop mathematical model of machines.	**K2**
CO4	Apply the different concepts of transformation on DC machines.	**K3**
CO5	Apply the concept of transformation of poly-phase induction machines.	**K3**
CO6	Describe the concepts and techniques of speed control of electrical machines.	**K1**

PRE-REQUISITE

Basics of Electrical machines

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S												
CO2	S	S												
CO3	M	M	S											
CO4	S	M	S											
CO5	M	S	M											
CO6	S	S	M											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

BASIC PRINCIPLES FOR ELECTRIC MACHINE ANALYSIS 9 Hours

Magnetically coupled circuits-coupled circuits with leakage-linear magnetic system - coupled circuits without leakage-linear magnetic system - non-linear magnetic system and computer simulation of coupled circuits with and without leakage - winding inductances and voltage equation-synchronous machine - induction machine.

MODELING OF DC MACHINES 9 Hours

Theory of operation induced EMF - equivalent circuit and electromagnetic torque - electromechanical Modeling - State-space modeling - block diagram and transfer functions - field excitation - measurement of motor constants - flow chart for computation.

LINEAR TRANSFORMATIONS IN MACHINES 9 Hours

The basic two pole machine - Kron's primitive machine - transformer & speed voltages in armature - Invariance of power - transformation from a displaced brush axis - transformation from three phases to two phases - transformation from rotating axes to stationary axes - Physical concepts of Park's transformations - transformed impedance matrix - How to apply generalized theory and electrical torque.

POLY-PHASE INDUCTION MACHINES 9 Hours

Introduction - construction and principle of operation - Induction motor equivalent circuit - steady-state performance equations of the induction motor - steady-state performance - Measurement of motor parameters - Dynamic modeling of induction machines

DYNAMIC MODEL 9 Hours

Slot harmonics - skewed slots - effect of space harmonics on IM performance - Reference – Frame Theory**:** Introduction, Background, equations of transformation – change of variables, stationary circuit variables transformed to the arbitrary reference frame - commonly used reference frames - transformation between reference frames.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Paul C Krause, "Analysis of Electric Machinery", McGraw – Hill Book Company, 2002.

REFERENCES

1. R. Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", PHI Learning Private Limited, New Delhi, 2011.
2. Dr. P. S. Bimbhra, "Generalized theory of Electrical Machines", Khanna Publishers, 1983.
3. K. R. Padiyar, "Power System Dynamics – stability & control", 2nd Edition, B S Publications, 2002.
4. Fitzerald, Kingsley and Kusko, "Electric Machinery", McGraw Hill, KOGA, 1997.

U15EEPE17	COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Acquire the knowledge on fundamental of CAD design.	**K1**
CO2	Understand the various design concepts of electrical machines.	**K1**
CO3	Apply the finite element analysis for machine design.	**K2**
CO4	Understand the elements of CAD packages and tools.	**K1**
CO5	Apply the fundamental tools for CAD drawing.	**K3**
CO6	Summarize and evaluate conventional and computerized design techniques.	**K3**

PRE-REQUISITE

Basics of Electrical machines

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S												
CO2	S	M												
CO3	S	M												
CO4	M	M	M		M									
CO5	M	S	M	M	M									
CO6	S	M												

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION 9 Hours

Conventional design methodology overview –computer aided design aspects –need for CAD –nature of design problems-analysis and synthesis approaches-advantages.

FINITE ELEMENT ANALYSIS 9 Hours

Mathematical formulation – discretisation – shape functions – stiffness matrix – solution techniques – post processing.

CAD PACKAGES 9 Hours

Recent developments – pre-processing – modeling - meshing – boundary conditions – material characteristics – problem formulation – solution – post processing.

CAD SOFTWARE 9 Hours

Program files – Installation – Screen menu structure - Fixing the size of a drawing – set up option - on line help – text fonts, shapes – Blocks – copy – array - Erasing facilities - editing – fill – zoom pan – hatching – isoplane – elevation – view point – dimension techniques – introduction to 3D drawing.

DESIGN EXAMPLES 9 Hours

Design of actuator – solenoid – transformer - induction motor – synchronous machines - switched reluctance motor.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. M Ramamoorthy, "Computer Aided Analysis and Design of Electrical Equipment", East West Press Pvt. Ltd, Madras, 1988.
2. C G Veinott, "Computer Aided Design of FHP Motors" Tata McGraw Hill Publishing Company limited, New Delhi.

REFERENCES

1. P.P. Silvester and Ferrari, "Finite Element for Electrical Engineers", Cambridge University Press, 3rd Edition, 1996.
2. M.V.K. Chari and P.P. Silvester, "Finite Elements in Electric and Magnetic Field Problems", John Wiley, 1980.
3. D.A. Lowther and P.P. Silvester, "Computer Aided Design in Magnetics", Springer Verlog, Newyork, 1986.
4. George, Omura, "Mastering AutoCAD-2012", BPB Publications, New Delhi, 2012.
5. Sham Tickoo, "AutoCAD 2002 with Applications" Tata McGraw Hill Publishing Company limited, New Delhi, 4th Edition, 2002.

U15EEPE18 SPECIAL ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Describe the construction and principle of operation of different special electrical machines.	**K2**
CO2	Identify the characteristics of different special electrical machines.	**K2**
CO3	Construct the power circuit and describe the modes of operation of power controllers for special electrical machines.	**K2**
CO4	Describe the control strategies for special electrical machines.	**K2**
CO5	Derive the EMF and Torque equation of Permanent Magnet and Reluctance motors.	**K2**
CO6	Select specific special machine for a particular application.	**K2**

PRE-REQUISITE

DC Machines and Transformers, AC Machines, Power Electronics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M			W										
CO2	M	W		M										
CO3	M		W											
CO4		W												
CO5	S	M												
CO6	W	M		W										

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

SYNCHRONOUS RELUCTANCE MOTORS 9 Hours

Constructional features – Axial and radial air gap motors – Operating principle – Reluctance Torque – Phasor diagram - Characteristics – Vernier motor.

STEPPER MOTORS 9 Hours

Constructional features – Principle of operation – Modes of excitation- Torque production in Variable reluctance stepper motor – PM stepper- Hybrid motor – Single and multi stack configurations – Linear and non- linear analysis – Characteristics – Drive circuits- open loop and closed loop control.

SWITCHED RELUCTANCE MOTORS 9 Hours

Constructional features – Principle of operation – Torque equation – Power controllers – Characteristics – Microprocessor based control - Computer control.

PERMANENT MAGNET BRUSHLESS DC MOTORS 9 Hours

Commutation in DC motors – Difference between mechanical and electronic commutators – Hall sensors- Optical sensors- square wave PMBLDC drives - EMF and torque equations – Speed Torque characteristics - Power controllers - Microprocessor based control.

PERMANENT MAGNET SYNCHRONOUS MOTORS 9 Hours

Principle of operation – EMF, power input and torque expressions – Phasor diagram – Power controllers – Converter Volt-ampere requirements – Torque speed characteristics - Microprocessor based control.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. K. V. Ratnam “Special Electrical Machines” Orient Blackswan/ University press, 2008.

REFERENCES

1. T.J.E. Miller, “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
2. P.P. Acarnley, “Stepping Motors – A Guide to Motor Theory and Practice”, 4th Edition, The Institution of Electrical Engineers, London, 2003.
3. T. Kenjo, “Stepping Motors and Their Microprocessor Controls”, Clarendon Press, Oxford University, London, 1994
4. T. Kenjo and S. Nagamori, “Permanent Magnet and Brushless DC Motors”, Clarendon Press, Oxford University, London, 1990.
5. V. V. Athani, “Stepper Motors – Fundamentals, Applications and Design”, New Age International Publications, India, 2013.
6. R. Krishnan “Switched Reluctance Motor and Drives” CRC Press, Washington, 2001.

U15EEPE19	DESIGN OF ENERGY EFFICIENT ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Summarize the concept of energy saving potential and reduction of losses.	**K2**
CO2	Estimate the design parameters of three phase and single phase induction motors.	**K3**
CO3	Select an efficient motor as per prescribed standards.	**K3**
CO4	Analyze the energy efficient operation by considering various procedures.	**K3**
CO5	Know about the energy efficient design of Electrical Machines.	**K2**
CO6	Understand the economic payback calculations of electrical machines.	**K2**

PRE-REQUISITE

DC Machines, AC Machines.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S					W	W							
CO2	S	M	M											
CO3	M		S			M		M						
CO4	M	M												
CO5	S	M				M								
CO6	S	S					M							

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION: 9 Hours

Definition - Benefits of Implementing Energy Efficient Motor Systems - Energy Efficient motors - Energy Profile - Types of Electric motors – Energy saving Potential – Overview of 17th Electric Power survey - Components of motor losses - calculation of Loss - Reduction - Economic Payback calculations.

GENERAL ASPECTS OF ELECTRICAL MACHINE DESIGN 9 Hours

O/P equation – choice of B_{av} and ac – MMF calculation of an Induction motor-– Electric Circuit calculation: estimation of number of conductors/turns - slots and slot dimension of stator and rotor of induction motors– estimation of air gap length – calculation of end ring current for cage rotor.

MOTOR SELECTION CONSIDERATIONS 9 Hours

Motor Enclosures - Motor Insulation Systems - Service Factor - Efficiency Labeling – IEC, IEE, IS Standard.

ENERGY EFFICIENT DESIGN OF INDUCTION MOTORS 9 Hours

ENERGY EFFICIENT DESIGN OF 3- PHASE IM: Design classification - Matching the motor to the load Prime characteristics – design procedure - Replacement Vs Repair - Thermal modeling and cooling.

ENERGY EFFICIENT DESIGN OF 1- PHASE IM : Design classification - Matching the motor to the load Prime characteristics - use of advanced materials -Electrical design consideration –selection of optimum capacitor value based on test results – Thermal protectors - General design procedure

ENERGY EFFICIENT OPERATION 9 Hours

Starting requirements and control methods of Energy Efficient Starting – Power factor and its effect on Energy consumption - Power factor correction

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Howard E Jordan, "Energy Efficient Electric Motors and their Application", Van Nostrand Reinhold Company Inc. London, 1983.

REFERENCES

1. Sawhney A K, “A Course in Electrical Machine Design”, Dhanpat Rai & Co (P) Ltd, New Delhi 2003.
2. John C. Andreas, “Energy Efficient Electric Motor Selection and Application”, Marcel Dekker Publisher, 1992.
3. Ion Boldea and Syed Nasar, “The Induction Machine Handbook” CRC Press 2002.

U15EEPE20	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Gain the knowledge on electrical and electronics systems available in modern automobiles.	**K2**
CO2	Understand the role of various Electronics Control Units embedded in modern automobiles.	**K2**
CO3	Understand the internals of various embedded systems design to ensure drivers safety and comfort.	**K2**
CO4	Apply the concepts of various protocols in establishing communication between nodes/ Electronics Control Units.	**K3**
CO5	Visualize the internals of each Electronics Control Unit with time stamp using IDE and RTOS support.	**K4**
CO6	Design and develop simple firmware modules to support Electronics Control Units communication at real-time balancing standards and pollution norms.	**K4**

PRE-REQUISITE

Basics of Electrical and Electronics , Digital Electronics, Microprocessors/Microcontrollers

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	W											
CO2	S	M		W										
CO3	M	S	W			M								
CO4		S	M	W								M		
CO5			S		S			M	M					
CO6			S			M	S	M	M					

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

AUTOMOBILE ELECTRICALS AND ELECTRONICS 9 Hours

Basic Electrical Components in an automobile - Starting system (Battery, Ignition Switch, Solenoid, Starter, Neutral Safety Switch), Charging system (Alternator Drive Belt, Battery, Alternator, Voltage Regulator), Fuses. Overview of Vehicle Electronic system - Driver - Vehicle - Environment system (Control and monitoring systems, Electronic systems of the vehicle and the environment)

ELECTRONICS CONTROL UNITS (ECUs) 9 Hours

ECUs and vehicle subsystems - Electronic systems of Power train subsystem - Electronic systems of Chassis subsystem - Electronic systems of Body subsystems (Comfort and Passive safety) - Multimedia subsystems. Automobile sensors and actuators - Engine management system - Vehicle safety systems - Environmental legislation (Pollution Norms - Euro / Bharat standards).

INTEGRATED DEVELOPMENT ENVIRONMENT IN EMBEDDED SYSTEMS 9 Hours

Integrated Development Environment (Introduction to IDE, Getting Started, Hardware / Software Configuration (Boot Service, Host – Target Interaction) - Booting (IDE-Interaction, target-Agent) – Reconfiguration - Managing IDE - Target Servers – Agents - Cross – Development, debugging) - Introduction to an IDE for the Laboratory board – RTOS - PC based debugger.

EMBEDDED SYSTEMS IN AUTOMOTIVE CONTEXT 9 Hours

Embedded systems in typical modern automobile - Distributed systems - Embedded components a) Engine Management system - Diesel / Gasoline system, Components - System architecture (H/W, S/W) - b) Vehicle safety systems - c) Body electronics systems - d) Infotainment systems – Navigation, Car radio.

EMBEDDED SYSTEMS COMMUNICATION PROTOCOLS 9 Hours

Introduction to Control networking - Communication protocols in embedded systems - SPI, I^2C, USB, -Vehicle communication protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP 2000 - Details of CAN

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Robert Bosch, “Bosch Automotive Handbook”, 9th Edition, Bentley Publishers, 2014.
2. Joerg Schaeuffele, Thomas Zurawka, “Automotive Software Engineering - Principles, Processes, Methods and Tools”, 1st Edition, SAE International, 2005.

REFERENCES

1. Jean J. Labrosse, “µC/OS-II Real Time Kernel”, 2nd Edition, CMP Books, 2002.

U15EEPE21	EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Differentiate the general purpose system and embedded system.	**K1**
CO2	Describe the components and compilation techniques in an embedded system.	**K2**
CO3	Familiarize with the concepts of real time operating system in embedded system design.	**K2**
CO4	Analyze and optimize embedded system using performance metrics.	**K2**
CO5	Design simple firmware modules using software development tools for Embedded system.	**K2**
CO6	Develop process flow to design and implement an embedded system using case studies.	**K3**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M										W		
CO2		S	S	W										
CO3		S	M											
CO4			M	W										
CO5			S		W						W			
CO6			S		M				W		W			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION TO EMBEDDED SYSTEM 9 Hours

Embedded system, Functional building block of embedded system - Characteristics of embedded system applications - Challenges in embedded system design - Embedded system design processes.

ARCHITECTURE OF EMBEDDED SYSTEM 9 Hours

Computer architecture taxonomy, CPUs – Programming input and output, Supervisor mode, Exceptions & Traps, Co-processors, Memory system mechanisms - CPU bus - Memory devices - I/O devices - Component interfacing - Assembly and linking - Basic compilation techniques – Program optimization.

OS FOR EMBEDDED SYSTEMS 9 Hours

Introduction to RTOS, Multiple tasks and multiple processes - Context switching - Operating system - Scheduling policies - Interprocess communication mechanisms - Introduction to µC/ OS II .

PERFORMANCE ISSUSES OF EMBEDDED SYSTEMS 9 Hours

CPU Performance, CPU power consumption - Program level performance analysis - Analysis and optimization of program size - energy and power - Evaluating operating system performance - Power management and optimization strategies for processes - Multiprocessors – CPUs and accelerators- Multiprocessor performance analysis .

DESIGN & IMPLEMENTATION 9 Hours

Development and debugging – Manufacturing – Testing - Program validation and Testing, - Distributed embedded architecture - Networks for Embedded Systems - I2C Bus, CAN Bus - Design examples: Cell phones, Digital Still Cameras, Elevator Controller.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Reed Elsevier Publications, Gurgaon, Haryana, 2008.
2. Rajkamal, "Embedded Systems – Architecture, Programming and Design", Tata McGraw-Hill, New Delhi, 2010.

REFERENCES

1. David E Simon, "An Embedded Software Primer", Pearson Education India, New Delhi, 2004.
2. Sriram V Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming**",** Tata McGraw-Hill, New Delhi, 2008.

U15EEPE22	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand and categorize various types of physical and electrical signals.	**K1**
CO2	Apply various methods of transformation techniques in time domain.	**K2**
CO3	Determine DFT by applying fast Fourier transform.	**K2**
CO4	Design and realize digital filters.	**K2**
CO5	Familiarize with the architecture and programming aspects of DSP processor.	**K1**
CO6	Program DSP Processor for power converter applications.	**K2**

PRE-REQUISITE

Partial Differential Equations and Transforms

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W												
CO2	M	M	W											
CO3	M	M	W											
CO4	M	M	W											
CO5	M		W		W						W			
CO6	W	M	M		W						W			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

SIGNALS AND REPRESENTATION 9 Hours

Classification of signals: continuous and discrete - energy and power; mathematical representation of signals; Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance - spectral density - sampling theorems.

DISCRETE TIME SYSTEM ANALYSIS 9 Hours

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

DISCRETE FOURIER TRANSFORM & COMPUTATION 9 Hours

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

DESIGN OF DIGITAL FILTERS 9 Hours

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

DSP PROCESSOR 9 Hours

Introduction to DSP processors - Architecture and features of TMS 320F281 Processor – General purpose timer - PWM generation unit - capture control units- Introduction to code composer studio - DSP based speed control of PMSM motor.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2003 / PHI.

REFERENCES

1. D.H. Hayes, "Digital Signal Processing", Schaum's Outline Series, Tata McGraw Hill, New Delhi, 2007.
2. B. Venkataramani, M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, New Delhi, 2003.
3. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, "Discrete – Time Signal Processing", Pearson Education, New Delhi, 2003.
4. Ramesh Babu, "Digital Signal Processing", 4th Edition, SciTech Publications (India) Pvt. Ltd., 2012.
5. "TMS320F281 data sheet and application notes", www.ti.com.

U15EEPE23	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Describe the internal architecture of PIC microcontroller.	**K1**
CO2	Write assembly language programs using timers and interrupt.	**K2**
CO3	Program and interface the peripheral devices with PIC Microcontroller.	**K2**
CO4	Explain the architecture and development tools of ARM processors.	**K2**
CO5	Interface the peripheral devices with ARM processor.	**K2**
CO6	Design, write and simulate the simple applications through PIC microcontroller and ARM processor.	**K3**

PRE-REQUISITE

Microprocessor and Microcontroller

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M												
CO2	W	M	M											
CO3			S	W	M						w			
CO4	M		M		M									
CO5			M	M	W						w			
CO6		S	M		M	W					w			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION TO PIC MICROCONTROLLER 9 Hours

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–PIC16cxx-Pipelining -Program Memory considerations – Register File Structure - Instruction Set - Addressing modes –Simple Operations.

INTERRUPTS AND TIMER 9 Hours

PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine -Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variable strings.

PERIPHERALS AND INTERFACING 9 Hours

I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM— Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

INTRODUCTION TO ARM PROCESSOR 9 Hours

ARM Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy –ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.

ARM ORGANIZATION 9 Hours

3-Stage Pipeline ARM Organization– 5-Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Peatman J.B., "Design with PIC Micro Controllers", Pearson Education, 3rd Edition, 2004.
2. Furber,S., "ARM System on Chip Architecture", Addison Wesley trade Computer Publication, 2000

.

REFERENCES

1. Mazidi, M.A., Rollin Mckinlay, Danny causey, "PIC Microcontroller", Prentice Hall of India, 2007.

U15EEPE24	LOW POWER VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Analyze the power dissipation in CMOS devices.	**K2**
CO2	Apply the concept of power optimization techniques for adders and multipliers.	**K2**
CO3	Design CMOS low power circuits.	**K2**
CO4	Estimate the power consumption of digital circuits.	**K2**
CO5	Gain the Knowledge of Synthesize process flow.	**K1**
CO6	Design CMOS circuits by considering the constraints.	**K2**

PRE-REQUISITE

Basics of CMOS circuits

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M	W											
CO2		M	W											
CO3		M	M											
CO4		M	W											
CO5	M	W	W											
CO6	M	W	M								W			

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

POWER DISSIPATION IN CMOS 9 Hours

Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices – Basic principle of low power design.

POWER OPTIMIZATION 9 Hours

Logic level power optimization – Circuit level low power design – circuit techniques for reducing power consumption in adders and multipliers.

DESIGN OF LOW POWER CMOS CIRCUITS 9 Hours

Computer arithmetic techniques for low power system – reducing power consumption in memories – low power clock, Inter connect and layout design – Advanced techniques – Special techniques.

POWER ESTIMATION 9 Hours

Power Estimation techniques – logic power estimation – Simulation power analysis – Probabilistic power analysis.

SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER 9 Hours

Synthesis for low power – Behavioural level transform – software design for low power.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley, 2000.

REFERENCES

1. Dimitrios Soudris, Chirstian Pignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer, 2002.
2. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley 1999.
3. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer, 1995.
4. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.
5. Abdelatif Belaouar, Mohamed.I.Elmasry, “Low power digital VLSI design”, Kluwer, 1995.
6. James B.Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons, 2001.

U15EEPE25 **VLSI DESIGN**

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Explain the design concepts, electrical properties and model the digital circuits.	**K1**
CO2	Design and model combinational, sequential circuits using CMOS technology.	**K2**
CO3	Design and model combinational, sequential circuits using low power VLSI.	**K3**
CO4	Describe the FPGA architecture and routing procedures.	**K1**
CO5	Design arithmetic building blocks considering data routing and area trade off.	**K2**
CO6	Implement digital circuits in CMOS technology using design consideration.	**K3**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W	W								W			
CO2	M		W											
CO3	M		W											
CO4	M		M								W			
CO5		M	W											
CO6		M	W											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

MOS TRANSISTOR PRINCIPLE **9 Hours**

NMOS and PMOS transistors - Process parameters for MOS and CMOS - Electrical properties of CMOS circuits and device modeling - Scaling principles and fundamental limits - CMOS inverter scaling - propagation delays - Stick diagram - Layout diagrams.

COMBINATIONAL LOGIC CIRCUITS **9 Hours**

Examples of Combinational Logic Design - Elmore's constant - Pass transistor Logic - Transmission gates - static and dynamic CMOS design - Power dissipation – Low power design principles

SEQUENTIAL LOGIC CIRCUITS 9 Hours

Static and Dynamic Latches and Registers - Timing issues – pipelines - clock strategies - Memory architecture and memory control circuits - Low power memory circuits - Synchronous and Asynchronous design

DESIGNING ARITHMETIC BUILDING BLOCKS 9 Hours

Data path circuits - Architectures for ripple carry adders - carry look ahead adders - High speed adders – accumulators – Multipliers – dividers - Barrel shifters - speed and area trade-off.

IMPLEMENTATION STRATEGIES 9 Hours

Full custom and Semi custom design - Standard cell design and cell libraries - FPGA building block architectures - FPGA interconnect routing procedures.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, 2nd Edition, Prentice Hall of India, 2003.
2. M.J. Smith, “Application Specific Integrated Circuits”, Addison Wesley, 1997

REFERENCES

1. N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, 2nd Edition, Addision Wesley ,1993
2. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005
3. A.Pucknell, Kamran Eshraghian, “Basic VLSI Design”, 3rd Edition, Prentice Hall of India, 2007.

U15EEPE26	FACTS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the concepts of FACTS controllers.	**K1**
CO2	Analyze and design various FACTS controllers.	**K2**
CO3	Explain the application of various FACTS controllers.	**K2**
CO4	Describe the various emerging FACTS controllers.	**K2**
CO5	Apply the control techniques for FACTS controllers using genetic algorithms.	**K3**
CO6	Observe the impact of FACTS on modern power systems.	**K2**

PRE-REQUISITE

Transmission and Distribution, Power Electronics.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S					W								
CO2		S	M											
CO3	M		S	W										
CO4	M	M												
CO5		M	M		W									
CO6		M				W								

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

REACTIVE POWER COMPENSATOR 9 Hours

Reactive power control in electrical power transmission lines - Uncompensated transmission line - series compensation – Basic concepts of static VAR Compensator (SVC) – Thyristor Controlled Series capacitor (TCSC) – Unified power flow controller (UPFC).

STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9 Hours

Voltage control by SVC – Advantages of slope in dynamic characteristics – influence of SVC on system voltage – Design of SVC voltage regulator – Applications: Enhancement of transient stability – steady state power transfer – Enhancement of power system damping – prevention of voltage instability.

THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS 9 Hours

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping – Voltage collapse prevention.

EMERGING FACTS CONTROLLERS 9 Hours

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics – Unified Power Flow Controller (UPFC) – Principle of operation – Modes of Operation – Applications – Modelling of UPFC for Power Flow Studies.

CO-ORDINATION OF FACTS CONTROLLERS 9 Hours

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Mohan Mathur R, Rajiv K Varma, Thyristor – Based Facts Controllers for Electrical Transmission Systems, IEEE press and John Wiley & Sons, Inc., 2002, Reprint 2009.

REFERENCES

1. A.T.John, “Flexible A.C. Transmission Systems”, Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. Narain G. Hingorani and Laszlo Gyugyi, “Understanding FACTS concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers, Delhi 2001.
3. K.R.Padiyar, “Facts Controllers in Power Transmission and Distribution”, New Age International, 1st Edition, 2007, Reprint August 2014, New Delhi.
4. V.K.Sood, “HVDC and FACTS controllers, Applications of Static converters in power System”, Klumer Academic Publishers, 2004.

U15EEPE27	SMART GRID ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the fundamental elements of the smart grid.	**K1**
CO2	Have knowledge on communication and networking technologies involved with the smart grid.	**K1**
CO3	Understand various sensing and measurement technologies involved with the smart grid.	**K1**
CO4	Illustrate the concepts of control and automation techniques in smart grid.	**K2**
CO5	Understand the role of power electronics in smart grid and to classify the different energy storage techniques.	**K2**
CO6	Apply and pass on knowledge, perspectives and terminology regarding Smart Grid as a basis for innovation in the energy sector.	**K3**

PRE-REQUISITE

Power System Analysis

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	S													
CO3	S													
CO4	S	M												
CO5	S													
CO6	S	M				W								

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

SMART GRID ARCHITECTURAL DESIGNS 9 Hours

Need for implementation of Smart grid - Smart Grid initiatives - Overview of the technologies required for the Smart Grid -Working Definition of the Smart Grid Based on Performance Measures - Representative Architecture - Functions of Smart Grid Components : Smart Devices Interface Component-Storage Component

Transmission Subsystem Component- Monitoring and Control Technology Component- Intelligent Grid Distribution Subsystem Component - Demand Side Management Component.

INFORMATION AND COMMUNICATION TECHNOLOGIES 9 Hours

Data Communication, Dedicated and shared communication channels, Layered architecture and protocols, Communication technology for smart grids, Information security for the smart grid.

SENSING AND MEASUREMENT TECHNOLOGIES 9 Hours

Synchrophasor Technology – Phasor Measurement Unit, Smart metering and demand side integration - Communication infrastructure and protocol for smart metering – Data Concentrator, Meter Data Management System. Demand side Integration – Services, Implementation and Hardware Support of DSI.

CONTROL AND AUTOMATION TECHNIQUES 9 Hours

Distribution automation equipment – Substation automation equipments: current transformer - potential transformer - Intelligent Electronic Devices - Bay controller - Remote Terminal Unit. Distribution management systems – SCADA: Modelling and analysis tools, applications.

POWER ELECTRONICS AND ENERGY STORAGE SYSTEMS 9 Hours

Power Electronics in smart grid application – Role of FACTS in smart grid by Shunt and series compensation techniques - Role of HVDC in smart grid for bulk power transfer and offshore wind connections. Energy Storage Technologies – Batteries - Flow Battery - Fuel Cell and Hydrogen Electrolyser – Flywheel - Super-Conducting magnetic energy storage system - Super Capacitor.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, “Smart Grid Technologies and applications”, John Wiley Publishers Ltd., 2012.
2. James Momoh, “Smart Grid Fundamentals of Design and Analysis”, IEEE Press, 2012.

REFERENCES

1. Lars T. Berger, Krzysztof Iniewski, “Smart Grid applications, Communications and Security”, John Wiley Publishers Ltd., 2012.
2. Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press, Taylor and Francis Group, 2012.
3. Caitlin G. Elsworth, “The Smart Grid and Electric Power Transmission”, Nova Science Publishers, 2010.

U15EEPE28	ILLUMINATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Describe the basic laws of illumination and lighting system.	**K2**
CO2	Know the various advanced light sources and to compare their performance.	**K2**
CO3	Propose and design energy efficient lighting scheme with suitable power sources.	**K3**
CO4	Design interior and exterior lighting systems.	**K3**
CO5	Understand the different types of loads, switching and control circuits.	**K2**
CO6	Suggest suitable protection units for lighting systems.	**K2**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M												
CO2	M													
CO3	M	M				M	W							
CO4	M	M		W										
CO5	M													
CO6	M		W			W								

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

INTRODUCTION OF LIGHTING SYSTEM 9 Hours

Radiation and colour - eye and vision - Laws of illumination - illumination from point - line and surface sources - Photometry and spectrophotometer – photocells - Environment and glare - traditional light sources.

ADVANCED LIGHT SOURCES 9 Hours

Comparative study of commercial CFLs – LEDs - electrical and optical properties - energy saving potential - LED drivers - intensity control techniques - Comparing LEDS with LASER - LEDs in communications - remote control.

LIGHTING SYSTEM AND ITS COMPONENTS 9 Hours

Utility services for large building/office complex and layout of different meters and protection units - Different type of loads and their individual protections - Selection of cable/wire sizes; wiring - switching and control circuits - potential sources of fire hazards and precautions - Emergency supply – stand by and UPS.

ENERGY EFFICIENT LIGHTING 9 Hours

Comparison between different light sources - comparison between different control gears - overcoming problems - energy efficient lighting - payback calculation - life cycle costing- (problems on payback calculations, life cycle costing) - solar lighting schemes.

INTERIOR AND EXTERIOR LIGHTING 9 Hours

Industrial – residential - office departmental stores - indoor stadium - theatre and hospitals - specific design problems on this aspect.

Flood, street, aviation and transport lighting - lighting for displays and signalling- neon signs, LED-LCD displays beacons and lighting for surveillance - specific design problems on this aspect.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Joseph B. Murdoch, “Illumination Engineering – from Edison’s Lamp to the Laser”, Macmillan Publishing Company, New York, 1985.
2. Gilbert Held, “Introduction to Light emitting diode Technology and applications”, CRC press, 2009.

REFERENCES

1. E. Fred Schubart, “Light Emitting Diodes”, Cambridge university press, 2006.
2. BIS, IEC standards for lamps, “Lighting fixtures and lighting”, Manak Bhavan, NewDelhi.

U15EEPE29	HVDC	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the importance of HVDC Transmission and HVDC converters.	**K1**
CO2	Explain the concepts of converter circuits and analyze simple problems.	**K2**
CO3	Apply the knowledge of converter circuits for converter control.	**K2**
CO4	Illustrate the concepts of faults and protection devices for HVDC system.	**K2**
CO5	Categorize the harmonics and explain the concepts of filters.	**K1**
CO6	Calculate the power conversion from AC to DC and from DC to AC	**K2**

PRE-REQUISITE

Power Electronics, Transmission and Distribution

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S					W								
CO2	S	M												
CO3		M	W											
CO4	S	M				W								
CO5	M	M												
CO6	M	M												

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

GENERAL ASPECTS OF HVDC AND HVAC TRANSMISSIONS — 9 Hours

Introduction -Comparison between AC and DC transmissions - DC links-DC cables and line insulators -Comparison between AC and DC cables-Important HVDC projects-Components of a HVDC system.

CONVERTER CIRCUITS AND ANALYSIS 9 Hours

Three Phase bridge converter using SCRs -Operating principles -Waveforms -Gate control and overlap –Voltage, current and power factor relations – Commutating resistance – Inversion –Equivalent circuits –Analysis and charts only for overlap less than 60º -Simple problems.

CONVERTER CONTROL 9 Hours

Principle of control –Manual control –Desirable features of control -Control characteristics – Constant minimum firing angle control –Constant current control –Constant extinction angle control –Tap changer control –Power and frequency control –Stability control –Compounding control and regulation –Reactive power requirement –Simple problems.

FAULTS AND PROTECTION 9 Hours

Bypass valve –SCR valves malfunctions –Over voltage and current oscillations –DC circuit breakers –DC lightning arrestors –Simple problems.

HARMONICS, FILTERS AND GROUND RETURN 9 Hours

Characteristic and uncharacteristic harmonics –Harmonic ac and dc filters –Interference with communication systems –Ground return – land, shore and sea electrodes –Cathodic protection –DC corona

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. Kimbark E.W., “Direct Current Transmission”, Vol.1, Wiley –Inter science, New york,1971.
2. Padiyar K.R, “HVDC Transmission Systems”, New Age International Pvt. Ltd, 2008.

REFERENCES

1. Adamson and Hingorani H.G., “High Voltage DC Power Transmission”, Garaway Ltd. England 1960.
2. Wadhwa C.L., “Electrical Power Systems”, New Age International Pvt. Ltd, New Delhi, 1995.
3. Arillaga J., “High Voltage Direct Current Transmission”, Peter Peregrinus, London, 1998.

U15EEPE30	ENERGY AUDITING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the energy scenario in India and Global market.	**K1**
CO2	Understand the importance of energy audit and instruments used for it.	**K1**
CO3	Describe the strategies of energy management and analysis techniques	**K2**
CO4	Understand the importance of SCADA energy monitoring systems and integrated resource planning.	**K1**
CO5	Describe management information system and optimization.	**K1**
CO6	Know the energy audit procedures and techniques and to prepare audit report.	**K3**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M	W							
CO2	M					W								
CO3	M	W		W										
CO4	W				M									
CO5	M				M									
CO6	M			W	M	W	W	M						

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

ENERGY SCENARIO

9 Hours

Energy sources-Primary and Secondary - Commercial and Non-commercial - Energy scenario in India and Global scenario - Energy Security - Energy and GDP - Energy Intensity - Energy conservation and its importance - Energy Conservation Act 2001 and related policies - Role of Non- conventional and renewable energy.

ENERGY AUDIT 9 Hours

Definition - need of energy Audit - Types of Energy Audit - Maximizing system efficiency - Optimizing the input energy requirements - fuel and energy substitution - Energy Audit instruments and metering – thermography - SMART metering

ENERGY MANAGEMENT AND INTEGRATED RESOURCE PLANNING 9 Hours

Definition and Objectives of Energy management - Energy management strategy - Key elements - Responsibilities and duties of Energy Manager - Energy efficiency Programs - Energy Monitoring System - Importance of SCADA - Analysis techniques - Cumulative sum of differences (CUSUM)

PROCEDURES AND TECHNIQUES 9 Hours

Data gathering: Level of responsibilities - energy sources - control of energy and uses of energy get Facts - figures and impression about energy /fuel and system operations - Past and Present operating data - Special tests - Questionnaire for data gathering.

Analytical Techniques: Incremental cost concept - mass and energy balancing techniques - Inventory of Energy inputs and rejections - Heat transfer calculations - Evaluation of Electric load characteristics - process and energy system simulation.

Energy Audit Reporting: The plant energy study report- Importance – contents - effective organization - report writing and presentation.

ENERGY BALANCE & MIS 9 Hours

First law of efficiency and Second law of efficiency - Facility as an Energy system - Methods for preparing process flow - Materials and Energy Balance diagram - Identification of losses - Improvements.

Energy Balance sheet and Management Information System (MIS) - Energy Modelling and Optimization.

Theory: 45 Hours **Tutorial: 0 Hours** **Total: 45 Hours**

TEXT BOOKS

1. S. C. Tripathy, “Utilization of Electrical Energy”, Tata Mc Graw Hill, 1993.
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)

REFERENCES

1. W.C. Turner, “Energy Management Handbook”, 6th Edition, CRC press, 2006.
2. Industrial Energy Management and Utilization – L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington)

OPEN ELECTIVES

U15EEOE01 RENEWABLE ENERGY RESOURCES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Acquire the knowledge about various renewable energy sources	**K1**
CO2	Explain the technological basis for harnessing renewable energy sources.	**K2**
CO3	Gain knowledge of low electrical energy generation.	**K2**
CO4	Identify various available renewable energy sources and techniques to utilize them effectively.	**K2**
CO5	To acquire the knowledge of modern energy conversion technologies	**K2**
CO6	To utilize local energy resources to obtain the sustainable energy system.	**K2**

PRE-REQUISITE

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2	M											
CO3	M											
CO4	M											
CO5	M						M					
CO6	M						M					

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

AN INTRODUCTION TO ENERGY SOURCES 9 Hours

General-Energy consumption as a measure of prosperity – World energy Scenario – Distributed generation – Deregulation and restructured electricity market.

SOLAR ENERGY 9 Hours

Solar Radiation and its measurements – Solar constant-Solar radiation at the earth's surface-Solar radiation geometry-Solar radiation measurements-Solar radiation Data- Solar Energy collectors- Physical properties- Flat plate collectors- Concentrating collectors-Comparison of flat plate and concentrating collectors- Solar Electric power generation: Solar Photovoltaic – Principle of photovoltaic conversion of solar energy – types of SPV cells and fabrication.

WIND ENERGY 9 Hours

Introduction – Basic principles of wind energy conversion power in the wind-Forces on blades and thrust on turbines – Wind energy conversion – site selection considerations-Basic components of WECS – Classification- Advantages and disadvantages – types of wind energy collectors.

BIO ENERGY 9 Hours

Introduction – Biomass conversion technologies – Bio gas generation – Factors affecting bio digestion or generation of gas – Classification of bio gas plants – advantages and disadvantages –Materials used for biogas plant – selection of site for biogas plant.

INTRODUCTION TO ALTERNATE SOURCES 9 Hours

Mini & micro Hydel plant – Magneto hydro dynamic power (MHD) – Introduction – MHD Systems – Thermo electric power – Basic principles – Thermionic generation – Thermo nuclear energy – The basic: Nuclear fusion reactor, Ocean, Tidal, Fuel cells.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. G. D. Rai, "Non Conventional Energy Sources", 1st Edition, Khanna Publishers, 2010.
2. B. H. Khan, "Non-conventional Energy Resources", 2nd Edition, Tata McGraw Hill, 2009, New Delhi.

REFERENCES

1. S. P. Sukhatme, "Solar Energy; Principles of Thermal Collection and Storage", 3rd Edition, Tata McGraw Hill, 2008, New Delhi.
2. Bent Sorensen, "Renewable Energy – Conversion, Transmission and Storage", 2nd Edition, Academic Press, 2000, New York.
3. Godfrey Boyle, "Renewable Energy; Power for a sustainable future", 3rd Edition, Oxford University Press, 2012.
4. Anthony San Pietro, "Biochemical and Photosynthetic aspects of Energy Production", Academic Press, New York, 2012.
5. R.C. Maheswari, Pradeep Chaturvedi, "Bio Energy for Rural Energisation", 1st Edition, Concept Publishing Co., 1997, New Delhi.
6. Khandelwal KC, Mahdi SS, "Biogas Technology – A Practical Handbook", Tata McGraw Hill, 1998.

U15EEOE02	CONTROL ENGINEEING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Gain the basic knowledge about various control system components.	**K1**
CO2	Derive the transfer function model and state space model of physical systems	**K2**
CO3	Determine the transient and steady state behaviour of systems subjected to standard test signals	**K2**
CO4	Analyze the linear systems for steady state errors.	**K3**
CO5	Analyze the linear systems for absolute and relative stability in time and frequency domain.	**K3**
CO6	Familiarize with system properties like Controllability and Observability.	**K2**

PRE-REQUISITE

DC Machines, AC Machines, Engineering Mathematics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	S	M										
CO2	S	M	W									
CO3	S	M	W									
CO4	S	M	W									
CO5	S	M	W									
CO6	S	M										

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

SYSTEMS AND THEIR REPRESENTATION 9Hours

Basic elements in control systems – Open and closed loop systems -Mathematical modelling of physical systems: Transfer function model of Mechanical and Electrical systems - Transfer function of DC Servo motor and AC Servomotor-Block diagram reduction techniques – Signal flow graphs.

TIME RESPONSE ANALYSIS 9Hours

Time response – Types of test input-step, ramp, impulse and parabolic inputs – I order system response for step, ramp and impulse input and II order system Response for step input– Time domain specifications -Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

FREQUENCY RESPONSE ANALYSIS 9Hours

Frequency response – Frequency domain specifications- Correlation between frequency domain and time domain specifications– Polar plot – Bode plot- Introduction to Constant M and N circles.

STABILITY OF CONTROL SYSTEM 9Hours

Definition of Stability - Location of roots of Characteristics equation in S plane for stability – Routh Hurwitz criterion – Root locus Techniques – Effect of pole, zero addition – Gain margin and phase margin.

STATE VARIABLE ANALYSIS 9 Hours

State space formulation-state model of linear system-state diagram-state space representation using physical variable- state space representation using phase variable - state space representation using canonical variable-Solution of state equations using Laplace transform-Concepts of Controllability and Observability.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. I.J. Nagrath & M. Gopal, "Control Systems Engineering", 5th Edition, New Age International Publishers, 2007.
2. M. Gopal, "Control Systems, Principles & Design", 4th Edition, Tata McGraw Hill, 2012, New Delhi.

REFERENCES

1. K. Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, 2010, New Delhi.
2. B.C. Kuo, "Automatic Control Systems", 7th Edition, Prentice Hall of India, 2003, New Delhi.
3. R. Anandha Natarajan and B. Ramesh Babu, "Control System Engineering", 3rd Edition, Scitech Publication, 2009.
4. Norman S. Nise, 'Control Systems Engineering' 4th Edition, John Wiley & Sons, Inc., 2007.
5. M.N. Bandyopadhyay, "Control Engineering Theory & Practice" Prentice Hall of India, 2004.

U15EEOE03	INDUSTRIAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the basic concept on control of DC and AC motor drives.	**K2**
CO2	Analyze AC& DC power control circuits employing thyristors.	**K3**
CO3	Analyze and design the specifications of commercially used Uninterrupted power Supplies**.**	**K3**
CO4	Gain knowledge on Opto-couplers and use photoelectric devices in relevant Applications.	**K2**
CO5	Explain the working of various heating methods.	**K2**
CO6	Understand the working of computer based servo-amplifiers**.**	**K2**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	S	M										
CO2	M	M										
CO3	M		W									
CO4	M											
CO5	M	W										
CO6	M											

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

DC MOTOR DRIVES 9Hours

Control of DC motors - Single-phase and Three-phase thyristor converters fed DC motors-control of DC motor using choppers of different configurations.

INDUCTION MOTOR DRIVES 9Hours

AC motor control - Induction motors - Stator voltage control – control using inverters – slip energy recovery scheme.

SOLID STATE POWER CONTROLLERS 9Hours

Power controllers - Uninterrupted power supplies – tap changing of Transformers- solid state exciters- solid state circuit breakers - battery driven vehicles.

OPTO ELECTRONIC DEVICES AND CIRCUITS 9Hours

Opto electronics – opto couplers; LEDS, photo-voltaic cells, photo- amplifier circuits for counting of moving objects, smoke detection, liquid level indicators etc.

ELECTRIC HEATING AND SERVO SYSTEMS 9 Hours

Induction heating – dielectric heating, high frequency power sources, introduction to servo systems, Micro – computer based servo amplifiers.

Theory: 45 Hours Tutorial: 0 Hours Total: 45 Hours

TEXT BOOKS

1. S.K. Bhattacharya and S. Chatterjee, "Industrial Electronics and control", 1st Edition, Mc Graw-Hill Publishing Company Limited, 2001.
2. M.D. Singh, K.B. Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill Publishing Co. Ltd., 2008.

REFERENCES

1. George M.Chute and Robert O. Chute, "Electronics in Industry", International Students Edition, McGraw Hill Ltd., 1981.
2. Schuler and Mc. Namee, "Industrial Electronics and Robotics", Mc Graw- Hill International Edition, 1986.
3. Thomas E. Kissell, "Industrial Electronics: Application for Programmable Controllers, Instrumentation and Process Control & Electrical Machines & Motor Controls", 3rd Edition, Prentice Hall, 2002.
4. Dale R. Patrick & Stephen W. Fardo, "Industrial Electronics: Devices & Systems", 2nd Edition, The Fairmont Press, Inc. Publications, 2000

U15EEOE04 POWER ELECTRONICS AND DRIVES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the basic concepts of semiconductor devices and power electronics circuits.	**K1**
CO2	Acquire knowledge on various types of drives.	**K2**
CO3	Compare various types of loads and characteristics of motors.	**K2**
CO4	Construct the power converter circuit for DC motor drives.	**K3**
CO5	Design the power converter circuit for AC motor drives.	**K3**
CO6	Select the motor for specific application.	**K2**

PRE-REQUISITE

Electronic Devices and Circuits, Electrical Machines

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M	W										
CO2	W	M										
CO3	W	M										
CO4			M		W							
CO5			M		W							
CO6			M			W						

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

POWER ELECTRONIC DEVICES AND DRIVE CHARACTERISTICS 9 Hours

Introduction to Power semiconductor devices- SCR, TRIAC, Power MOSFET, IGBT- Elements of electric drive system- speed torque characteristics of various types of loads- classes of duty, heating and cooling - Starting, types of braking & reversing operations.

AC TO DC CONVERTER FED DC DRIVES 9 Hours

Single phase and three phase half and fully controlled converters – Single and three phase half and fully controlled converter fed DC motor drive.

DC TO DC CONVERTERS FED DC DRIVES 9 Hours

Step-down chopper - Step-up chopper- Two quadrant and four quadrant choppers - Single quadrant chopper fed separately excited DC motor drive- Two and four quadrant chopper fed DC drive

DC TO AC INDUCTION MOTOR DRIVES 9 Hours

Single phase and three phase bridge voltage source inverters – Stator voltage controller fed induction motor drive – VSI fed induction motor drive - V/F control -static rotor resistance control.

AC TO AC CONVERTER FED INDUCTION MOTOR DRIVE AND DRIVE APPLICATIONS 9 Hours

Single phase and Three phase AC voltage controllers – Phase control – Voltage control of Induction motor drive.

Drive applications: steel rolling mill, paper mill, traction, cranes and lifts.

Theory: 45 Hours **Tutorial: 0 Hours** **Total: 45 Hours**

TEXT BOOKS

1. M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, Pearson Education, 2014, New Delhi.
2. M.D. Singh, K.B.Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill, 2006, New Delhi.
3. Gopal K. Dubey, "Fundamentals of Electric Drives", 2nd Edition, Narosa Publishing House, 2015, New Delhi.

REFERENCES

1. Ned Mohan, Tore. M. Undeland, William. P. Robbins, "Power Electronics: Converters, Applications and Design", 3rd Edition, Wiley, 2010, India.
2. Vidhyathil Joseph, "Power *Electronics* Principles and Applications*",* McGraw Hill Education (India)*, 2010.*
3. M.D. Singh, K.B. Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill, 2008, New Delhi.
4. Vedam Subramanium, "Electric Drives Concepts and Applications", 2nd Edition, Tata McGraw Hill, 2011, New Delhi.
5. P.C.Sen, "Thyristor DC drives", John Wiley & sons, 2008, New York.

U15EEOE05	ELECTRICAL SAFETY AND ENERGY MANAGEMENT	L	T	P	C
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COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Gain basic knowledge on Indian Power sector organization and their roles.	**K1**
CO2	Understand the concepts of earthing and its standards.	**K2**
CO3	Acquire the basic knowledge on First aid and safety during electrical installation**.**	**K2**
CO4	Distinguish various fire extinguishers and their classification.	**K2**
CO5	Explain the safety policy in management & organizations.	**K2**
CO6	Understand the basic concepts of energy auditing.	**K2**

PRE-REQUISITE

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M											
CO2	M					M	W					
CO3	M					M	W					
CO4	M						W					
CO5	W					M						
CO6	M					W						

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal tests 2. Assignment 3. Group Presentation 4. End Semester Exam	1. Course Exit Survey

RULES & REGULATIONS **9 Hours**

Power sector organization and their roles – significance of IE rules & IE acts – general safety requirements: span, conductor configuration, spacing and clearing, sag, erection, hazards of electricity.

INSTALLATION AND EARTHING OF EQUIPMENTS **9 Hours**

Classification of electrical installation - earthing of equipment bodies – electrical layout of switching devices and SC protection – safety in use of domestic appliances – safety documentation and work permit system – flash hazard calculations – tools and test equipments.

SAFETY MANAGEMENT AND FIRST AID **9 Hours**

Safety aspects during commissioning – safety clearance notice before energizing – safety during maintenance – maintenance schedule – special tools – security grand– check list for plant security – effects of electric and electromagnetic fields - in HV lines and substations – safety policy in management & organizations – economic aspects – safety program structure – elements of good training program – first aid – basic principles – action taken after electrical shock – artificial respiration and methods – chocking – poisoning.

FIRE EXTINGUISHERS **9 Hours**

Fundamentals of fire – initiation of fires – types – extinguishing – techniques – prevention of fire – types of fire extinguishers- fire detection and alarm system – CO_2 and Halogen gas schemes, foam schemes.

ENERGY MANAGEMENT & ENERGY AUDITING **9 Hours**

Objectives of energy management – energy efficient electrical systems – energy conservation and energy policy – renewable source of energy – energy auditing – types and tips for improvement in industry.

Theory: 45 Hours **Tutorial: 0 Hours** **Total: 45 Hours**

TEXT BOOKS

1. John Codick, “Electrical safety hand book”, McGraw Hill Inc, New Delhi, 2000.
2. V. Manoilov, “Fundamentals of electrical safety”, Mir Publishers, MOSCOW, 1975.

REFERENCES

1. C.S. Raju, “A Practical Book on domestic safety”, Sri Sai Publisher, Chennai, 2003.
2. Power Engineering Hand book, TNEB Engineers officers, Chennai, 2002.
3. S. Rao, R.C. Khanna, “Electrical safety, Fire safety engineering and safety management”, Khanna Publisher, Delhi, 1998.
4. The Indian electricity rules, 1956, authority regulations, 1979, Commercial Law Publication, Delhi, 1999.
5. W.F.Cooper, “Electrical safety Engineering”, Newnes-Butterworth company, 1978.

ONE CREDIT COURSES

U15EEIN02 **CIVIL CONSTRUCTION FOR POWER SYSTEM**

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1: Classify surveying, explain various civil engineering materials, categorize foundations and plan superstructure.
CO2: Explain the working of various power plants and engines.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2												

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Continuous assessment method	1. Course exit survey

SURVEYING ENGINEERING MATERIALS 5 Hours

Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

CIVIL ENGINEERING MATERIALS 5 Hours

Bricks – stones – sand – cement – concrete – steel sections.

BUILDING COMPONENTS AND STRUCTURES 5 Hours

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.

Theory:15 Hrs **Total: 15 Hrs**

U15EIIN02 **DCS FUNDAMENTALS AND INDUSTRIAL COMMUNICATION PROTOCOL**

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1: Explain the role of DCS in process industries.
CO2: Explain the architecture of CS 3000 – YOKOGAWA DCS
CO3: Understand the concept of HMI and GUI.
CO4: Explain the control operation in DCS.
CO5: Explain the various buses and communication Protocol used in Yokogawa system.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2												
CO3												
CO4												
CO5												

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Continuous assessment method	1. Course exit survey

INTRODUCTION TO DIGITAL CONTROL 3 Hours

Direct Digital Control (DDC) - Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations - Functional block diagram of computer control systems - Alarms, interrupts - Characteristics of digital data - controller software - linearization - Digital controller modes: Error, proportional, derivative and composite controller modes.

INTRODUCTION TO DCS 2 Hours

DCS Evolution - DCS Overview - Generalized architecture - local control unit - LCU languages.

CONFIGURATION OF DCS 2 Hours

LCU - Process interfacing issues - communication facilities - high level and low level operator interfaces - displays, redundancy concept.

YOKOGAWA DCS 2 Hours

CS-3000 System Architecture - System Builder Configuration - Project Creation - Field Control Station Configuration - IOM Configuration.

HMI AND RTU CONFIGURATION 3 Hours

Human Machine Interface-Features - Configuration and working of loops-open loop and closed loop Different types of graphical user Interface(GUI) - Face plate - Tuning window operation - Configuration of loops Cascade loop - Ratio control - Split range control - Signal Selectors - Multiple cascade - Control group – Trends - sequential control functions. Generation of Interlocks using - Sequence tables - Logic charts - Real time graphics Configuration.

NETWORKING AND COMMUNICATION PROTOCOL 3 Hours

Networking Principles - Types of Network - Introduction to Industrial Communication Protocols - Intranet & Internet concepts - HART Communication - MBUS Communication - Communication protocols in Yokogawa System - Introduction to FF communication.

Theory:15 Hrs **Total: 15 Hrs**