PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

PERIYAR MANIAMMAI
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University)
Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited
think • innovate • transform

Criterion 1 – Curricular Aspects

Key Indicator	1.1	Curriculum Design and Development
Metric	1.1.3	Average percentage of courses having focus on employability/ entrepreneurship/ skill Development offered by the department.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SYLLABUS COPY OF THE COURSES HIGHLIGHTING THE FOCUS ON EMPLOYABILITY/ ENTREPRENEURSHIP/ SKILL DEVELOPMENT

1. List of courses for the programmes in order of

S. No.	Programme Name
i.	Bachelor of Technology(Electrical and Electronics Engineering)(Full Time)
ii.	Bachelor of Technology (Electrical and Electronics Engineering)(Part Time)

2. Syllabus of the courses as per the list.

Legend : Words highlighted with **Blue Color** - Entrepreneurship
Words highlighted with **Red Color** - Employability
Words highlighted with **Purple Color** - Skill Development

1. List of Courses

Name of the Course	Course Code	Year of introduction	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
Electrical and Electronics Engineering Systems	XBE102	2007-08	**Entrepreneurship-**Assignment, Seminar,Poster Presentation
Applied Chemistry for Engineers	XAC103	2007-08	**Entrepreneurship-**Assignment, Seminar,Poster Presentation
Engineering Graphics and Design	XEG104	2007-08	**Employability-**Drawing Assignment, Model Making
Speech Communication	XGS105	2007-08	**Skill Development-** Quiz, Test, Assignment Seminar
Constitution of India	XUM106	2007-08	**Skill Development-** Quiz, Test, Assignment Seminar
Electrical and Electronics Engineering Systems Labaratory	XBE107	2007-08	**Entrepreneurship-**Assignment, Seminar,Poster Presentation
Applied Chemistry for Engineers Labaratory	XAC108	2007-08	**Entrepreneurship-**Assignment, Seminar,Poster Presentation
Electrical Circuit Analysis	XEE301	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Analog Electronics	XEE302	2007-08	**Employability**-Assignment, Test,Seminar
Electrical Machines - I	XEE303	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Electromagnetic Fields	XEE304	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Transmission and Distribution	XEE305	2007-08	**Employability**-Assignment, Test,Seminar
In-plant Training – I	XEE306	2007-08	**Employability**-Industrial visit, Viva Voce
Power Systems - I (Apparatus and Modelling)	XEE501	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Control Systems	XEE502	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Microprocessors and Microcontrollers	XEE503	2007-08	**Employability**-Assignment, Test,Seminar
Professional Elective – 1	XEEE11	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Constitution of India	XUM506	2007-08	**Skill Development-** Quiz, Test, Assignment Seminar
In-plant Training – II	XEE507	2015-16	**Employability**-Industrial visit, Viva Voce
Minor Course – I	XEEM01	2019-20	**Employability**-Test
High Voltage Engineering	XEEE41	2013-14	**Employability**-Assignment, Test,Seminar
Electrical Drives	XEE E51	2013-14	**Employability**-Assignment, Test,Seminar
Human Ethics,Values,Rights and Gender Equality	XEE703	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Project Phase – I	XEE706	2013-14	**Employability**-Presentation, Viva Voce

In-plant Training – III	XEE707	2015-16	**Skill Development-** Presentation, Mock Interviews Group Discussion
Minor Course – II	XEE708	2007-08	**Employability**-Industrial visit, Viva Voce
Programming for Problem Solving	XCP202	2018-19	**Entrepreneurship-**Test, Assignment, Problem Solving Exercises
Applied Physics for Engineers	XAP203	2007-08	**Entrepreneurship-**Assignment, Seminar,Poster Presentation
Technical Communication	XGS204	2007-08	**Skill Development-** Quiz, Test, Assignment,Seminar
Workshop Practices	XWP205	2007-08	**Entrepreneurship-**Machining Processes,Model Making
Engineering Mechanics	XEM206	2007-08	**Employability-**Drawing Assignment, Model Making
Programming for Problem Solving Labaratory	XCP207	2007-08	**Entrepreneurship-**Test, Assignment, Problem Solving Exercises
Applied Physics for Engineers Labaratory	XAP 208	2007-08	**Entrepreneurship-**Test, Assignment, Problem Solving Exercises
Digital Electronics	XEE402	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Power Electronics	XEE403	2007-08	**Employability**-Assignment, Test, Seminar
Electrical Machines - II	XEE404	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Entrepreneurship Development	XUM405	2013-14	**Entrepreneurship-**Quiz, Test, Assignment, Seminar, Group Discussion
Signals and Systems	XEE406	2018-19	**Employability**-Quiz, Test, Problem Solving Assignment
Power Systems - II (Operation and Control)	XEE602	2007-08	**Employability**-Assignment, Test,Seminar
Measurement and Instrumentation	XEEE21	2007-08	**Employability**-Assignment, Test,Seminar
Industrial Automation	XEEE31	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Disaster Management	XUM606	2015-16	**Employability**-Assignment, Test,Seminar
Minor Course – II	XEEM02	2019-20	**Employability**-Test
Cyber Security	XUM801	2013-14	**Employability**-Assignment, Test,Seminar
Electrical and Hybrid Vehicles	XEEE51	2013-14	**Employability**-Assignment, Test,Seminar
Project Phase – II	XEE 804	2013-14	**Employability**-Assignment, Test,Seminar
Applied Physics for Engineers	PAP102	2007-08	**Entrepreneurship-**Assignment, Test, Seminar
Applied Chemistry for Engineers	PAC103	2007-08	**Entrepreneurship-**Assignment, Test, Seminar
Electrical Circuit Analysis	PEE104	2007-08	**Employability**-Quiz, Test, Assignment, Mini Project, Viva Voce
Electrical Circuit Analysis Laboratory	PEE105	2007-08	**Employability**-Quiz, Test, Assignment, Mini Project, Viva Voce
Transmission and Distribution	PEE301	2007-08	**Employability**-Assignment, Test,Seminar
Environmental Sciences	PEE302	2007-08	**Entrepreneurship-**Test, Assignment, Seminar
Signals and Systems	PEE303	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment

Electrical Machines-II	PEE304	2018-19	**Employability**-Quiz, Test, Problem Solving Assignment
Power system - I(Apparatus and Modelling)	PEE501	2007-08	**Employability**-Assignment, Test,Seminar
Bio Medical Instrumentation	PEEE31	2007-08	**Employability**-Assignment, Test,Seminar
Industrial Economics and Foreign Trade	PEE503	2007-08	**Employability**-Assignment, Test,Seminar
Control Systems	PEE504	2007-08	**Employability**-Quiz, Test, Assignment, Mini Project, Viva Voce
Power Plant Engineering	PEEE41	2015-16	**Employability**-Assignment, Test,Seminar
Electrical Drives	PEEE51	2007-08	**Employability**-Assignment, Test,Seminar
HVDC Transmission Systems	PEEE61	2007-08	**Employability**-Assignment, Test,Seminar
Main Project	PEE704	2007-08	**Employability**-Presentation, Viva Voce
Analog Electronics	PEE 202	2007-08	**Employability**-Assignment, Test,Seminar
Electromagnetic Fields	PEE 203	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Electrical Machines-I	PEE 204	2007-08	**Employability**-Quiz, Test, Problem Solving AssignmentMini Project, Viva Voce
Electrical Machines - I Labaratory	PEE 205	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Digital Electronics	PEE 401	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Professional Elective-1(Energy Auditing and Management)	PEE E13	2007-08	**Employability**-Assignment, Test,Seminar
Professional Elective-2(High Voltage Engineering)	PEE E21	2007-08	**Employability**-Assignment, Test,Seminar
Power Electronics	PEE 404	2007-08	**Employability**-Quiz, Test, Assignment, Mini Project, Viva Voce
Power System -II (Operation and Control)	PEE 601	2007-08	**Employability**-Assignment, Test,Seminar
E-Waste Management	PEE 602	2007-08	**Employability**-Quiz, Test, Problem Solving Assignment
Disaster Management	PEE 603	2007-08	**Employability**-Assignment, Test,Seminar
Microprocessors and Microcontrollers	PEE 604	2007-08	**Employability**-Quiz, Test, Assignment, Mini Project, Viva Voce

SYLLABUS FOR B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING

`SEMESTER - I

COURSE CODE	COURSE NAME	L	T	P	C
XMA 101	CALCULUS AND LINEAR ALGEBRA	3	1	0	4
Prerequisite	Differentiation and Integration	L	T	P	H
C : P : A		3	1	0	4
3 : 0.5 : 0.5					

Course Outcomes :		Domain	Level
CO1	**Apply** orthogonal transformation to reduce quadratic form to canonical forms.	Cognitive	Remembering Applying
CO2	**Apply** power series to tests the convergence of the sequences and series. Half range Fourier sine and cosine series.	Cognitive Psychomotor	Applying Remembering Guided Response
CO3	**Find** the derivative of composite functions and implicit functions. Euler's theorem and Jacobian.	Cognitive Psychomotor	Remembering Guided Response
CO4	**Explain** the functions of two variables by Taylors expansion, by finding maxima and minima with and without constraints using Lagrangian Method. Directional derivatives, Gradient, Curl and Divergence.	Cognitive Affective	Remembering Understanding Receiving
CO5	**Apply** Differential and Integral calculus to notions of Curvature and to improper integrals.	Cognitive	Applying

UNIT - I: MATRICES	**9 + 3**
Linear Transformation - Eigen values and Eigen vectors -Properties of Eigen values and Eigen vectors - Cayley-Hamilton Theorem – Diagonalisation of Matrices – Real Matrices: Symmetric - Skew-Symmetric and Orthogonal Quadratic form – canonical form - Nature of Quadratic form and Transformation of Quadratic form to Canonical form (Orthogonal only).	
UNIT - II: SEQUENCES AND SERIES	**9 + 3**
Sequences: Definition and examples-Series: Types and convergence- Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test-. Fourier series: Half range sine and cosine series- Parseval's Theorem.	
UNIT - III: MULTIVARIABLE CALCULUS: PARTIAL DIFFERENTIATION	**9 + 3**
Limit and continuity –Partial differentiation – Total Derivative – Partial differentiation of Composite Functions: Change of Variables – Differentiation of an Implicit Function - Euler's Theorem- Jacobian.	
UNIT - IV: MULTIVARIABLE CALCULUS: MAXIMA AND MINIMA AND VECTOR CALCULUS	**9 + 3**
Taylor's theorem for function of Two variables- Maxima, Minima of functions of two variables: with and without constraints - Lagrange's Method of Undetermined Multipliers – Directional Derivatives - Gradient, Divergence and Curl.	

UNIT - V: DIFFERENTIAL AND INTEGRAL CALCULUS			9 + 3
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.			
	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

TEXT BOOKS:

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2015**. (Unit-1, Unit-3 and Unit-4).**

2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2014. **(Unit-2).**

3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition,2010. **(Unit-5).**

REFERENCE BOOKS:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, PearsonReprint, 2002.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi,2008.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons,2006.

Mapping of COs with GAs

	GA 1	**GA 2**	**GA 3**	**GA 4**	**GA 5**	**GA 6**	**GA 7**	**GA 8**	**GA 9**	**GA 10**	**GA 11**	**GA 12**
CO 1	3	2	0	0	2	0	0	0	0	1	0	2
CO 2	3	2	0	0	0	0	0	0	0	1	0	1
CO 3	3	2	0	0	0	0	0	0	0	1	0	1
CO 4	3	2	0	0	0	0	0	0	0	1	0	1
CO 5	3	2	0	0	1	0	0	0	0	1	0	2
Total	**15**	**10**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**5**	**0**	**7**
Scaled	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**2**

1-5 → 1, 6-10 → 2, 11-15 → 3

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XBE 102	**ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS**	**3**	**1**	**0**	**4**
Prerequisites	**Physics**	**L**	**T**	**P**	**H**
C : P : A		**3**	**1**	**0**	**4**
3 : 0 : 0					

Course Outcomes :		**Domain**	**Level**
CO1	**Define and Relate** the fundamentals of electrical parameters and **build** and **explain** AC, DC circuits by Using measuring devices	Cognitive	Understand
CO2	**Define and Explain** the operation of DC and AC machines.	Cognitive	Understand

CO3	**Recall and Illustrate** various semiconductor devices and their applications and displays the input output characteristics of basic semiconductor devices.	Cognitive	Understand	0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation
CO4	**Relate and Explain the** number systems and logic gates. **Construct** the different digital circuit.	Cognitive	Understand	
CO5	**Label and Outline the** different types of microprocessors and their applications.	Cognitive	Understand	

UNIT - I: FUNDAMENTALS OF DC AND AC CIRCUITS, MEASUREMENTS	**9 + 3**
Fundamentals of DC– Ohm's Law – Kirchhoff's Laws - Sources - Voltage and Current Relations – Star/Delta Transformation - Fundamentals of AC – Average Value, RMS Value, Form Factor - AC power and Power Factor, Phasor Representation of sinusoidal quantities, Simple Series, Parallel, Series Parallel Circuit - Operating Principles of Moving coil and Moving Iron Instruments (Ammeter, Voltmeter) and Dynamometer type meters (Watt meter and Energy meter).	
UNIT - II: ELECTRICAL MACHINES	**9 + 3**
Construction, Principle of Operation, Basic Equations, Types and Application of DC Generators, DC motors - Basics of Single-Phase Induction Motor and Three Phase Induction Motor- Construction, Principle of Operation of Single-Phase Transformer, Three phase transformers, Auto transformer.	
UNIT - III: SEMICONDUCTOR DEVICES	**9 + 3**
Classification of Semiconductors, Construction, Operation and Characteristics: PN Junction Diode – Zener Diode, PNP, NPN Transistors, Field Effect Transistors and Silicon Controlled Rectifier – Applications	
UNIT - IV: DIGITAL ELECTRONICS	**9 + 3**
Basic of Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, Subtractors, multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.	
UNIT - V: MICROPROCESSORS	**9 + 3**
Architecture, 8085, pin diagram of 8085, ALU timing and control unit, registers, data and address bus, timing and control signals, Instruction types, classification of instructions, addressing modes, Interfacing Basics: Data transfer concepts – Simple Programming concepts.	

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

TEXT BOOKS:

1. Metha V.K, Rohit Mehta, 2020. Principles of Electronics,12th ed, S Chand Publishing.
2. Albert Malvino, David J.Bates., 2017. Electronics Principles. 7th ed, Tata McGraw-Hill. New Delhi.
3. Rajakamal, 2014. Digital System-Principle & Design. 2nd ed. Pearson education.
4. Morris Mano, 2015. Digital Design. Prentice Hall of India.
5. Ramesh, S. Gaonkar, 2013, Microprocessor Architecture, Programming and its Applications with the 8085, 6th ed , India: Penram International Publications.

REFERENCE BOOKS:

1. Cotton, H.,2005 Electrical Technology. CBS Publishers & Distributors Pvt Ltd.
2. Syed, A. Nasar, 1998, Electrical Circuits. Schaum Series.
3. Jacob Millman and Christos, C. Halkias, 1967, Electronics Devices, New Delhi: Tata McGraw-Hill.
4. Millman, J. and Halkias, C. C., 1972. Integrated Electronics: Analog and Digital Circuits and Systems, Tokyo: McGraw-Hill, Kogakusha Ltd.
5. Mohammed Rafiquzzaman, 1999. Microprocessors - Theory and Applications: Intel and Motorola. Prentice Hall International.

E-REFERENCES:

1. NTPEL, Basic Electrical Technology (Web Course), Prof. N. K. De, Prof. T. K. Bhattacharya and Prof. G.D. Roy, IIT Kharagpur.
2. Prof.L.Umanand, http://freevideolectures.com/Course/2335/Basic-Electrical-Technology#, IISc Bangalore.
3. http://nptel.ac.in/Onlinecourses/Nagendra/, Dr. Nagendra Krishnapura, IIT Madras.
4. Dr.L.Umanand, http://www.nptelvideos.in/2012/11/basic-electrical-technology.html, IISC Bangalore.

Mapping of COs with GAs

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
CO 1	3	3	1	1	1	1	0	0	1	1	1	0
CO 2	3	3	1	1	1	1	0	0	1	1	1	0
CO 3	2	2	2	1	2	2	1	1	1	1	1	0
CO 4	2	2	1	1	1	1	1	1	1	1	1	0
CO 5	2	2	1	1	1	1	1	1	1	1	1	0
Total	**12**	**12**	**6**	**5**	**6**	**6**	**3**	**3**	**5**	**5**	**5**	**0**
Scaled	**3**	**3**	**2**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**0**

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

COURSE CODE	**XAC103**	**L**	**T**	**P**	**C**
COURSE NAME	**Applied Chemistry for Engineers – Theory/Practical**	**3**	**1**	**1**	**5**
PREREQUISITES	**Nil**	**L**	**T**	**P**	**H**
C:P:A	**3.5:1.0:0.5**	**3**	**1**	**3**	**7**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	*Understand* the address of the electron and know the trend of periodic properties; *Recall* the water treatment methods.	Cognitive Psychomotor	Remember Perception
CO2	*Understand* the laws of chemical thermodynamics; *Classify the compounds as acids and bases*	Cognitive Psychomotor	Understand Set

CO3	*Determine* the stability and reactions of co-ordination compounds; *Explain and Measure* microscopic chemistry in terms of atomic, molecular orbitals and intermolecular forces	Cognitive Psychomotor Affective	Apply Mechanism Receive
CO4	*Apply, Measure* and *Distinguish* the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques; *Construct* the MO theory to diatomic molecules.	Cognitive Psychomotor Affective	Remember Analyze Perception Respond
CO5	*Knowledge* about aliphatic and aromatic substitution reactions, oxidation and reduction, addition and elimination reactions will kindle the mind for proposing the new reactions and mechanisms.	Cognitive Psychomotor	Remember Apply Mechanism

UNIT – I	**PERIODIC PROPERTIES AND WATER CHEMISTRY**	**8+3+6**
Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries. Water Chemistry-Water quality parameters-Definition and explanation of hardness, determination of hardness by EDTA method-Introduction to alkalinity.		
UNIT–II	**USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA**	**12+3+6**
Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion-Types, factors affecting corrosion rate and Control methods. Use of free energy considerations in metallurgy through Ellingham diagrams. Advantages of electroless plating, electroless plating of nickel and copper on Printed Circuit Board (PCB).		
UNIT–III	**ATOMIC AND MOLECULAR STRUCTURE**	**10+3+6**
Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures. *Intermolecular forces and potential energy surfaces* Ionic, dipolar and Vander waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.		
UNIT-IV	**SPECTROSCOPIC TECHNIQUES AND APPLICATIONS**	**7+3+6**
Principles of spectroscopy and selection rules. Electronic spectroscopy-chromophore, auxochromes, types of electronic transition and application. Fluorescence and its applications in medicine. Vibrational spectroscopy-types of vibrations, Instrumentation and applications. Rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance spectroscopy-concept of chemical shift and applications-magnetic resonance imaging. Diffraction and scattering.		
UNIT–V	**STEREOCHEMISTRY AND ORGANIC REACTIONS**	**8+3+6**
Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds *Organic reactions and synthesis of a drug molecule* Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization reactions and ring opening reactions. Synthesis of a commonly used drug molecule- Aspirin and paracetamol.		

	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
Hours	45	15	30	90

TEXT BOOKS

	Theory Part		

1. Puri B.R. Sharma, L.R., Kalia K.K. Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., 1993
2. Lee. J.D. Concise Inorganic Chemistry, UK, Black well science, 2006.
3. Trapp. C, Cady, M. Giunta. C, Atkins's Physical Chemistry, 10th Edition, Oxford publishers, 2014.
4. Glasstone S., Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co. Ltd, 1983.
5. Morrison R.T. and Boyd R.N. Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., 1976.
6. Banwell. C.N, Fundamentals of Molecular Spectroscopy, (3th Edition), McGraw-Hill Book Company, Europe 1983.
7. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (4th edition), S./ Chand & Company Ltd. New Delhi, 1977.
8. P. S. Kalsi, Stereochemistry: Conformation and mechanism, (9th Edition), New Age International Publishers, 2017.

REFERENCE BOOKS

1. Puri B R Sharma L R and Madan S Pathania, " Principles of Physical Chemistry", Vishal publishing Co., Edition 2004
2. Kuriocose, J C and Rajaram, J, "Engineering Chemistry", Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000

E Resources - MOOCs:

1. http://www.mooc-list.com/course/chemistry-minor-saylororg
2. https://www.canvas.net/courses/exploring-chemistry
3. http://freevideolectures.com/Course/2263/Engineering-Chemistry-I
4. http://freevideolectures.com/Course/3001/Chemistry-I
5. http://freevideolectures.com/Course/3167/Chemistry-II
6. http://ocw.mit.edu/courses/chemistry/

Table 1: Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	2	3	3
CO2	2	0	0	0	0	0	1	2	2
CO3	3	0	0	0	0	0	2	3	3
CO4	8	0	0	0	0	0	3	3	3
CO5	3	0	0	0	0	0	2	2	3

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3
0-No Relation, 1- Low Relation, 2-Medium Relation, 3-High Relation

COURSE CODE:			**XEG104**	**L**	**T**	**P**	**C**
COURSE NAME :			**ENGINEERING GRAPHICS AND DESIGN**	**2**	**0**	**1**	**3**
C	**P**	**A**		**L**	**T**	**P**	**H**
1.75	**1**	**0.25**		**2**	**0**	**6**	**8**

PREREQUISITE: NIL

COURSE OUTCOMES:

	Course outcomes:	**Domain**	**Level**
CO1	*Apply* the national and international standards, *construct* and *practice* various curves	**Cognitive, Psychomotor and Affective**	Applying, Guided response and Responds to Phenomena
CO2	*Interpret*, *construct* and *practice* orthographic projections of points, straight lines and planes.	**Cognitive, Psychomotor**	Understanding, Mechanism and Responds

		and Affective	to Phenomena
C O3	*Construct Sketch* and *Practice* projection of solids in various positions and true shape of sectioned solids.	**Cognitive, Psychomotor and Affective**	Applying, Complex Overt Response and Responds to Phenomena
C O4	*Interpret*, *Sketch* and *Practice* the development of lateral surfaces of simple and truncated solids, intersection of solids.	**Cognitive, Psychomotor and Affective**	Understanding, Complex Overt Response and Responds to Phenomena
C O5	*Construct sketch* and *practice* isometric and perspective views of simple and truncated solids.	**Cognitive, Psychomotor and Affective**	Applying, Complex Overt Response and Responds to Phenomena

UNIT-I	**INTRODUCTION, FREE HAND SKETCHING OF ENGG OBJECTS AND CONSTRUCTION OF PLANE CURVE**	**12+6**
Importance of graphics in engineering applications – use of drafting instruments – BIS specifications and conventions as per SP 46-2003. Pictorial representation of engineering objects – representation of three dimensional objects in two dimensional media – need for multiple views – developing visualization skills through free hand sketching of three dimensional objects. Polygons & curves used in engineering practice – methods of construction – construction of ellipse, parabola and hyperbola by eccentricity method – cycloidal and involute curves – construction – drawing of tangents to the above curves. Practice on basic tools of CAD		
UNIT –II	**PROJECTION OF POINTS, LINES AND PLANE SURFACES**	**12+6**
General principles of orthographic projection – first angle projection – layout of views – projections of points, straight lines located in the first quadrant – determination of true lengths of lines and their inclinations to the planes of projection – traces – projection of polygonal surfaces and circular lamina inclined to both the planes of projection-CAD practice on points and lines		
UNIT-III	**PROJECTION OF SOLIDS AND SECTIONS OF SOLIDS**	**12+6**
Projection of simple solids like prism, pyramid, cylinder and cone when the axis is inclined to one plane of projection – change of position & auxiliary projection methods – sectioning of above solids in simple vertical positions by cutting plane inclined to one reference plane and perpendicular to the other and above solids in inclined position with cutting planes parallel to one reference plane – true shapes of sections-CAD practice on solid models		
UNIT –IV	**DEVELOPMENT OF SURFACES AND INTERSECTION OF SOLIDS**	**12+6**
Need for development of surfaces – development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones – development of lateral surfaces of the above solids with square and circular cutouts perpendicular to their axes – intersection of solids and curves of intersection –prism with cylinder, cylinder & cylinder, cone & cylinder with normal intersection of axes and with no offset-CAD practice on intersection of solids.		
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**12+6**
Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms,		

pyramids, cylinders and cones – principles of perspective projections – projection of prisms, pyramids and cylinders by visual ray and vanishing point methods-CAD practice on isometric view	

THEORY 30	PRACTICAL 60	TOTAL HRS 90

TEXT BOOKS

1. Bhatt,N.D, "Engineering Drawing", Charotar Publishing House, 46th Edition-2003.
2. Natarajan,K.V, " A Textbook of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006 .
3. Dr. P.K. Srividhya, P. Pandiyaraj, "Engineering Graphics", PMU Publications, Vallam, 2013

REFERENCES

1. Luzadder and Duff, "Fundamentals of Engineering Drawing" Prentice Hall of India PvtLtd, XI Edition - 2001.
2. Venugopal,K. and Prabhu Raja, V., "Engineering Graphics", New Age International(P) Ltd., 2008.
3. Gopalakrishnan.K.R,. "Engineering Drawing I & II", Subhas Publications, 1998.
4. Shah,M.B and Rana,B.C.,"Engineering Drawing", Pearson Education,2005.

E RESOURCES

1. http://periyarnet/Econtent
2. http://nptel.ac.in/courses/112103019/

Table 1: Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	3	2	3	1	1	2	3	3	3	-
CO2	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO3	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO4	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO5	3	3	3	1	3	1	3	1	1	1	2	3	3	-
Total	15	15	15	6	15	6	15	5	5	6	11	3	3	-
Scaled	3	3	3	2	3	2	3	1	1	2	3	3	3	-

0 - No relation 1- Low relation 2- Medium relation 3- High relation

1-5 → 1, 6-10 → 2, 11-15 → 3

COURSE CODE	COURSE NAME	L	T	P	C
XGS105	**SPEECH COMMUNICATION**	**0**	**1**	**2**	**3**
Prerequisite	**Basic Understanding Skills**	**L**	**T**	**P**	**H**
C : P : A		**0**	**1**	**4**	**5**
2.6 : 0.4 : 0					

Course Outcomes:		**Domain**	**Level**
CO1	**Ability** to recall the types of speeches.	Cognitive	Remember
CO2	**Apply** the techniques in public speaking.	Cognitive	Apply
CO3	**Identify** the common patterns in organizing a speech.	Cognitive	Remember
CO4	**Construct** the nature and style of speaking.	Cognitive	Create
CO5	**Practicing** the speaking skills.	Psychomotor	Guided Response

UNIT – I: TYPES OF SPEECHES	**9**
1.1 – Four types of speeches 1.2 – Analyzing the audience 1.3 - Developing ideas and supporting materials	
UNIT – II: PUBLIC SPEAKING	**9**
2.1 - Introduction to Public Speaking 2.2 - Competencies Needed for successful speech making 2.3 – Speaking about everyday life situations	
UNIT – III: ORGANIZATION OF SPEECH	**9**
3.1 – Developing a speech out line 3.2 - Organizing the speech 3.3 – Introduction - development – conclusion	
UNIT – IV: PRESENTATION	**9**
4.1 - Tips for preparing the draft speech 4.2 – Presentation techniques using ICT tools 4.3 – Using examples from different sources	
UNIT – V: ACTIVITIES	**9**
5.1 – Reading activities 5.2 – Creative presentations 5.3 – Media presentation techniques	
	TOTAL **45**

SUGGESTED READINGS:

1. Michael Swan. Practical English Usage. OUP. 1995.
2. Sanjay Kumar and Pushp Lata. Communication Skills. Oxford University Press. 2011.

COURSE CODE	XUM 106	L	T	P	C
COURSE NAME	CONSTITUTION OF INDIA	3	0	0	3
PREREQUISITE:	NIL	L	T	P	H
C:P:A	3:0:0	3	0	0	3

COURSE OUTCOMES		Domain	Level
CO1	**To Study** History of Constitution	Cognitive	Understanding
CO2	**To Explain** the Union Executive	Cognitive	Remembering
CO3	**To Identify** the concept of Union Legislature	Cognitive	Applying
CO4	**To Analysis** the Union Judiciary	Cognitive	Analyzing
CO5	**To Explain** the Centre State Relation	Cognitive	Evaluating

UNIT I	**08**
Constitutional History- The Constitutional Rights- Preamble- Fundamental Rights- Fundamental Duties- Directive principles of State Policy.	
UNIT II	**09**
The Union Executive- The President of India (powers and functions)- Vice-President of India- The Council of Ministers-Prime Minister- Powers and Functions.	
UNIT III	**10**
Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of Rajya Sabha- Legislative Procedure in India- Important Committes of Lok Sabha- Speaker of the Lok Sabha.	
UNIT IV	**09**
The Union Judiciary- Powers of the Supreme Court- Original Jurisdiction- Appelete jurisdictions- Advisory Jurisdiction- Judicial review.	
UNIT V	**09**
Centre State relations- Political Parties- Role of governor, powers and functions of Chief Minister- Legislative Assembly- State Judiciary- Powers and Functions of the High Courts.	

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

REFERENCES

1. W.H.Morris Shores- Government and politics of India, NewDelhi,B.1.Publishers,1974.
2. M.V.Pylee- Constitutional Government in India, Bombay, Asia Publishing House, 1977.
3. R.Thanker- The Government and politics of India, London:Macmillon, 1995.
4. A.C.Kapur- Select Constitutions S,Chand & Co.,NewDelhi, 1995
5. V.D.Mahajan- Select Modern Governments,S,Chand &Co, NewDelhi,1995.
6. B.C.Rout- Democractic Constitution of India.
7. Gopal K.Puri- Constitution of India, India 2005.

Table 1: Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	2			1					
CO 2	2			1					
CO 3	2			1					1
CO 4	2			1				1	1
CO 5	2	2		1				1	1
Total	10	2		5				2	3
Scaled to 0,1,2,3	2	1		1				1	1

1-5 →1, 6-10 →2, 11-15 →3

0 – No Relation, 1- Low Relation, 2- Medium Relation, 3- High Relation

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
107	**ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS LABORATORY**	**0**	**0**	**1**	**1**
Prerequisite	**Physics**	**L**	**T**	**P**	**H**
C : P : A		**0**	**0**	**2**	**2**
1.5 : 1 : 0.5					

COURSE OBJECTIVES:

The course helps to

a. Learn the basic concepts of electrical and electronics components.
b. Understand the basic wiring methods and connection.
c. Study the characteristics of diodes, Zener diodes, NPN transistors.
d. Verify the working of simple logic gates, adders and subtractors.

Course Outcomes:		**Domain**	**Level**
CO1	**Apply** the fundamental electrical concepts and **differentiate** the various electronic components.	Cognitive Psychomotor Affective	Understand Set Valuing
CO2	**Implement** and **execute** the different types of wiring connections.	Cognitive Psychomotor Affective	Understand Set Valuing
CO3	**Demonstrate** the Fluorescent lamp connection with choke.	Cognitive Psychomotor Affective	Understand Set Valuing
CO4	**Characterize** and **display** the basic knowledge on the working of PN junction and Zener diode.	Cognitive Psychomotor Affective	Understand Set Valuing
CO5	**Implement** and **execute** the various digital electronic circuits such as Adders and Subtractors.	Cognitive Psychomotor Affective	Understand Set Valuing

List of Experiments:

1. Study of Electrical Symbols, Tools and Safety Precautions, Power Supplies.
2. Study of Active and Passive elements – Resistors, Inductors and Capacitors, Bread Board.
3. Testing of DC Voltage and Current in series and parallel resistors which are connected in breadboard by using Voltmeter, Ammeter and Multimeter.
4. Fluorescent lamp connection with choke.
5. Staircase Wiring
6. Forward and Reverse bias characteristics of PN junction diode.
7. Forward and Reverse bias characteristics of zener diode.
8. Input and Output Characteristics of NPN transistor.
9. Construction and verification of simple logic gates.
10. Construction and verification of adders and subtractors.

	PRACTICAL	TOTAL
	30	30

Mapping of COs with GAs

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
CO 1	3	3	1	1	1	1	0	0	1	1	1	0
CO 2	3	3	1	1	1	1	0	0	1	1	1	0
CO 3	2	2	2	1	2	2	1	1	1	1	1	0
CO 4	2	2	1	1	1	1	1	1	1	1	1	0
CO 5	2	2	1	1	1	1	1	1	1	1	1	0
Total	**12**	**12**	**6**	**5**	**6**	**6**	**3**	**3**	**5**	**5**	**5**	**0**
Scaled Value	**3**	**3**	**2**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**0**

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

COURSECODE	COURSE NAME	L	T	P	
XAC108	Applied Chemistry for Engineers – Practical	0	0	1	
Prerequisite		L	T	P	
C : P : A		0	0	2	
1.5 : 1 : 0.5					

Experiments :

1. Determination of chloride ion present in the water sample by Argentometric method.	CO1
2. Determination of total, temporary and permanent hardness of water sample by EDTA method.	CO1
3. Determination of cell constant and conductance of solutions.	
4. Potentiometry - determination of redox potentials and emfs.	CO2
5. Determination of surface tension and viscosity.	CO2
6. Adsorption of acetic acid by charcoal.	CO3
7. Determination of the rate constant of a reaction.	CO3
8. Estimation of iron by colorimetric method.	CO4
9. Synthesis of a polymer/drug.	CO4
10. Saponification/acid value of an oil.	CO5
	CO5

REFERENCE BOOKS

1. Mendham, Denney R.C,. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004.

2. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003.

E Resources - MOOCs:

1.http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques
2. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011
3.http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques

	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
HOURS	45	15	45	105

COURSE CODE	COURSE NAME	L	T	P	C
XMA201	Calculus, Ordinary Differential Equations and Complex Variable	3	1	0	4

C	P	A		L	T	P	H
3	0.5	0.5		3	1	0	4

PREREQUISITE:Mathematics I (Calculus and Linear Algebra)

COURSE OUTCOMES:

Course outcomes:	Domain	Level

CO1: Find double and triple integrals and to find line, surface and volume of an integral by **Applying** Greens, Gauss divergence and Stokes theorem.	Cognitive	Applying Remembering
CO2: Solve first order differential equations of different types which are solvable for p, y, x and Clairaut's type.	Cognitive	Applying
CO3:Solve Second order ordinary differential equations with variable coefficients using various methods.	Cognitive	Applying
CO4:Use CR equations to verify analytic functions and to find harmonic functions and harmonic conjugate. Conformal mapping of translation and rotation. Mobius transformation.	Cognitive Psychomotor	Remembering Applying Guided Response
CO5:Apply Cauchy residue theorem to evaluate contour integrals involving sine and cosine function and to state Cauchy integral formula, Liouvilles theorem. Taylor's series, zeros of analytic functions, singularities, Laurent's series.	Cognitive Affective	Applying Receiving

Unit 1: Multivariable Calculus (Integration)	**12**
Multiple Integration: Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Triple integrals (Cartesian), Scalar line integrals - vector line integrals - scalar surface integrals - vector surface integrals - Theorems of Green, Gauss and Stokes.	
Unit 2: First order ordinary differential equations	**12**
Exact - linear and Bernoulli's equations - Euler's equations - Equations not of first degree: equations solvable for p - equations solvable for y- equations solvable for x and Clairaut's type.	
Unit 3: Ordinary differential equations of higher orders	**12**
Second order linear differential equations with variable coefficients- method of variation of parameters - Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties.	
Unit 4: Complex Variable – Differentiation	**12**
Differentiation-Cauchy-Riemann equations- analytic functions-harmonic functions-finding harmonic conjugate- elementary analytic functions (exponential, trigonometric, logarithm) and their properties- Conformal mappings- Mobius transformations and their properties.	
Unit 5: Complex Variable – Integration	**12**
Contour integrals - Cauchy-Goursat theorem (without proof) - Cauchy Integral formula (without proof)-Liouville's theorem (without proof)- Taylor's series- zeros of analytic functions- singularities- Laurent's series – Residues- Cauchy Residue theorem (without proof)- Evaluation of definite integral involving sine and cosine- Evaluation of certain improper integrals using the Bromwich contour.	

LECTURE	**TUTORIAL**	**TOTAL**
45	**15**	**60**

Text Book:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40thth Edition, 2008.

Reference Books:
1.G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3.W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdn. Wiley India, 2009.
4. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India, 1984.
5.E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
6. E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
7.J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., McGraw Hill, 2004.
8. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

COs Versus GA mapping

Table 1: Mapping of COs with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3
0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Course Code	**:**	**XCP 202**		**L**	**T**	**P**	**C**
Course Name	**:**	**PROGRAMMING FOR PROBLEM SOLVING**		**3**	**0**	**0**	**3**
Prerequisite	**:**	**Basic Understanding Skills**		**L**	**T**	**P**	**H**
C	**P**	**A**		**3**	**0**	**0**	**3**
3	**0**	**0**					

Course Objectives

- To learn programming language basics and syntax
- To ignite logical thinking
- To understand structured programming approach
- To deal with user defined data types

- To know about data storage in secondary memory

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	***Define*** programming fundamentals and	Cognitive	RememberUnderstand Apply
CO2	***Define*** syntax and ***write simple programs*** using controlstructures and arrays	Cognitive	RememberUnderstand Apply
CO3	***Explain*** and ***write simple programs*** using functions andpointers	Cognitive	RememberUnderstand Apply
CO4	***Explain*** and ***write simple programs*** using structures andunions	Cognitive	RememberUnderstand Apply
CO5	***Explain*** and ***write simple programs*** using files and ***Build*** simple projects	Cognitive	Remember UnderstandApply

COURSE CONTENT

UNIT- I	**PROGRAMMING FUNDAMENTALS AND I/O STATEMENTS**	**9**

Introduction to components of a computer system, Program – Flowchart – Pseudo code – Software – Introduction to C language – Character set – Tokens: Identifiers, Keywords, Constants, and Operators – sample program structure -Header files – Data Types- Variables - Output statements –Input statements.

UNIT – II	**CONTROL STRUCTURE AND ARRAYS**	**9**

Control Structures – Conditional Control statements: Branching, Looping - Unconditional control structures: switch, break, continue, goto statements – Arrays: One Dimensional Array – Declaration – Initialization – Accessing Array Elements – Searching – Sorting – Two Dimensional arrays - Declaration – Initialization – Matrix Operations – Multi Dimensional Arrays - Declaration – Initialization. Storage classes: auto – extern – static. Strings: Basic operations on strings.

UNIT – III	**FUNCTIONS AND POINTERS**	**9**

Functions: Built in functions – User Defined Functions - Parameter passing methods - Passingarrays to functions – Recursion - Programs using arrays and functions. Pointers - Pointer declaration - Address operator - Pointer expressions & pointer arithmetic - Pointers and function - Call by value - Call by Reference - Pointer to arrays - Use of Pointers in self-referential structures-Notion of linkedlist

UNIT – IV	**STRUCTURES AND UNIONS**	**9**

Structures and Unions - Giving values to members - Initializing structure - Functions and structures - Passing structure to elements to functions - Passing entire function to functions - Arrays of structure - Structure within a structure and Union.

UNIT - V	**FILES**	**9**

File management in C - File operation functions in C - Defining and opening a file - Closing a file - The getw and putw functions - The fprintf & fscanf functions - fseek function – Files and Structures.

		L	T	P	Total
		45	0	0	45

TEXT BOOKS

1. Byron Gottfried, "Programming with C", III Edition, (Indian Adapted Edition), TMHpublications, 2010
2. Yeshwant Kanethker, “Let us C”, BPB Publications, 2008

REFERENCE BOOKS

1. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill, 7th edition 2017.
2. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education Inc. 2005
3. Johnson baugh R. and Kalin M., “Applications Programming in ANSI C”, III Edition, Pearson Education India, 2003

E-REFERENCES

1. https://www.indiabix.com/c-programming/questions-and-answers/
2. https://www.javatpoint.com/c-programming-language-tutorial
3. https://www.w3schools.in/c-tutorial/

Mapping of CO with PO’s

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	0	0	3	0	0	0	0	0	2	3	2	0
CO 2	3	2	0	0	2	0	0	0	0	0	2	3	2	0
CO 3	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO 4	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO 5	2	2	1	0	2	0	0	1	0	2	2	2	2	0
Total	12	10	3	4	11	0	0	1	0	2	10	12	10	0
Scaled Value	3	2	1	1	3	0	0	1	0	1	2	3	2	0

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

COURSE CODE	XAP203	L	T	P	C
COURSE NAME	APPLIED PHYSICS FOR ENGINEERS	3	1	0	4
C:P:A	2.8:0.8:0.4	L	T	P	H
PREREQUISITE:	Basic Physics in HSC level	3	1	0	4

COURSE OUTCOMES		Domain	Level
CO1	***Identify*** the basics of mechanics, ***explain*** the principles of elasticity and ***determine*** its significance in engineering systems and technological advances.	Cognitive: Psychomotor:	Remember, Understand Mechanism
CO2	***Illustrate*** the laws of electrostatics, magneto-statics and electromagnetic induction; ***use*** and ***locate*** basic applications of electromagnetic induction to technology.	Cognitive: Psychomotor: Affective:	Remember, Analyze, Mechanism Respond

CO3	***Understand*** the fundamental phenomena in optics by measurement and ***describe*** the working principle and application of various lasers and fibre optics.	Cognitive: Psychomotor: Affective:	Understand, Apply Mechanism Receive
CO4	***Analyse*** energy bands in solids, ***discuss*** and ***use*** physics principles of latest technology using semiconductor devices.	Cognitive: Psychomotor: Affective:	Understand, Analyze Mechanism Receive
CO5	***Develop*** Knowledge on particle duality and ***solve*** Schrodinger equation for simple potential.	Cognitive:	Understand, Apply

UNIT - I MECHANICS OF SOLIDS	**9+3+9**

Mechanics: Force - Newton's laws of motion - work and energy - impulse and momentum - torque - law of conservation of energy and momentum - Friction.
Elasticity: Stress - Strain - Hooke's law - Stress strain diagram - Classification of elastic modulus - Moment, couple and torque - Torsion pendulum - Applications of torsion pendulum - Bending of beams - Experimental determination of Young's modulus: Uniform bending and non-uniform bending.

UNIT -II ELECTROMAGNETIC THEORY	**9+3+3**

Laws of electrostatics - Electrostatic field and potential of a dipole; Dielectric Polarisation, Dielectric constant, internal field - Clausius Mossotti Equation - Laws of magnetism - Ampere's Faraday's law; Lenz's law - Maxwell's equation - Plane electromagnetic waves; their transverse nature - expression for plane, circularly and elliptically polarized light - quarter and half wave plates - production and detection of plane, circularly and elliptically polarized light.

UNIT –III OPTICS, LASERS AND FIBRE OPTICS	**9+3+12**

Optics: Dispersion- Optical instrument: Spectrometer - Determination of refractive index and dispersive power of a prism- Interference of light in thin films: air wedge - Diffraction: grating.
LASER: Introduction - Population inversion -Pumping - Laser action - Nd-YAG laser - CO_2 laser - Applications
Fibre Optics: Principle and propagation of light in optical fibre - Numerical aperture and acceptance angle - Types of optical fibre - Fibre optic communication system (Block diagram).

UNIT –IV SEMICONDUCTOR PHYSICS	**9+3+6**

Semiconductors: Energy bands in solids - Energy band diagram of good conductors, insulators and semiconductors - Concept of Fermi level - Intrinsic semiconductors - Concept of holes - doping - Extrinsic semiconductors - P type and N type semiconductors - Hall effect.
Diodes and Transistors: P-N junction diode - Forward bias and reverse bias - Rectification action of diode - Working of full wave rectifier using P N junction diodes - PNP and NPN transistors - Three different configurations - Advantages of common emitter configuration - working of NPN transistor as an amplifier in common emitter configuration.

UNIT –V QUANTUM PHYSICS	**9+3+0**

Introduction to quantum physics, black body radiation, Compton effect, de Broglie hypothesis, wave – particle duality, uncertainty principle, Schrodinger wave equation (Time dependent and Time independent), particle in a box, Extension to three dimension - Degeneracy.

TEXT BOOKS

1. Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publications, 2009.
2. Avadhanulu M. N. "Engineering Physics" (Volume I and II), S. Chand & Company Ltd., New Delhi, 2010.

REFERENCE BOOKS

1. Palanisamy P. K., "Engineering Physics", Scitech Publications (India) Pvt. Ltd, Chennai.

2. Arumugam M., "Engineering Physics" (Volume I and II), Anuradha Publishers, 2010.
3. Senthil Kumar G., " Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2011.
4. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2007.

E RESOURCES

NPTEL , Engineering Physics, Prof. M. K. Srivastava, Department of Physics, IIT, Roorkee.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
Hours	**45**	**15**	**-**	**60**

Table 1: Mapping of CO's with PO:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS1	PS2
CO1	3	2	2	2	1	-	-	-	1	-	-	1		
CO2	3		1		1	-	-	-		-	-	1		
CO3	3	2	2	2	1	-	-	-	1	-	-	1		
CO4	3	2	2	2	1	-	-	-	1	-	-	1		
CO5	3		2			-	-	-		-	-	1		
Total	**15**	**6**	**9**	**6**	**4**				**3**			**5**		
aled to 0,1,2, 3 scale	**3**	**2**	**2**	**2**	**1**				**1**			**1**		

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3
0-No Relation, 1- Low Relation, 2-Medium Relation, 3-High Relation

COURSE CODE	COURSE NAME	L	T	P	C
	TECHNICAL COMMUNICATION	**2**	**0**	**0**	**2**
Prerequisite	**Basic English in HSC level**	**L**	**T**	**P**	**H**
C : P : A		**2**	**0**	**0**	**2**
3 : 0 : 0					

Course Outcomes:		**Domain**	**Level**
CO1	**Ability** to understand the basic principles.	Cognitive	Remember
CO2	**Apply** the techniques in writing.	Cognitive	Apply
CO3	**Identify** communicative styles.	Cognitive	Remember
CO4	**Construct** the nature of writing.	Cognitive	Create

UNIT – I: BASIC PRINCIPLES	**9**
1.1 – Basic Principles of Technical Writing 1.2 – Styles used in Technical Writing 1.3 – Language and Tone	
UNIT – II: TECHNIQUES	**9**

2.1 – Special Techniques used in writing 2.2 – Definition & Description of mechanism 2.3 – Description- Classification-Interpretation	
UNIT – III: COMMUNICATION	**6**
3.1 – Modern development in style of writing 3.2 - New letter writing formats	
UNIT – IV: REPORT WRITING	**6**
4.1 – Types of Report writing 4.2 – Project writing formats	

	LECTURE	**TOTAL**
	30	**30**

SUGGESTED READINGS:

1. John Sealy, Writing and Speaking Author; Oxford University Press, New Delhi, 2009.
2. Williams K.S, Communicating Business. Engage Learning India Pvt Ltd, 2012.

SUB CODE	**SUB NAME**	**L**	**T**	**P**	**C**
XWP205	**Workshop Practices**	**1**	**0**	**2**	**3**

C	**P**	**A**		**L**	**T**	**P**	**H**
1	**3**	**0**		**1**	**0**	**4**	**5**

PREREQUISITE:

	Course outcomes:	**Domain**	**Level**
CO1:	*Summarize* the machining methods and *Practice* machining operation.	Cognitive Psychomotor	Understanding Guided response
CO2:	*Defining*metal casting process, moulding methodsand relatesCasting and Smithy applications.	Cognitive Psychomotor	Remembering Perception
CO3:	*Plan* basic carpentry and fitting operation and *Practice* carpentry and fitting operations.	Cognitive Psychomotor	Applying Guided response
CO4:	*Summarize* metal joining operation and *Practice* welding operation.	Cognitive Psychomotor	Understanding Guided response
CO	*Illustrate*the, electrical and electronics basics and *Makes* appropriate connections.	Cognitive Psychomotor	Understanding Origination

5 :			

COURSE CONTENT		
EXP. NO	**TITLE**	**CO RELATION**
1	Introduction to machining process	CO1
2	Plain turining using lathe operation	CO1
3	Introduction to CNC	CO1
4	Demonstration of plain turning using CNC	CO1
5	Study of metal casting operation	CO2
6	Demonstration of moulding process	CO2
7	Study of smithy operation	CO2
8	Study of carpentry tools	CO3
9	Half lap joint – Carpentry	CO3
10	Mortise and Tenon joint – Carpentry	CO3
11	Study of fitting tools	CO3
12	Square fitting	CO3
13	Triangular fitting	CO3
14	Study of welding tools	CO4
15	Square butt joint – welding	CO4
16	Tee joint – Welding	CO4
17	Introduction to house wiring	CO5
18	One lamp controlled by one switch	CO5
19	Two lamps controlled by single switch	CO5
20	Staircase wiring	CO5

TEXT BOOKS

1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay
2. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.

REFERENCES

1. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd.
2. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
3. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.
4. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

E RESOURCES

1. http://nptel.ac.in/courses/112107145/

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2	1			1	1		1	2

CO2	2	1	2	2	1			1	1		1	2
CO3	2	1	2	2	1			1	1		1	2
CO4	2	1	2	2	1			1	1		1	2
CO5	2	1	2	2	1			1	1		1	2
Total												
Scaled												

0- No relation 1- Low relation 2- Medium relation 3- High relation

Semester	**II**	
Subject Name	**ENGINEERING MECHANICS**	
Subject Code	**XEM 206**	
L –T –P –C **3 - 1 – 0- 4**	**C: P: A** **2.6: 02: 0.2**	**L –T -P- H** **3- 2 - 0 -5**

Course Outcome:		**Domain**
CO1	Identify and choose various types of loading and support conditions that act on structural and dynamic systems.	C(Understand)
CO2	Apply pertinent mathematical, physical and engineering mechanics principles to the system to predict the problem.	C(Application)
CO3	Display and Apply knowledge on the concepts of centroid and moment of inertia of various sections and solids.	C (Application) A (Develop)
CO4	Analyze and Model the problem using free-body diagrams and accurate equilibrium equations and finding the solution.	C(Analyse) P (Model)
CO5	Develop concepts of friction, rigid body kinematics and dynamics with an emphasis on the modeling and analysis and solving simple dynamic problems involving kinematics and momentum.	C(Create)

COURSE CONTENT

UNIT-I	**BASICS AND STATICS OF PARTICLES** **15 hrs**
	Introduction - Units and Dimensions - Laws of Mechanics –Coplanar and Non coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Equivalent systems of forces - Principle of transmissibility – single equivalent force.
UNIT –II	**EQUILIBRIUM OF RIGID BODIES** **15 hrs**
	Free body diagram - Types of supports and their reactions - requirements of stable equilibrium – Equilibrium of Rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions.
UNIT-III	**PROPERTIES OF SURFACES AND SOLIDS** **15 hrs**
	Determination of Areas and Volumes - First moment of area and the centroid - second and product moments of plane area - Parallel axis theorem and Perpendicular axis theorem - Polar moment of inertia – Mass moment of inertia - relation to area moment of inertia.
UNIT – IV	**DYNAMICS OF PARTICLES** **15 hrs**

	Displacement, Velocity and Acceleration - their relationships - Relative motion - Curvilinear motion - Newton's Law - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.
UNIT V	**ELEMENTS OF RIGID BODY DYNAMICS AND FRICTION 15 hrs**
	Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion - Moment of Momentum Equations - Rotation of rigid Body - Work energy equation. Frictional Force - Laws of Coulomb friction - Simple Contact friction - Rolling Resistance - Belt Friction.
	L=45 hrs T = 30 hrs Total = 75 hrs

Text books

1. D.S.Kumar "A text book of Engineering Mechanics" Publishers S.K.Kataria and Sons , 2012
2. R.S.Khurmi "A Textbook of Engineering Mechanics" , S. Chand Publishers, 2011
3. Engineering Mechanics: Statics (14th Edition) by Russell C. Hibbeler , Best Sellers, 2015
4. Engineering Mechanics: Dynamics (14th Edition) by Russell C. Hibbeler , Best Sellers, 2015
5. Velusami.M.A. "Engineering Mechanics with Vector Approach": S.Chand Publishers, 2012
6. J. L. Meriam, L. G. Kraige "Engineering Mechanics: Dynamics",Sixth Edition 2012

References

1. Beer F.P and Johnson E.R., "Vector Mechanics for Engineers – Statics and Dynamics", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2001.
2. K.V.Natarajan, "Engineering Mechanics", Dhanalakshmi Publishers, Chennai, 2006.
3. Chandramouli, Engineering Mechanics, PHI Learning Pvt Ltd, 2011
4. Jayakumar and Kumar , Engineering Mechanics, PHI Learning Pvt Ltd, 2013

Mapping of COs with GAs:

	GA1	GA2	GA3	GA 4	GA5	GA6	GA7	GA 8	GA9	GA10	GA11	GA12
CO1	2	3	1	3								
CO2		3		2								
CO3									2			
CO4	3	3										1
CO5	3	3										
	8	12	1	5					2			1

1 - Low , 2 – Medium , 3 – High

COURSE CODE	XCS207	L	T	P	C

COURSE NAME	PROGRAMMING FOR PROBLEMSOLVING LAB	0	0	1	1
PREREQUISITES	Basic Understanding Skills	L	T	P	H
P	A	0	0	2	2
0	0.25				

LEARNING OBJECTIVES

- To learn programming language basics and syntax
- To ignite logical thinking
- To understand structured programming approach
- To deal with user defined data types
- To know about data storage in secondary memory

COURSE OUTCOMES	DOMAIN	LEVEL
Solve simple programs using I/O statements	Cognitive Psycomotor	Apply Responding
Solve programs using control structures and arrays	Cognitive Psycomotor	Apply Responding
Solve programs using functions and pointers	Cognitive Psycomotor	Apply Responding
Solve programs using structures	Cognitive Psycomotor	Apply Responding
Solve programs using files	Cognitive Psycomotor	Apply Responding

S. No.	List of Experiments	COs
1	Program to display a Leave Letter as per proper format	CO1
2	i. Program for addition of two numbers ii. Program to solve any mathematical formula.	CO1
3	Program to find greatest of 3 numbers using Branching Statements	CO2
4	Program to display divisible numbers between n1 and n2 using looping Statement	CO2
5	Program to search an array element in an array.	CO2
6	Program to find largest / smallest element in an array.	CO2
7	Program to perform string operations.	CO3

8	Program to find area of a rectangle of a given number use four function types.	CO3
9	Programs to pass and receive array and pointers using four function Types	CO3
10	Programs using Recursion for finding factorial of a number	CO3
11	Program to read and display student mark sheet of a student structures with variables	CO4
12	Program to read and display student marks of a class using structures with arrays	CO4
13	Program to create linked list using structures with pointers	CO4
14	Program for copying contents of one file to another file.	CO5
15	Program using files to store and display student mark list of a class using structures with array	CO5

HOURS	TUTORIAL	PRACTICAL	TOTAL
	0	30	30

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	0	0	3	0	0	0	0	0	2	3	2	0
CO 2	3	2	0	0	2	0	0	0	0	0	2	3	2	0
CO 3	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO 4	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO 5	2	2	1	0	2	0	0	1	0	2	2	2	2	0
Total	12	10	3	4	11	0	0	1	0	2	10	12	10	0
Scaled Value	3	2	1	1	3	0	0	1	0	1	2	3	2	0

0- No relation **1- Low relation** **2- Medium relation** **3- High relation**

COURSE CODE	XAP208	L	T	P	C
COURSE NAME	APPLIED PHYSICS FOR ENGINEERS LAB	0	0	1	1
C:P:A	0:2:0	L	T	P	H
PREREQUISITE:	Basic Physics in HSC level	0	0	2	2

COURSE OUTCOMES		Domain	Level
CO1	*Determine* the significance of elasticity in engineering systems and technological advances.	Psychomotor:	Mechanism
CO2	*use* and *locate* basic applications of electromagnetic induction to technology.	Psychomotor: Affective:	Mechanism Respond
CO3	*Describe* the working principle and application of various lasers and fibre optics.	Psychomotor:	Mechanism

CO4	*use* physics principles of latest technology using semiconductor devices.	Psychomotor:	Mechanism

LABORATORY	
1.	Torsional Pendulum - determination of moment of inertia and rigidity modulus of the given material of the wire.
2.	Uniform Bending - Determination of the Young's Modulus of the material of the beam.
3.	Non-Uniform Bending - Determination of the Young's Modulus of the material of the beam.
4.	Meter Bridge - Determination of specific resistance of the material of the wire.
5.	Spectrometer - Determination of dispersive power of the give prism.
6.	Spectrometer - Determination of wavelength of various colours in Hg source using grating.
7.	Air wedge - Determination of thickness of a given thin wire.
8.	Laser - Determination of wavelength of given laser source and size of the given micro particle using Laser grating.
9.	Post office Box - Determination of band gap of a given semiconductor.
10.	PN Junction Diode - Determination of V-I characteristics of the given diode.

REFERENCE BOOKS

1. Samir Kumar Ghosh, "A text book of Advanced Practical Physics", New Central Agency (P) Ltd, 2008.
2. Arora C.L., "Practical Physics", S. Chand & Company Ltd., New Delhi, 2013.
3. Umayal Sundari AR., "Applied Physics Laboratory Manual", PMU Press, Thanjavur, 2012.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
Hours	**0**	**0**	**30**	**15**

Table 1: Mapping of CO's with PO:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS1	PS2
CO1	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**		
CO2	**3**		**1**		**1**	**-**	**-**	**-**		**-**	**-**	**1**		
CO3	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**		
CO4	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**		
Total	**12**	**6**	**7**	**6**	**4**				**3**			**5**		
Scaled to 0,1,2,3 scale	**3**	**2**	**2**	**2**	**1**				**1**			**1**		

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

SEMESTER III

ELECTRICAL CIRCUIT ANALYSIS

COURSE CODE	COURSE NAME	L	T	P	C

XEE 301	**ELECTRICAL CIRCUIT ANALYSIS**	**3**	**1**	**1**	**5**
C:P: A		**L**	**T**	**P**	**CH**
3:1:0		**3**	**1**	**2**	**6**

UNIT- I: NETWORK THEOREMS **09+03**

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

List of Experiments 1.Verification of KVL and KCL 2.Verification of Thevenin theorem3.Verification of Norton theorem 4.Verification of Maximum power transfer theorem

UNIT- II: SOLUTION OF FIRST AND SECOND ORDER NETWORKS **08+03**

Solution of first and second order differential equations for Series and parallel R-L, R-C, RL-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

List of Experiments

5. Transient analysis of Series RL, RC circuits

6.Sinusoidal analysis of Series RL, RC circuits.

UNIT- III: SINUSOIDAL STEADY STATE ANALYSIS **08+03**

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, ACcircuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

List of Experiments

7.Measurement of active power for star and delta connected balanced loads

8.Verification of self, mutual inductance and coefficient of coupling

UNIT- IV: ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS **08+03**

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

List of Experiments

9.RLC Series and parallel Resonance

UNIT- V: NETWORK FUNCTIONS AND TWO PORT NETWORKS **12+03**

Concepts of complex frequency, Transform impedance, Networks function of one port and two port networks, concepts of poles and zeros, property of driving point and transfer function. Two Port Networks, terminal pairs, Relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	**15**	**30**	**90**

TEXTBOOKS

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.

REFERENCES

1. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
2. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.

E REFERENCES

1. NPTEL: http://nptel.ac.in/courses/108102042/
2. MOODLE: http://moodle.cecs.pdx.edu/course/view.php?id=16

REFERENCES

1. Department Lab Manual
2. Sudhakar.A and Shyam Mohan.S.P, “Circuits and Networks Analysis and Synthesis”, Fourth edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3									1		1	1	1
CO 2	3									1		1	2	1
CO 3	3	2								1	1	2	3	1
CO 4	3	2			1					1	1	1	3	3
CO 5	3	2			1					1	1	1	2	2
Total	15	6	0	0	2	0	0	0	0	5	3	6	11	8
Scaled	3	2	0	0	1	0	0	0	0	1	1	2	3	2

0 –No Relation 1 – Low Relation 2 – Medium Relation3 – High Relation

ANALOG ELECTRONICS

Course Outcomes (XEE 302):		Domain	Level
CO1	Understand the characteristics of diode and analyze the rectifier circuits.	Cognitive Psychomotor	Understand Analyze Guided Response
CO2	Understand the characteristics of transistor.	Cognitive Psychomotor	Understand Mechanism
CO3	Understand the concept of MOSFET and analyze the circuits and its characteristics	Cognitive Psychomotor	Understand Analyze Mechanism
CO4	Classify and explain different types of amplifier	Cognitive Psychomotor	Understand Mechanism

CO5	Recall and explain linear and non-linear application of OP-AMP	Cognitive Psychomotor	Understand Mechanism

COURSE CODE	COURSE NAME	L	T	P	C
XEE 302	ANALOG ELECTRONICS	3	0	1	4
C:P: A = 3:1:0		L	T	P	H
		3	0	2	5

UNIT- I: DIODE CIRCUITS **9+9**

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, Special diodes, clamping and clipping circuits.

List of Experiments

1. Design of full wave rectifier with and without filter.
2. Design of bridge rectifier circuits using with and without filter.
3. Conduct an experiment to test clipping and clamping circuits.

UNIT- II: BJT CIRCUITS **8+3**

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.

List of Experiments

4. Design of BJT common emitter amplifier using voltage divider bias with and without feedback.

UNIT- III: MOSFET CIRCUITS **8+3**

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

UNIT- IV: DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS **8+3**

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an opera amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset cu slew rate, gain bandwidth product)

List of Experiments

6. Conduct experiment on differential amplifier

UNIT -V: LINEAR AND NONLINEAR APPLICATIONS OF OP-AMP **9+15**

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumen amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, v regulator, oscillators (Wien bridge and phase shift). Analog to Digital Conversion. Hysteretic Comparator, Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector, Monoshot.

List of Experiments

7.Design of Phase shift and Wien bridge oscillators using OP-AMP.

8.Conduct experiment on Inverting, Non inverting amplifier using OP-AMP.

9.Conduct experiment on astable and monostable multivibrator using OP-AMP.10.Conduct experiment on integrator and differentiator circuit using OP-AMP. 11.Conduct experiment on Schmitt trigger circuit using OP-AMP.

	LECTURE	PRACTICAL	TOTAL
	45	30	75

TEXTBOOKS

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford UniversityPress, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.

REFERENCES

1. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
. P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”,John Wiley & Sons, 2001.
3. Department Lab Manual.

E REFERENCES

1. www.nptel.ac.in.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3									1		1	2	2
CO 2	3									1		1	2	2
CO 3	3	2								1	1	2	2	2
CO 4	2	2			1					1	1	1	2	2
CO 5	3	1			2					1	1	1	2	2
Total	14	5	0	0	3	0	0	0	0	5	3	6	10	10
Scaled	3	1	0	0	1	0	0	0	0	1	1	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ELECTRICAL MACHINES-I

Course Outcomes (XEE 303):		Domain	Level
CO 1	Understand the operation of DC machines.	Cognitive Psychomotor	Understand Perception
CO 2	Understand the winding concepts of DC machine.	Cognitive Psychomotor	Understand Complex Overt Response

CO 3	**Understand the motoring and generating concepts of DC machine.**	**Cognitive Psychomotor**	**Understand Set**
CO 4	**Analyse single phase and three phase transformers circuits.**	**Cognitive Psychomotor**	**Analyse Set**
CO 5	**Understand the various loss in magnetic circuits**	**Cognitive Psychomotor**	**Understand Set**

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 303	**ELECTRICAL MACHINES - I**	**3**	**1**	**1**	**5**
C:P: A = 3:1:0		**L**	**T**	**P**	**H**
		3	**1**	**2**	**6**

UNIT -I: INTRODUCTION TO DC MACHINES **9+3+6**

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, airgap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil.

List of Experiments

1. Study of D.C. Motor Starters.

UNIT- II: DC MACHINES – ARMATURE AND WINDING **9+3+6**

Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

2. Open Circuit Characteristics (OCC) and load Characteristics of D.C self-excited generator.

3.Load characteristics of D.C shunt

UNIT- III: DC MACHINE - MOTORING AND GENERATION **8+3+6**

Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

List of Experiments

4.Load characteristics of D.C. shunt motor.

5.Load characteristics of D.C series motor.

6.Speed control of D.C shunt motor

UNIT -IV: TRANSFORMERS AND TEST **10+3+6**

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, volta regulation, transformer - construction, types of connection and their comparative features, Parallel operation single-phase and three-phase transformers, Phase conversion - Scott connection, three-phase to six-pha conversion, Tap-changing transformers losses and efficiency Testing - open circuit and shortcircuit tests, polar test, back-to-back test- separation of hysteresis and eddy current losses

List of Experiments

7. Load test on single-phase transformer.
8. Open circuit and short circuit tests on single phase transformer.

UNIT -V: AUTOTRANSFORMERS	**9+3+6**

Autotransformers - construction, principle, applications and comparison with two winding transform Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetizationcurren

	LECTURE	**TUTORIAL**	**PRACTICAL**	**TOTAL**
	45	**15**	**30**	**90**

TEXTBOOKS

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

REFERENCES

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**
CO 1	**3**	**2**	**2**	**2**	**1**				**1**			**1**	**1**	**0**
CO 2	**3**	**-**	**2**	**1**				**1**				**1**		**1**
CO 3	**3**			**1**				**1**			**1**			**1**
CO 4	**3**	**2**	**2**	**2**	**1**		**1**			**1**		**1**		**1**
CO 5	**3**			**1**						**1**				**1**
Total	**15**	**4**	**6**	**7**	**2**	**0**	**1**	**2**	**1**	**2**	**1**	**3**	**1**	**4**
Scaled	**3**	**1**	**2**	**2**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ELECTROMAGNETIC FIELDS

Course Outcomes (XEE 304):		**Domain**	**Level**
CO1	To understand the basics of vector and outline differentcoordinate system.	Cognitive	Remembering Understanding
CO2	To understand the concept of static electric field for simple configuration using gauss and Coulombs law.	Cognitive	Understanding
CO3	Define the knowledge of electrostatics using, boundary conditions, Poissons and Laplace equation.	Cognitive	Understanding

CO4	Recall the magnetic field configuration using Different laws and outline time varying electric and magnetic fields using Maxwell's equation.	Cognitive	Remembering Understanding
CO5	Recall the concept of magnetization and magnetic field configuration using boundary condition.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 304	**ELECTROMAGNETIC FIELDS**	**3**	**1**	**0**	**4**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**1**	**0**	**4**

UNIT- I: REVIEW OF VECTOR CALCULUS **9+3**

Vector algebra-addition, subject traction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

UNIT- II: STATIC ELECTRIC FIELD **9+3**

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

UNIT -III: CONDUCTORS, DIELECTRICS AND CAPACITANCE **9+3**

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two-wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

UNIT -IV: STATIC MAGNETIC FIELDS, TIME VARYING FIELDS AND MAXWELL'S EQUATIONS **9+3**

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Condit ions. Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic circuits, inductances and mutual inductances.

UNIT -V: ELECTROMAGNETIC WAVES **9+3**

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equationin Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

TEXTBOOKS

1. M. N. O. Sadiku, “Elements of Electromagnetics”, Oxford University Publication, 2014.
. A. Pramanik, “Electromagnetism - Theory and applications”, PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, “Electromagnetism-Problems with solution”, Prentice Hall India, 2012.
4. G. W. Carter, “The electromagnetic field in its engineering aspects”, Longmans, 1954.

REFERENCES

1. W. J. Duffin, “Electricity and Magnetism”, McGraw Hill Publication, 1980.
2. W. J. Duffin, “Advanced Electricity and Magnetism”, McGraw Hill, 1968.
3. E. G. Cullwick, “The Fundamentals of Electromagnetism”, Cambridge University Press,1966.
4. B. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, International Edition, 1971.
5. W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education, 2012.

REFERENCES

1. NPTEL: http://nptel.ac.in/courses

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	2	-	1	-	-	-	-	-	1	-	1	1	1
CO2	1	2	-	1	-	-	-	-	-	-	1	-	2	1
CO3	1	2	-	-	-	-	-	-	-	-	-	1	1	2
CO4	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	2	1	-	-	-	-		-	-	-	1	1	1
Total	6	11	1	3	0	0	0	0	0	1	1	3	7	7
Scaled	2	3	1	1	0	0	0	0	0	1	1	1	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

TRANSMISSION AND DISTRIBUTION

Course Outcomes (XEE 305):		**Domain**	**Level**
CO 1	Explain the major components of Transmission and Distribution Systems (TDS). Classify different types of single and three phase transmission line parameters.	Cognitive	Understanding Understanding
CO 2	Outline the types of transmission line efficiency calculations and its performance	Cognitive	Understanding
CO 3	Explain the different types of insulators and solve for stress and sag in overhead lines.	Cognitive	Understanding Applying
CO 4	Interpret different type’s underground cables.	Cognitive	Understanding

CO 5	Summarize the latest technologies in the field of distribution systems.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 305	**TRANSMISSION AND DISTRIBUTION**	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**

UNIT- I: TRANSMISSION LINE PARAMETERS	**09**
Structure of electric power system: Various levels such as generation, transmission and distribution; – Resistance, Inductance and Capacitance calculations – Single-phase and three-phase lines – double circuitlines – effect of earth on transmission line capacitance.	
UNIT- II: PERFORMANCE OF TRANSMISSION LINES	**09**
Regulation and efficiency – Tuned power lines, Power flow through a transmission line – Power circle diagrams, Introduction to Transmission loss and Formation of corona – critical voltages – effect on line performance – travelling waveform phenomena.	
UNIT- III: MECHANICAL DESIGN OF OVERHEAD LINES	**09**
Line supports – Insulators, Voltage distribution in suspension insulators – Testing of insulators – string efficiency – Stress and sag calculation – effects of wind and ice loading.	
UNIT -IV: UNDERGROUND CABLES	**09**
Comparison with overhead line – Types of cables – insulation resistance – potential gradient – capacitanceof single-core and three-core cables.	
UNIT- V: DISTRIBUTION SYSTEM	**09**
General aspects – Kelvin's Law – A.C. distribution – Single-phase and three phase – Techniques of voltagecontrol and power factor improvement – Introduction to Distribution loss – Recent trends in transmissionand distribution systems	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXTBOOKS

1.D.P. Kothari and I.J. Nagrath, 'Power System Engineering', Tata McGraw–Hill,2nd Edition, 2008.
2. B.R.Gupta, 'Power System Analysis and Design', S.Chand, New Delhi, 2003.
. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice HallIndia Pvt. Ltd, 2002.

REFERENCES

. Luces M.Fualkenberry ,Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 1996.
2. Hadisaddak, 'Power System Analysis,' Tata McGraw Hill Publishing Company',2003
3. Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning', New Delhi
4. Tamil Nadu Electricity Board Handbook', 2012.

E REFERENCES

1. NPTEL, Power System Generation, Transmission and Distribution Prof. D. P. Kothari Center for Energy Studies Indian Institute of Technology, Delhi.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3								1		2	2	1
CO2	1	3	1		1							1	3	1
CO3	1			1	1					1			2	1
CO4	1	2									1	1	2	1
CO5	1	2										1	2	1
Total	5	10	1	1	2	0	0	0	0	2	1	5	11	5
Scaling	2	3	1	1	1	0	0	0	0	1	1	2	3	2

0 – No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

PROBABILITY AND STATISTICS

Course Outcomes (XPS 401):		Domain	Level
CO1	**Explain** conditional probability, independent events; **find** expected values and Moments of Discrete random variables with their properties.	Cognitive	Understanding Remembering
CO2	**Find** distribution function, Marginal density function, conditional density function and to **define** density function of conditional distribution functions normal, exponential and gamma distributions.	Cognitive	Remembering

CO 3	**Determine** the statistical parameters of Binomial, Poisson and Normal and to find correlation, regression and Rank Correlation coefficient of two variables. Moments, skewness and Kurtosis.	Cognitive Psychomotor	Understanding Guided Response
CO 4	**Explain** large sample test for single proportion, difference of proportion, single mean, difference of means and difference of standard deviations with simple problems.	Cognitive	Understanding
CO 5	**Explain** small sample test for single mean, difference of mean and correlation coefficients, variance test, chi square test with simple problems.	Cognitive Affective	Understanding Receiving

COURSE CODE	COURSE NAME	L	T	P	C
XEE 401	MATHEMATICS – III (PROBABILITY AND STATISTICS)	3	1	0	4
C:P: A = 3.5:2.5:2.5		L	T	P	CH
		3	1	0	4

UNIT - I: BASIC PROBABILITY	**12**
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality	
UNIT-II: CONTINUOUS PROBABILITY DISTRIBUTIONS & BIVARIATE DISTRIBUTIONS	**12**
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	
UNIT - III: BASIC STATISTICS	**12**
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation	
UNIT- IV: APPLIED STATISTICS	**12**
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.	
UNIT-V: SMALL SAMPLES	**12**
Test for single mean, difference of means and correlation coefficients, test for ratio of variances -Chi-square test for goodness of fit and independence of attributes	

	LECTURE	TUTORIAL	TOTAL
	45	15	60
TEXTBOOKS			

1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 43rd Edition, 2015.
2. N.P. Bali and M. Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, 2010.
3. Veerarajan T., “Probability, Statistics and Random processes”, Tata McGraw-Hill, New Delhi,2010.

REFERENCES

1. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal BookStall, 2003.
2. S. Ross, “A First Course in Probability”, Pearson Education India, 2002.
3. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, Wiley, 1968.
4. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.

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nptel

Probability and Statistics by Prof.Somesh kumar, Department of Mathematics, IIT Kharagpur. (http://nptel.ac.in/noc/noc_courselist.php)

Mapping of COs Vs GAs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2	1						1	1		1
CO 2	3	2	1						1	1		1
CO 3	3	2	1	1					1	1		1
CO 4	3	2	1	1	1	1			1	1	1	1
CO 5	3	2	1	1	1	1	1		1	1	1	1
Total	15	10	5	3	2	2	1		5	5	2	5
Scaled	3	2	1	1	1	1	1		1	1	1	1

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

DIGITAL ELECTRONICS

Course Outcomes (XEE 402):		**Domain**	**Level**
CO1	To Understand numerical values in various number systems and show number conversions between different number Systems.	Cognitive Psychomotor	Understanding Guided Response
CO2	To Analyze Boolean functions and minimization techniques using k –maps and postulates and theorems of Boolean Algebra, minimization of Boolean functions using basic laws.	Cognitive Psychomotor	Analyze Perception

CO3	To Apply Logic gates and their applications and constructthe simple adders and subtractors using logic gates.	Cognitive Psychomotor	Apply Mechanism
CO4	To Understand the process of Analog to Digital conversion and its applications.	Cognitive Psychomotor	Understanding Mechanism
CO5	To Understand the process of Digital to Analog conversion and its applications.	Cognitive Psychomotor	Understanding Mechanism

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 402	**DIGITAL ELECTRONICS**	**3**	**0**	**1**	**4**
C:P: A		**L**	**T**	**P**	**CH**
2:1:0		**3**	**0**	**2**	**5**

UNIT - I: FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES **9+9**

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

List of Experiments

1. Verification and study of logic gates.
2. Binary to Gray and Gray to binary code converters.3.Excess -3 to BCD and vice-versa code converters.

UNIT - II: COMBINATIONAL DIGITAL CIRCUITS **9+6**

Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders Q-M method of function realization.

List of Experiments

3. Implementation and verification of Multiplexers and Demultiplexer using logic gates.
4. Implementation and verification of Encoders and Decoders using logic gates.

UNIT - III: SEQUENTIAL CIRCUITS AND SYSTEMS **9+6**

A 1-bit memory, the circuit properties of Bistable latch, JK, SR, D and T types flip-flops, applications of flip-flops, shift registers, applications of shift registers, Asynchronous counters, synchronous counters design using flip flops, special counter IC's, applications of counters.

List of Experiments

5.Design and verify operation of Half / Full adder.
6.Design and verify operation of Half/Full Subtractor.

UNIT- IV: A/D AND D/A CONVERTERS **9+6**

Digital to analog converters: weighted resistor/converter, R-2R Ladder DAC, specifications for D/A converters, examples of DAC ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator ADC, successive approximation ADC, specifications of ADC, example of ADC ICs. **List of Experiments** 8.Verification of state tables of RS, JK, T and D flip flops using NAND and NOR gates.
UNIT-V: SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES **9+3**
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, ROM, RAM, content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, PLA, PAL, CPLDS, and FPGA. **List of Experiments** 9. Shift registers and Counters**.**

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	30	75

TEXTBOOKS

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

REFERENCES

5. Taub and Schilling, 'Digital Integrated Circuits', McGraw Hill, 2002.
6. Samuel C. Lee “Digital Circuits and Logic Designs” Prentice Hall of India; 2000.
7. Fletcher, W.I., 'An Engineering Approach to Digital Design', Prentice Hall of India, 2002.
8. Anand Kumar, Fundamental of Digital circuits, PHI 2003.

E REFERENCES

1. NPTEL, Digital Logic Circuits, Prof. S.Srinivasan, IIT Madras.
2. NPTEL, Digital Logic Circuits, Prof. D. Roychoudhury, IIT Kharagpur.

Mapping of COs with POs

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	1	3	-	-	1	1	1	-	1	-	2	2	1
CO 2	3	2	1	-	-	2	0	2	1	-	-	2	1	2
CO 3	2	2	1	-	-	1	2	2	1	1	-	1	2	2
CO 4	2	2	3	-	-	1	1	1	-	-	1	1	1	2
CO 5	3	2	2	-	-	0	1	1	1	1	1	2	2	2
Total	12	9	10	-	-	5	5	7	3	3	2	8	8	9
Scaled	3	2	2	0	0	1	1	2	1	1	1	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

POWER ELECTRONICS

Course Outcomes (XEE 403):	Domain	Level

CO1	To Understand the structure, operation and characteristics of power switching devices.	Cognitive Psychomotor	Understanding Response
CO2	Determine the operation, characteristics and performance parameters of controlled rectifiers.	Cognitive Psychomotor	Understanding Mechanism
CO3	Analysis the operation of DC - DC choppers.	Cognitive Psychomotor	Analyzing Mechanism
CO4	Analysis the operation of various inverters and infer the suitable PWM techniques.	Cognitive Psychomotor	Analyzing Mechanism
CO5	To Understand the concept of various types of AC voltage controllers.	Cognitive Psychomotor	Understanding Mechanism

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 403	**POWER ELECTRONICS**	**3**	**0**	**1**	**4**
C:P: A		**L**	**T**	**P**	**H**
2:1:0		**3**	**0**	**2**	**5**

UNIT – I: POWER SWITCHING DEVICES	**9+9**

Review on Semiconductor devices – I-V characteristics and Switching Characteristics of power Diodes, SCR, TRIAC, power BJT, power MOSFET and IGBT. Triggering and Commutation Circuits.

List of Experiments

1.Characteristics of SCR
2.Characteristics of MOSFET
3.Characteristics of IGBT

UNIT – II: THYRISTOR RECTIFIERS	**9+3**

Single phase half-wave and full-wave thyristor rectifiers – Single phase full-bridge thyristor rectifier with R-load and highly inductive load – Three phase full-bridge thyristor rectifier with R-load and highly inductive load.

List of Experiments

4. Single phase fully controlled rectifier with R, RL load

UNIT – III: DC TO DC CHOPPERS	**9+6**

Types of Choppers, Class A to E, step-up and step-down choppers – Analysis of Voltage, Current and Load commutated choppers –Introduction to Resonant converters

List of Experiments

5.BUCK- BOOST converter using MOSFET.
6.IGBT based choppers.

UNIT – IV: INVERTERS	**9+6**

Single phase, Three phase voltage source inverters (Both 120º and 180º mode of conductions) – Bipolar sinusoidal modulation and unipolar sinusoidal modulation, Modulation Index - PWM Techniques- Current Source Inverters.

List of Experiments

7.Single phase IGBT PWM inverter.
8.Series Inverter/ Parallel Inverter

UNIT – V:AC VOLTAGE CONTROLLERS	**9+6**

Single-phase and three phase AC voltage controllers -. Multi-stage sequence control – step-up and step-down cycloconverter – Single phase to single phase and Single phase to Three phase cycloconverters.

List of Experiments

9.Single phase AC voltage controller using SCR / TRIAC.

10.Single phase cycloconverter.

11.Mini project: Design of basic power converter circuits**.**

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	30	75

TEXTBOOKS

1. Rashid, M.H., 'Power Electronics: Circuits, Devices and Applications', Pearson Education India, 2009.
2. Singh, M.D and Kanchandani, 'Power Electronics', Tata McGraw Hill & Hill publication Company Ltd New Delhi, 2009.
3. Bimbhra, P.S, 'Power Electronics', Khanna Publishers, 2007.
4. Ned Mohan, Tore M. Undeland and William P.Robbins, 'Power Electronics: Converters, Applications and Design', New Jersey, John Wiley and Sons, 2007.

REFERENCES

1. Dubey, G.K., Doradia, S.R., Joshi, A. and Sinha, R.M., 'Thyristorised Power Controllers', Wiley Eastern Limited, 1986.
2. Lander,W., 'Power Electronics', McGraw Hill and Company, Third Edition, 2009.
3. Sen.P.C., 'Power Electronics', Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2005.
4. Joseph Vithayathil, 'Power Electronics', McGraw-Hill New York, 1996.
5. Erickson, R.W and Maksimovic, D., 'Fundamentals of Power Electronics', Springer Science & Business Media, 2007.
6. Umanand, L., 'Power Electronics: Essentials and Applications', Wiley India, 2009.
7. Department Laboratory Manual

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1. **Lecture** Series on **Power Electronics** by Prof. B.G. Fernandes, Department of Electrical Engineering, IIT Bombay.
2. http://www.nptel.ac.in/courses/108105066/PDF/L-1(SSG)(PE)%20((EE)NPTEL).pdf

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO 1	3	2	1	0	0	1	3	0	0	0	0	1	3	1
CO 2	2	1	2	1	0	0	1	0	0	0	0	0	2	2
CO 3	3	1	1	0	0	0	0	0	0	0	0	0	1	2

CO 4	1	3	2	0	0	1	0	0	0	0	0	0	2	1
CO 5	1	2	3	1	3	0	1	1	0	0	0	0	3	2
Total	10	9	9	2	3	2	5	1	0	0	0	1	11	8
Scaled	2	2	2	1	1	1	1	1	0	0	0	1	3	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ELECTRICAL MACHINES – II

Course Outcomes (XEE 404):		**Domain**	**Level**
CO1	To Understand the fundamentals of different types of slots and windings used for AC machines.	Cognitive Psychomotor	Understanding Mechanism
CO2	To Understand the concepts of pulsating and revolving magnetic fields.	Cognitive Psychomotor	Understanding Mechanism
CO3	To Understand the operation of induction machines, ttorque slip characteristics, equivalent circuit and its phasor diagram.	Cognitive Psychomotor	Understanding Mechanism
CO4	To Understand the different typesof starting, braking and speed control for induction motors. React the generator operation, self-excitation and doubly-fed Induction machines.	Cognitive Psychomotor	Understanding Mechanism
CO5	To Understand the operation of single-phase induction motors and its performance parameters.	Cognitive Psychomotor	Understanding Mechanism

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 404	**ELECTRICAL MACHINES – II**	**3**	**1**	**1**	**5**
C:P: A = 2:1:0		**L**	**T**	**P**	**H**
		3	**1**	**2**	**6**

UNIT – I: FUNDAMENTALS OF AC MACHINE WINDINGS **9+3+12**

Physical arrangement of windings in stator and cylindrical rotor–Slots for windings –Single-turn coil – Active portion and overhang –Full-pitch coils–Types of windings– 3D visualization of the above winding types– Air-gap MMF distribution with fixed current through winding –Winding distribution factor.

List of Experiments

1.Load test on three phase squirrel cage induction motor.
2.Load test on three phase slip ring induction motor.
3.Load test of a three-phase alternator.
4.Load test on single-phase induction motor.

UNIT – II: PULSATING AND REVOLVING MAGNETIC FIELDS **9+3+6**

Types of magnetic fields –Alternating current in windings with spatial displacement – Magnetic field produced by a single winding – Fixed current and alternating current. Pulsating fields produced by spatially displaced windings– Windings spatially shifted by 90° – Three windings spatially shifted by 120° (carrying three-phase balanced currents) – Revolving magnetic field.

List of Experiments

5.No load and blocked rotor test on three phase induction motor.
6.No load and blocked rotor test on single phase induction motor.

UNIT – III: INDUCTION MACHINES	12+3+3
Constructional details –Types of rotors (squirrel cage and slip-ring) – Torque Slip Characteristics – Equivalent circuit – Phasor Diagram– Effect of parameter variation on torque speed characteristics –Methods of starting, braking and speed control for induction motors–Generator operation –Self-excitation– Doubly-Fed Induction Machines. **List of Experiments** 7.Regulation of three phase alternator by EMF /MMF methods.	
UNIT – IV: SINGLE PHASE INDUCTION MOTORS	**6+3+6**
Constructional details of single-phase induction motor – Double revolving field theory and operation – Equivalent circuit – Determination of parameters – Split-phase starting methods and applications. **List of Experiments** 8.OCC and load characteristics of three phase alternator 9.V and inverted V curves of three phase synchronous motor.	
UNIT – V: SYNCHRONOUS MACHINES	**9+3+3**
Constructional details – Cylindrical rotor synchronous machine– EMF equation –Equivalent circuit – Phasor diagram–Armature reaction–Voltage regulation– V-curves. Salient pole machine – Two reaction theory – Phasor diagram –Power angle characteristics. Synchronizing and parallel operation. (Basic operation of synchronous motors) **List of Experiments** 10.Study of induction motor starters.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	30	90

TEXTBOOKS

1. I. J. Nagrath and D. P. Kothari, ‘Electric Machines’, Tata McGraw Hill Publishing Company Ltd, 2010.
2. M. G. Say, ‘Performance and Design of AC Machines’, CBS Publishers, 2002.
3. P. S. Bimbhra, ‘Electrical Machinery’, Khanna Publishers, 2011.
4. B.L.Theraja, ‘A Textbook of Electrical Technology’, Vol. I & II, M/s S.Chand, Delhi,2013.

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1. A. E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, ‘Electric Machinery’, Tata McGraw Hill publishing Company Ltd, 2013.
2. A. S. Langsdorf, ‘Alternating Current Machines’, Tata McGraw Hill publishing Company Ltd, 1984.
3. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 2007.
4. J.B. Gupta, ‘Theory and Performance of Electrical Machines’, S.K.Kataria and Sons, 2002.
5. DeshPande M.V., ‘Electrical Machines’, PHI Learning Pvt Ltd., New Delhi – 2011.
6. A. G. Warren, ‘Problems in Electrical Engineering’, Parker and Smith Solutions, Newyork, 1940.
7. K. Murugesh Kumar, ‘Electric Machines’, Vikas Publishing House Pvt Ltd, 2002.
8. Department Laboratory Manual.

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1. http://freevideolectures.com/Course/2335/Basic-Electrical-Technology35-38,Prof. L. Umanand, IISc Bangalore.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO 1	3	2	2	2	1	0	0	0	0	0	0	2	2	1
CO 2	3	2	2	2	1	0	0	0	0	0	0	1	2	1
CO 3	3	2	2	2	1	0	0	0	0	0	0	1	1	1
CO 4	2	2	1	3	2	0	0	0	0	0	0	1	1	1
CO 5	3	0	0	0	1	0	0	0	0	0	0	1	1	1
Total	14	8	7	9	6	0	0	0	0	0	0	6	7	5

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ENTREPRENEURSHIP DEVELOPMENT

Course Outcomes (XUM 405):		**Domain**	**Level**
CO1	***Recognise*** and ***describe*** the personal traits of an entrepreneur.	Cognitive Affective	Understand Receiving
CO2	***Determine*** the new venture ideas and ***analyze*** the feasibility report.	Cognitive	Understand Analyze
CO3	***Develop*** the business plan and ***analyze*** the plan as an individual or in team.	Cognitive Affective	Receiving Analyze
CO4	***Describe*** various parameters to be taken into consideration for launching and managing small business.	Cognitive	Understand
CO5	***Describe*** Technological management and Intellectual Property Rights	Cognitive	Understand

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XUM 405	**ENTREPRENEURSHIP DEVELOPMENT**	**3**	**0**	**0**	**3**
C:P: A = 2:0:1		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT – I: ENTREPRENEURIAL TRAITS AND FUNCTIONS	**9**
Definition of Entrepreneurship; competencies and traits of an entrepreneur; factors affecting Entrepreneurship Development; Role of Family and Society; Achievement Motivation; Entrepreneurship asa career and national development.	
UNIT – II: NEW PRODUCT DEVELOPMENT AND VENTURE CREATION	**9**
Ideation to Concept development; Sources and Criteria for Selection of Product; market assessment; Feasibility Report; Project Profile; processes involved in starting a new venture; legal formalities; Ownership; Case Study.	

UNIT – III: ENTREPRENEURIAL FINANCE	9
Financial forecasting for a new venture; Finance mobilization; Business plan preparation; Sources of Financing, Angel Investors and Venture Capital; Government support in start-up promotion.	
UNIT – IV: LAUNCHING OF SMALL BUSINESS AND ITS MANGEMENT	**9**
Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units.	
UNIT–V: TECHNOLOGY MANAGEMENT, IPR PORTFOLIO FOR NEW PRODUCT VENTURE	**9**
Technology management; Impact of technology on society and business; Role of Government in supporting Technology Development and IPR protection; Entrepreneurship Development Training and Other Support Services.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXTBOOKS

1. Hisrich, 2016, Entrepreneurship, Tata McGraw Hill, New Delhi.
2. S.S.Khanka, 2013, Entrepreneurial Development, S.Chand and Company Limited, New Delhi.

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1. Mathew Manimala, 2005, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis,
2. Biztrantra ,2nd Edition.
3. Prasanna Chandra, 2009, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill.
4. P.Saravanavel, 1997, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai.
5. Arya Kumar,2012, Entrepreneurship: Creating and Leading an Entrepreneurial Organisation, Pearson Education India.
6. Donald F Kuratko, T.V Rao, 2012, Entrepreneurship: A South Asian perspective, Cengage Learning India.
7. Dinesh Awasthi, Raman Jaggi, V.Padmanand, Suggested Reading / Reference Material
8. for Entrepreneurship Development Programmes (EDP/WEDP/TEDP), EDI Publication, Entrepreneurship Development Institute of India, Ahmedabad. Available from: http://www.ediindia.org/doc/EDP-TEDP.pdf

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1. Jeff Hawkins, “Characteristics of a successful entrepreneur”, ALISON Online entrepreneurship courses, “https://alison.com/learn/entrepreneurial-skills
2. Jeff Cornwall, “Entrepreneurship -- From Idea to Launch”, Udemy online Education, https://www.udemy.com/entrepreneurship-from-idea-to-launch/

Mapping of COs with POs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	0	0	0	0	0	0	0	0	3	3	3	1
CO 2	0	0	1	2	3	2	1	1	1	2	3	0
CO 3	0	0	0	0	0	1	0	2	3	3	0	2
CO 4	0	0	0	0	0	1	1	2	3	0	3	3

CO 5	0	0	0	0	0	1	1	3	0	0	0	3
Total	0	0	1	2	3	5	3	8	10	8	9	9
Scaled	0	0	1	1	1	2	1	2	3	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

SIGNALS AND SYSTEMS

Course Outcomes (XEE 406):		**Domain**	**Level**
CO1	Understand the concepts of continuous time and discrete time systems.	Cognitive	Understand
CO2	Analyse systems in complex frequency domain.	Cognitive	Analyse
CO3	Learn about Fourier transformation techniques	Cognitive	Remembering
CO4	Learn about Laplace transformation techniques	Cognitive	Remembering
CO5	Learn about Z- transformation techniques	Cognitive	Remembering

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 406	**SIGNALS AND SYSTEMS**	**2**	**1**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**2**	**1**	**0**	**3**

UNIT -I: INTRODUCTION TO SIGNALS AND SYSTEMS **09**

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability. Examples.

UNIT- II: BEHAVIOUR OF CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS **09**

Impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its Relation to the impulse response.

UNIT -III: FOURIER TRANSFORMS **09**

Fourier series representation of periodic signals, Waveform Symmetries, Fourier Coefficients, harmonic spectrum and THD. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Application to simple circuits.

UNIT- IV: LAPLACE TRANSFORMS **06**

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behaviour. Application to simple circuits.

UNIT -V: Z- TRANSFORMS AND SAMPLING RECONSTRUCTION **12**

The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis. The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

	LECTURE	TUTORIAL	TOTAL
	30	15	45

TEXTBOOKS

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice HallIndia, 1997.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms,and Applications", Pearson, 2006.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.

REFERENCES

1. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
2. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
3. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	2	1				1			1	1	0
CO 2	3	3	2	1		3		1				2		1
CO 3	3			1		3		1			1			1
CO 4	3	2	2	2	1		1			2		2		1
CO 5	3			1						2				1
Total	15	7	6	7	2	6	1	2	1	4	1	5	1	4
Scaled	3	2	2	2	1	2	1	1	1	1	1	1	1	1

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High

SEMESTER V

POWER SYSTEMS-I (APPARATUS AND MODELLING)

Course Outcomes (XEE 501):		Domain	Level
CO1	**Demonstrate** the per phase analysis of power system	Cognitive	Understanding
CO2	**Develop** the model of various components of power system and **Construct** the Y Bus and Z Bus for a power system.	Cognitive	Applying
CO3	**Analyse** the power system network with symmetrical and unsymmetrical faults. **Calibrate** the fault current in apower system.	Cognitive psychomotor	Analysing Complex
CO4	**Summarize** the power flow equation. **Assess** the voltage profile of a power system by performing the load flow analysis and **Identify** the line loss and line flow.	Cognitive psychomotor	Understanding Evaluating Perception
CO5	**Classify** and **determine** the stability of power system. **Detect** the transient behaviour of power system when it issubjected to a fault.	Cognitive psychomotor	Understanding Evaluating Perception

COURSE CODE	COURSE NAME	L	T	P	C
XEE 501	POWER SYSTEMS-I (APPARATUS AND MODELLING)	3	1	1	5
C:P: A		L	T	P	H
3:1:0		3	1	2	6

UNIT - I: INTRODUCTION **9+3**

Need for system analysis in planning and operation of modern power system – per phase analysis - Single line diagram - Per unit representation and Per unit calculations – Change of base –introduction to Electricity Deregulation.

UNIT -II: MODELLING OF POWER SYSTEM COMPONENTS **12+3+6**

Primitive network and its matrices – bus incidence matrix – bus admittance and bus impedance matrix formation – Z – Bus building algorithm - Modelling of generator, load, transformer, transmission line for different power system studies.

List of Experiments

1. Formation of Bus Admittance Matrix.
2. Formation of Bus Impedance Matrix using building Algorithm

UNIT - III: FAULT ANALYSIS-UNSYMMETRICAL FAULTS **12+3+6**

Need for short circuit study - basic assumptions in fault analysis of power systems. Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z- bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage and currents. Introduction to symmetrical components – sequence impedances – sequence networks Unsymmetrical fault analysis: L-G, L-L and L-L-G faults.

List of Experiments

3. Symmetrical Fault Analysis.
4. Unsymmetrical Fault Analysis.

UNIT- IV: POWER FLOW ANALYSIS **9+3+9**

Need for Power Flow Analysis – bus classification – derivation of power flow equation – solution by Gauss–Seidel, Newton–Raphson and Fast Decoupled Power Flow methods –comparison of three methods

List of Experiments

5. Solution of power flow using Gauss-Seidel Method.
6. Solution of power flow using Newton Raphson Method.
7. Solution of power flow using Fast Decoupled Power Flow Method.

UNIT -V: STABILITY ANALYSIS **9+3+3**

Types of stability - Swing equation in state space form - equal area criterion - stability analysis of single machine connected to infinite bus by modified Euler's method using classical machine model– critical clearing angle and time. Causes of voltage instability – voltage stability proximity indices for two-bus system – methods of improving power system stability. **List of Experiments**

9. Transient Stability Analysis of Single-Machine Infinite Bus System

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	30	90

TEXT BOOKS

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw-HillEducation; 2nd edition (December 28, 2015)
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1st July 2017.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 2nd Edition, 2009.

REFERENCES

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw HillEducation, 4th Edition (29 June 2011)
2. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "ElectricPower Systems", Wiley, 5 **edition** (December 26, 2012)

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https://nptel.ac.in/courses/108104051/ https://nptel.ac.in/courses/108102047/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3									1		1	3	2
CO 2	3									1		1	3	2
CO 3	3	2								1	1	2	3	2
CO 4	3	2			1					1	1	1	3	2
CO 5	3	2			1					1	1	1	3	2
Total	15	6	0	0	2	0	0	0	0	5	3	6	15	10
Scaled	3	1	0	0	0	0	0	0	0	1	1	1	3	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

CONTROL SYSTEMS

Course Outcomes (XEE 502):		**Domain**	**Level**
CO1	**Identify** the basic elements, derive the transfer function and **Compute** the overall gain of the control system and **Construct** the transfer function of DC motors and DCgenerators.	Cognitive Psychomotor	Understanding
CO2	**Explain** the performance of First and Second order systemwith static and dynamic error coefficients.	Cognitive Psychomotor	UnderstandingSet
CO3	**Describe** the frequency domain specifications and show the response of frequency response.	Cognitive Psychomotor	Remembering UnderstandingSet
CO4	**Determine** the stability of the systems and **Design** the suitable compensator and controller for the given performance criteria of the control system	Cognitive Psychomotor	Understanding Design Perception
CO5	**Describe** State transition matrix. **Explain** State space model **and construct** and **verify** the canonical state model and Kalman's test for controllability and observability.	Cognitive	Remembering

COURSE CODE	COURSE NAME	L	T	P	C
XEE 502	CONTROL SYSTEMS	3	0	1	4
C:P: A		L	T	P	H
3:1:0		3	0	2	5

UNIT - I: SYSTEMS AND THEIR REPRESENTATION **9+9**

Basic elements in control systems – Open and closed loop systems – Principles of feedback, Transfer function Block diagram reduction techniques – Signal flow graphs. Mason gain formula, Modelling of electric systems translation and rotational mechanical systems.

List of Experiments

1. Transfer function and modelling of separately excited DC Generator.
2. Transfer function and modelling of Armature & field-controlled DC Motor.
3. Transfer function of AC Servomotor

UNIT – II: TIME RESPONSE ANALYSIS **9+9**

Time response – Time domain specifications - Standard test signals. Time response of first and second order systems for standard test inputs. Error coefficients – Generalized error series – Steady state error

List of Experiments

4. Analysis of Synchro Transmitter and Receiver.
5. Performance of DC Stepper Motor
6. Digital simulation of I order and II order system by using Scilab.

UNIT - III: FREQUENCY-RESPONSE ANALYSIS **9+6**

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

List of Experiments

7. Frequency response of Lag, Lead & Lag – Lead networks.
8. Determination of Phase margin and Gain margin of the Bode plot using Scilab.

UNIT – IV: STABILITY ANALYSIS AND CONTROLLER DESIGN **9**

Characteristics equation – Location of roots in S plane for stability –Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition –Nyquist stability criterion. Introduction to design of Proportional, Integral and Derivative Controllers- Lead and Lag compensator- Analog and Digital implementation of controllers.

UNIT – V: STATE VARIABLE ANALYSIS **9+6**

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Physical variable phase variable and canonical variable forms State Space representation of continuous time system. Transfer function from state variable representation –. Concept of controllability and observability.

List of Experiments

9. Transfer function and modeling of Ward – Leonard speed control system applied to DC motor.
10. DC Position using feedback Control system.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	30	75

TEXTBOOKS

1. I.J. Nagrath & M. Gopal, 'Control Systems Engineering', New Age International Publishers Pvt Ltd; Sixth edition (1 September, 2018)
2. Norman S. Nise, "Control System Engineering" Seventh edition, John Wiley &Sons, Inc, 2015.
3. M. Gopal, "Control Systems, Principles & Design", Tata McGraw Hill, New Delhi, 2002.
4. Richard C. Dorf & Robert H. Bishop, "Modern Control Systems", Addison– Wesley, 2012.

REFERENCES

1. B.C. Kuo, 'Automatic Control Systems', Prentice Hall of India Ltd., New Delhi, 2014.
2. K. Ogata, 'Modern Control Engineering', 4th edition, Pearson Education, New Delhi, 2003 / PHI.
3. N. Bandyopadhyay, 'Control Engineering Theory and Practice', Prentice Hall of India, 2009
4. John J.D'azzo & Constantine H.Houpis, 'Linear control system analysis and design', Tata McGrow-Hill, Inc., 2013

E – REFERENCES

1. NTPEL, Control Systems Engineering (Web Course), Prof. M. Gopal, IIT Kharagpur.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1			1	1	1			1		
CO2	2	3	1		2	1	1	1	1	1		2	2	1
CO3	3	3	3	2			1		3				2	2
CO4	1	2	2	3	2	2	1	1	2	1	1	2	1	2
CO5	2	1	1	1	2	1	1	1	2	1		1	2	2
Total	10	10	9	7	4	4	5	4	9	3	1	6	7	7
Scaled	2	2	2	2	1	1	1	1	2	1	1	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

MICROPROCESSORS AND MICROCONTROLLERS

Course Outcomes (XEE 503):		**Domain**	**Level**
CO1	To understand the fundamentals of microprocessors, microcontrollers and embedded systems	Cognitive	Understanding
CO2	To understand the architecture, Timing diagrams and Execution cycles of 8051	Cognitive	Understanding
CO3	To understand the types of addressing modes, Instruction types and to understand the basic concepts of programming	Cognitive Psychomotor Affective	Understanding Set Responding
CO4	To understand interfacing design of peripherals like I/O, A/D, D/A, timer etc.	Cognitive Psychomotor Affective	Understanding Set Responding

CO5	To understand communication protocols and interfacing with external devices	Cognitive Psychomotor Affective	Understanding Set Responding

Learning Outcomes: Able to do assembly language programming, do interfacing design of peripherals like I/O, A/D, D/A, timer etc. and to develop systems using different microcontrollers.

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 503	**MICROPROCESSORS AND**	**3**	**0**	**1**	**4**
C:P: A	**MICROCONTROLLERS**	**L**	**T**	**P**	**H**
3:1:0		**3**	**0**	**2**	**5**

UNIT- I: FUNDAMENTALS OF MICROPROCESSORS	**9**
Fundamentals of Microprocessor Architecture. 8-bit Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.	
UNIT -II: THE 8051 ARCHITECTURE	**9**
Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Dataand Program Memory, Timing diagrams and Execution Cycles.	
UNIT- III: INSTRUCTION SET AND PROGRAMMING	**9+12**
Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and Debugging tools.	
List of Experiments 1. Simple arithmetic operations with 8085 Microprocessors: Multi precision addition / subtraction / multiplication / division. 2. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions. 3. Demonstration of basic instructions with 8051 Micro controller execution, including: a. Conditional jumps, looping b. Calling subroutines. c. Stack parameter testing 4. Design program for code conversions.	
UNIT -IV: MEMORY AND I/O INTERFACING	**9+3**
Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices. **List of Experiments** 5. Interfacing Converters of 8-bit D/A and A/D.	
UNIT -V: EXTERNAL COMMUNICATION INTERFACE AND APPLICATIONS	**9+15**

Synchronous and Asynchronous Communication. RS232, SPI, I2C.Introduction and interfacing to protocols like Blue-tooth and Zig-bee LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

List of Experiments

6. Interfacing of Keyboard with 8085
7. Interfacing of seven segment display with 8085.
8. Serial communication, I/O Port operations.
9. Design and implementation of Traffic Light control.
10. Design and implementation of Stepper motor control

	LECTURE	PRACTICAL	TOTAL
	45	30	75

TEXTBOOKS

1. M.A.Mazidi, J.G.Mazidi and R.D.McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.
2. K.J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.
3. R. Kamal, "Embedded System", McGraw Hill Education, Third Edition, 2017.
4. R.S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 6th Edition, 2013

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1. D.A.Patterson and J.H.Hennessy, "Computer Organization and Design: The Hardware /Software interface", Morgan Kaufman Publishers, 5th Edition, 2013.
2. D.V.Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education,2005.

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Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	0	2	0	0	0	0	0	0	1	1	0	1	1
CO 2	1	2	1	3	1	0	0	0	2	1	2	1	1	1
CO 3	0	0	0	0	0	1	2	0	1	2	0	0	1	1
CO 4	1	1	2	2	1	0	0	0	2	1	2	1	0	1
CO 5	1	2	2	1	0	0	3	0	3	2	1	0	0	1
Total	4	5	7	6	2	1	5	0	8	7	6	2	3	5
Scaled	1	1	2	1	1	1	1	0	2	2	1	1	1	1

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

PROTECTION AND SWITCHGEAR

Course Outcomes (XEE E11):		Domain	Level
CO1	To **Illustrate** and **recall** the principle, characteristics and working of different types of relay.	Cognitive	Understanding Remembering
CO2	To **choose** relevant protection systems for the Generator and Transformers.	Cognitive	Applying Evaluating
CO3	**To compare the** concepts of arc quenching techniques of different equipments	Cognitive	Analyzing
CO4	**To classify** the different type of Circuit breakers and its selection criteria.	Cognitive	Analyzing
CO5	**To select** of different type of equipments used for over voltage protection and Lightning arrestors.	Cognitive	Applying

COURSE CODE	COURSE NAME	L	T	P	C
XEE E11	PROTECTION AND SWITCHGEAR	3	0	0	3
C:P: A		L	T	P	H
3:0:0		3	0	0	3

UNIT- I: RELAYS — **09**

General classification, Principle of operation, types, characteristics, Torque equation, Relaying Schemes, Relay Co- ordination. Requirement of relays, Primary & backup protection, Desirable qualities of relays, Terminology used in protective relay, Over current relays directional, distance and differential, under frequency, negative sequence relays

UNIT -II: APPARATUS PROTECTION — **09**

Protection of Generator: Earth Fault, percentage, differential, Loss of excitation, Prime mover failure, over current, Negative phase sequence, heating, Reverse power protection schemes. Protection of Transformers: Internal and external fault protection, Differential, Earth fault, Over Current, Overheating. Transformer Protection - Incipient fault.

UNIT- III: THEORY OF CIRCUIT INTERRUPTION — **09**

Physics of arc phenomena and interruption- rate of rise of recovery voltage. Elementary principle of arc quenching, Recovery and re-striking voltage, arc quenching devices, current chopping, capacitive current, resistance switching, interruption of capacitive current

UNIT- IV: CIRCUIT BREAKERS — **09**

Switchgear, fault clearing, description and operation of Bulk oil, Minimum oil, Air break, Air blast, SF6, Vacuum circuit breakers and DC circuit breakers, LT Switch gear, HRC fuses, current limiting reactor & influence of reactors in CB ratings, selection of circuit breakers, Testing of circuit breaker, Intelligent circuit breakers.

UNIT -V: PROTECTION AGAINST OVERVOLTAGE — **09**

Switching surges, Phenomena of Lightning, over voltage due to lightning, Protection against lightning, Lightning arrestors, selection of lightning arrestors, Surge absorbers, and diverters, Rod gap, Horn gap expulsion type & valve type lightning arrestors, solid resistance and reactance earthing, Arc suppression coil, Earthing transformers, Earth wires, insulation co-ordination.

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXTBOOKS

1. Badri Ram, Vishwakarma D N., "Power System Protection and Switchgear" Tata McGraw Hill Publishing House Limited, New Delhi, 2005.
2. Soni, M.L., Gupta, P.V., Bhatnagar, U.S. and Chakrabarti, A., "A Text Book on Power Systems Engineering", Dhanpat Rai& Sons Company Limited, New Delhi, 2008.
3. Sunil, S.Rao, "Switchgear Protection and Power Systems (Theory, Practice & Solved Problems", Khanna Publishers Limited, New Delhi, 12th Edition, 2008.
4. B.Ravindranath, and N.Chander, 'Power System Protection and Switchgear', Wiley Eastern Ltd., 2000.

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1. Paithankar Y. G., Bhide S. R., "Fundamentals of Power System Protection" Prentice Hall of India Limited, New Delhi, 2nd Edition, 2010.
2. Wadhwa, C.L., "Electrical Power Systems", New Age International Publishers Limited, 2006, New Delhi,6th Edition, 2010
3. Patra, S.P., Basu, S.K. and Chowduri, S., 'Power systems Protection', Oxford and International Book House Publishing Co, 2000.

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NTPEL, Power System Generation, Transmission and Distribution, Prof. D. P. Kothari Center for Energy Studies, Indian Institute of Technology, Delhi

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	1	1	1	1	-	-	-	1	-	1	2	2
CO 2	1	1	2	2	1	1	1	-	-	1	-	1	1	1
CO 3	2	1	1	2	-	-	-	-	-	1	-	2	2	2
CO 4	1	1	1	1	-	-	1	-	-	1	-	1	2	2
CO 5	1	1	1	1	-	-	-	-	-	1	-	1	1	1
Total	7	7	6	5	5	2	2	0	0	5	0	6	8	8
Scaled	2	2	2	1	1	1	1	0	0	1	0	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

CONSTITUTION OF INDIA

Course Outcomes:		**Domain**	**Level**
CO1	***Understand*** the Constitutional History	Cognitive	Understanding
CO2	***Understand*** the Powers and Functions	Cognitive	Understanding
CO3	***Understand*** the Legislature	Affective	Remembering
CO4	***Understand*** the Judiciary	Affective	Remembering
CO5	***Understand*** the Centre State relations	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**

XUM 506	**CONSTITUTION OF INDIA**	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**

UNIT- I: **9**

Constitutional History- The Constitutional Rights- Preamble- Fundamental Rights- FundamentalDuties- Directive principles of State Policy.

UNIT- II: **9**

The Union Executive- The President of India (powers and functions)- Vice-President of India-The Council of Ministers-Prime Minister- Powers and Functions.

UNIT- III: **9**

Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of RajyaSabha- Legislative Procedure in India- Important Committees of Lok Sabha- Speaker of the Lok Sabha.

UNIT- IV: **9**

The Union Judiciary- Powers of the Supreme Court- Original Jurisdiction- Appellatejurisdictions- Advisory Jurisdiction- Judicial review.

UNIT- V: **9**

Centre State relations- Political Parties- Role of governor, powers and functions of ChiefMinister-Legislative Assembly- State Judiciary- Powers and Functions of the High Courts.

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

REFERENCES

1. W.H.Morris Shores- Government and politics of India, NewDelhi,B.1.Publishers,1974.
2. M.V.Pylee- Constitutional Government in India, Bombay, Asia Publishing House, 1977.
3. R.Thanker- The Government and politics of India, London:Macmillon, 1995.
4. A.C.Kapur- Select Constitutions S,Chand & Co.,NewDelhi, 1995
5. V.D.Mahajan- Select Modern Governments,S,Chand &Co, NewDelhi,1995.
6. B.C.Rout- Democractic Constitution of India.
7. Gopal K.Puri- Constitution of India, India 2005.

Mapping COs versus POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	0	0	1	0	0	0	0	0	0	0	0	0	0
CO 2	2	0	0	1	0	0	0	0	0	0	0	0	0	0
CO 3	2	0	0	1	0	0	0	0	1	0	0	0	0	0
CO 4	2	0	0	1	0	0	0	1	1	0	0	0	0	0
CO 5	2	2	0	1	0	0	0	1	1	0	0	0	0	0
Total	10	2	0	5	0	0	0	2	3	0	0	0	0	0

Scaled	2	1	0	1	0	0	0	1	1	0	0	0	0	0

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

SEMESTER VI

ECONOMICS FOR ENGINEERS

Course Outcomes:		**Domain**	**Level**
CO1	***Understand*** the concepts of economics in engineering.	Cognitive	Remembering
CO2	***Interpret*** Break-even analysis.	Cognitive	Understanding
CO3	***Illustrate*** value engineering procedure.	Cognitive	Understanding
CO4	***Understand*** *and* ***analyze*** replacement problem.	Cognitive	Understanding
CO5	***Explain*** depreciation.	Cognitive	Understanding

Learning Objectives:

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XUM 601	**ECONOMICS FOR ENGINEERS**	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**
UNIT- I: INTRODUCTION TO ECONOMICS					**8**
Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- types of costing, element of costs, preparation of cost sheet and estimation, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost					
UNIT- II: BREAK-EVEN ANALYSIS & SOCIAL COST BENEFIT ANALYSIS					**12**
Margin of Safety, Profit, Cost & Quantity Analysis-Product Mix decisions and CVP analysis, Profit/Volume Ratio (P/V Ratio), Application of Marginal costing, Limitations **Social Cost Benefit Analysis**: compare different project alternatives, Calculate direct, indirect and external effects; Monetizing effects; Result of a social cost benefit analysis.					
UNIT- III: VALUE ENGINEERING & COST ACCOUNTING					**10**
Value engineering – Function, aims, Value engineering procedure - Make or buy decision Business operating costs, Business overhead costs, Equipment operating costs					
UNIT- IV: REPLACEMENT ANALYSIS					**7**
Replacement analysis –Types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset.					
UNIT- V: DEPRECIATION					**8**

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation.			
	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXTBOOKS

1. 1 Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad, Haryana, 2012
2. S.P.Jain & Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012
3. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.
4. William G.Sullivan, James A.Bontadelli & Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.

REFERENCES

1. Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007
2. Truett & Truett, "Managerial economics- Analysis, problems & cases "Wiley India 8th edition 2004.
3. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
4. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002

E REFERENCES

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POWER SYSTEMS-II (OPERATION AND CONTROL)

Course Outcomes (XEE 602):		**Domain**	**Level**
CO1	**Explain** power system load characteristics and generation reserve requirements.	Cognitive	Understanding
CO2	**Demonstrate** and **Apply** the mathematical knowledge to model and analysis of power system for frequency control.	Cognitive	Understanding Applying
CO3	**Identify** fundamental aspects of reactive power and its effect on system voltage and **Select** the suitable voltage control method for the system operating condition.	Cognitive	Applying
CO4	**Formulate** economic dispatch and unit commitment problem and its solution.	Cognitive	Creating
CO5	**Apply** computer control methods for power system operation and control	Cognitive	Applying

Learning Objectives: To provide the knowledge of optimization techniques used in the power system and Load Frequency Control (LFC). To provide a solid foundation in mathematical and engineering fundamentals required to control the governing system in Turbine models. To provide the knowledge of Hydrothermal scheduling, reactive power control.

COURSE CODE	COURSE NAME	L	T	P	C
XEE 602	POWER SYSTEMS-II (OPERATION AND CONTROL)	3	1	1	5
C:P: A = 3:1:0		L	T	P	H
		3	1	2	6

UNIT - I: INTRODUCTION **9+3**

An overview of power system operation and control - system load variation - load characteristics - load curves and load-duration curve - load factor - diversity factor - Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves - Importance of load forecasting - quadratic and exponential curve fitting techniques for forecasting – plant level and system level controls.

UNIT - II: REAL POWER - FREQUENCY CONTROL **12+3+9**

Basics of speed governing mechanism and modelling - 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 - two-area system: modelling - static analysis of uncontrolled case - tie line with frequency bias control - state variable model.

List of Experiments

1. Simulink model of single area load frequency control with PI controller.
2. Simulink model of single area load frequency control without PI controller.
3. Simulink model for two area load frequency control.

UNIT - III: REACTIVE POWER–VOLTAGE CONTROL **9+3+6**

Generation and absorption of reactive power - basics of reactive power control - excitation systems– modelling - static and dynamic analysis - stability compensation - methods of voltage control: tap-changing transformer, injection reactive power - SVC (TCR + TSC) and STATCOM – secondary voltage control.

List of Experiments

4. Modelling of reactive power compensation using STATCOM in MATLAB.
5. Modelling of reactive power compensation using SVC in MATLAB.

UNIT -IV: UNIT COMMITMENT AND ECONOMIC DISPATCH **12+3+9**

Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve - coordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ-iteration method - statement of unit commitment problem – priority-list method - forward dynamic programming.

List of Experiments

6. MATLAB program to find optimum loading of generators with penalty factor.
7. MATLAB program to find optimum loading of generators neglecting transmission losses.
8. MATLAB program to find economic load dispatch problem.

UNIT- V: COMPUTER CONTROL OF POWER SYSTEMS **9 +3**

Need for computer control of power systems - concept of energy control centre – functions - system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - network topology - state estimation – WLSE - Contingency Analysis - state transition diagram showing various state transitions and control strategies.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	30	90

TEXT BOOKS

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 3rd Edition ,2013.
3. Kundur P., 'Power System Stability and Control, Tata McGraw Hill, New Delhi, 5th reprint, 2014.

REFERENCES

1. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition,2011.
2. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
3. Abhijit Chakrabarti, Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

E REFERENCES

1. www.nptel.ac.in
2. NPTEL : http://nptel.ac.in/courses/108104052/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	2	-	-	-	-	1	-	-	2	1
CO2	2	3	2	2	2	-	-	-	1	1	1	-	2	-
CO3	2	2	2	2	3	-	-	-	-	-	1	1	2	-
CO4	2	2	3	3	2	-	-	-	-	1	-	-	1	-
CO5	1	2	2	2	2	-	-	-	-	-	-	1	1	1
Total	10	12	10	10	11	0	0	0	1	3	2	2	8	2
Scaled	2	3	2	1	3	0	0	0	1	1	1	1	2	1

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

MEASUREMENTS AND INSTRUMENTATION

Course Outcomes (XEE E21):		**Domain**	**Level**
CO1	**Describe** the different errors in measurements and **Describe** the working principle of different measuring instruments.	Cognitive Psychomotor	Remembering Perception
CO2	**Understanding** about the instruments used for different types of AC measurements. **Carryout** calibration test for measuring electrical instruments	Cognitive Psychomotor	Understanding Set
CO3	**Use** different types bridge circuits for the measurements of unknown passive elements. **Relate** the different types of the transducers. **Demonstrate** the use of different bridges and transducers.	Cognitive Psychomotor	Applying Mechanism
CO4	**Explain** the construction and operation of recording and display instruments. **Establish** Relations between analog and digital signal conversions.	Cognitive Psychomotor	Understanding Set

CO5	**Explain** the construction and working of different types signal conditioners. **Demonstrate** the recent trends in measurement of AC quantities.	Cognitive Psychomotor	Remembering Mechanism

Learning Objectives:

Understanding about the instruments used for different types of AC measurements. Understanding about various types of AC and DC bridges. Understanding about various types of transducers and display units.

COURSE CODE	COURSE NAME	L	T	P	C
XEE E21	MEASUREMENTS AND INSTRUMENTATION	3	0	1	4
C:P: A		L	T	P	H
3:1:0		3	0	2	5

UNIT- I: INTRODUCTION **9+9**

Measurements – Errors & classification, Measurement of voltage & current - permanent magnet moving coil and moving iron meters, Measurement of power and energy - dynamometer and induction instruments, Instrument transformers – Current and Potential transformers

List of Experiments

1. Calibration of Current Transformer and Potential transformer.
2. Measurement of three phase active, Reactive Power and Power factor
3. Calibration of Single phase / Three Phase Energy meter

UNIT – II: DC AND AC BRIDGES **9+9**

Measurement of resistance, inductance and capacitance using dc and ac bridges, Wheatstone bridge, Maxwell bridge, Kelvin's Bridge, Schering Bridge

List of Experiments

4. Resistance measurement using Wheat stone bridge
5. Inductance measurement using Maxwell Bridge
6. Capacitance measurement using Schering Bridge

UNIT - III: TRANSDUCERS **9+6**

Active and Passive transducers, Piezoelectric transducer, Photoelectric transducers, Thermocouples, Strain gauge transducers, LVDT, differential capacitive transducers, Fiber optic transducers, Resistive, Inductive and capacitive transducers.

List of Experiments

7. Study of Transducers

UNIT- IV: SIGNAL CONDITIONING UNITS **9+3**

Signal conditioners – Instrumentation amplifiers, voltage–current converters, A/D and D/A converters, voltage-frequency converters, analog multiplexers and de-multiplexers. Microprocessor Based Measurements, Case Studies in Instrumentation.

List of Experiments

8. A/D converters
9. D/A converters

UNIT -V: RECORDERS AND DISPLAY **9+3**

Signal sources – Oscillators, Function generator and pulse generators. Oscilloscopes - CRO, Digital storage and Analog storage Oscilloscope, Digital Phosphor Oscilloscopes. Analog and Digital Recorders and printers. Spectrum Analyzers, Data and Logic Analyzers.

List of Experiments

10. Measurement of Current / Voltage / power / Energy using Arduino board.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	30	75

TEXTBOOKS

1. A. K. Sawhney, 'A Course in Electrical and Electronic Measurements and Instrumentation', Dhanpat Rai & Co., 9th Edition, 2015.
2. Bouwens A. J., 'Digital Instrumentation', Tata McGraw Hill Publications, 16th Reprint (2008).
3. Kalsi H.S, 'Electronic Instrumentation', Tata McGraw-Hill Education, 3rd Edition, 2010.
4. Deobelin, 'Measurements Systems', Tata McGraw Hill Publications, 2nd Edition, 2010.

REFERENCES

1. W. D. Cooper, 'Electronic Instrumentation and Measurement Techniques', Prentice Hall of India Publications, 1st Edition, 2009.
2. Rangan C.S., 'Instruments Devices and System', Tata McGraw Hill Publications, 2nd Edition, 2009.

E REFERENCES

1. NTPEL, Electrical Machines (Web Course), Prof.N.K.De, Prof.T.K.Bhattacharya and Prof. G. D. Roy, IIT Kharagpur.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	1			1		1	1			3			2	3
CO 2	1	1										1	2	3
CO 3	1		1		1			2		1			2	2
CO 4	1	2										1	2	2
CO 5									1		1	1	2	3
Total	4	3	1	1	1	1	1	2	1	4	1	3	10	13
Scaled	1	3	1	1	1	1	1	1	1	1	1	1	2	3

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

INDUSTRIAL AUTOMATION

Course Outcomes (XEE E31):		**Domain**	**Level**
CO1	Able to **define** and **Explain** the fundamentals of Pneumatics, hydraulics and electrical drives. **List** out the advantages, disadvantages and its application	Cognitive Mechanism	Remembering Understanding Psychomotor
CO2	Apply the knowledge of electrical ladder diagram for hydraulic and pneumatic system and able to define pressure proximity switches and intelligent relays	Cognitive	Remembering Applying

CO3	**Explain** and **Categorize** different types of Sensors and their application. **List** out timer, counter and their application.	Cognitive Mechanism	Remembering Understanding Analyzing Psychomotor
CO4	**Illustrate** the knowledge in the PLC logic, Architecture and design the industrial automation system for specific applications and apply the knowledge for PLC programming to interface pneumatics.	Cognitive Mechanism	Applying Understanding Psychomotor
CO5	**Outline** the overview of robotics and their application. Apply the knowledge of robotics programming	Cognitive	Applying Understanding

COURSE CODE	COURSE NAME	L	T	P	C
XEE E31	INDUSTRIAL AUTOMATION	3	0	1	4
C:P: A		L	T	P	H
3:1:0		3	0	2	5

UNIT -I: INTRODUCTION TO PNEUMATICS AUTOMATION — **9 + 6**

Introduction to Pneumatics- Overall structure- Electro pneumatic –hydraulics- Overall –structure – Advantages and disadvantages – Application-Electrical drives.

List of Experiments

1. Control of Pneumatically operated single acting cylinder
2. Extension and Retraction of double acting cylinder
3. Control of pneumatically operated double acting cylinder using sensor
4. Control of pneumatically operated double acting cylinder using timer
5. Sequential control of two double acting cylinder

UNIT- II: APPLICATIONS OF RELAYS — **9 + 6**

Essential qualities of relays- NO & NC contacts- Electrical signal storage – Electrical Ladder Diagram- Pneumatic system- Hydraulic system-pressure and proximity switches- Intelligent Relays.

UNIT- III: SMART SENSORS AND TIMERS IN CONTROLLERS — **9 + 6**

Introduction to sensors- characteristics- types of sensors-resistive - inductive-capacitive- magnetic-ultrasonic - photoelectric- Nano sensors- timers-counters-types-application.

List of Experiments

6. Study of Sensor

UNIT -IV: PROGRAMMABLE LOGIC CONTROLLERS — **9+12**

Evolution of PLC – Sequential and Programmable controllers – Architecture – Programming of PLC – Relay logic and Ladder logic – Functional blocks – PLC interface to pneumatics.

List of Experiments

7. AND and OR Logical function PLC
8. Automatic tank filing control using PLC
9. Traffic light control using PLC
10. Starter control of motor using PLC

UNIT -V: ROBOTICS — **9**

Introduction and overviews of Robotics – Terms and Definition, Historical development of robotics, classification and configuration of robots, Basic components - Drives, controller gripper, application-programming in Robotics.

	LECTURE	PRACTICAL	TOTAL
	45	30	75

TEXTBOOKS

1. James Dally, W., **"**Instrumentation for Engineering Measurements**"**, John Wiley & sons
2. Patranabis, D., **"**Sensors and Transducers**"**, Wheeler Publishing, 2000.
3. Harry Colestock, Industrial Robotics, McGraw Hill Book Co., New Delhi, 2005.

REFERENCES

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education, 5th Edition, New Delhi, 2000.
2. Stuart A. Boyer.," SCADA: Supervisory Control and Data Acquisition", 4th Edition (Kindle), 2016.
3. "The Instrumentation systems and Automation Society", 2013.
4. "Micro-sensors; principles and applications" J.W.Gardner", Wiley, 1 edition (August 1994).
5. "Semiconductor sensors and its application" S.M.Sze, Wiley-Interscience, 1 edition (October 1994)

E REFERENCES

1. NPTEL- Industrial automation, Prof. S. Mukhopadhyay - IIT Kharagpur.
2. Web Course - http://elearning.vtu.ac.in/

Mapping of COs with 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	PSO 1	PSO 2
CO1	3	2	-	2	1	1	1	-	-	1	1	-	2	1
CO2	3	2	-	-	1	1	-	1	-	1	3	2	2	1
CO3	2	3	-	-	1	1	1	-	-	-	-	1	2	1
CO4	2	1	3	-	-	1	-	1	1	-	-	1	-	2
CO5	2	2		-	1	-	-	2	-	-	-	1	-	2
Total	12	10	3	2	4	4	2	4	1	2	4	5	6	7
Scaled	3	2	1	1	1	1	1	1	1	1	1	0	2	2

XUM 606 DISASTER MANAGEMENT

Course Outcomes:		**Domain**	**Level**
CO1	Understanding the concepts of application of types of disaster preparedness	Cognitive	Application
CO2	On completion of this course the students will be able to understand planning essentials of disaster.	Cognitive	Analyze
CO3	Have a good understanding of importance of seismic waves occurring globally	Cognitive	Analyze
CO4	On completion of this course, the students will be able to perform drill essential for disaster mitigation	Cognitive	Application
CO5	Have a keen knowledge on essentials of risk reduction	Cognitive	Application

COURSE CODE	COURSE NAME	L	T	P	C
XUM 606	DISASTER MANAGEMENT	3	0	0	3
C:P: A		L	T	P	H
3:0:0		3	0	0	3

UNIT- I: INTRODUCTION	**9**
Introduction – Disaster preparedness – Goals and objectives of ISDR Programme- Risk identification – Risk sharing – Disaster and development: Development plans and disaster management –Alternative to dominant approach– disaster-development linkages -Principle of risk partnership	
UNIT- II: APPLICATION OF TECHNOLOGY IN DISASTER RISK REDUCTION	**9**
Application of various technologies: Data bases – RDBMS – Management Information systems – Decision support system and other systems – Geographic information systems – Intranets andextranets – video teleconferencing. Trigger mechanism – Remote sensing-an insight – contribution of remote sensing and GIS - Case study	
UNIT- III: AWARENESS OF RISK REDUCTION	**9**
Trigger mechanism – constitution of trigger mechanism – risk reduction by education – disaster information network – risk reduction by public awareness	
UNIT- IV: DEVELOPMENT PLANNING ON DISASTER	**9**
Implication of development planning – Financial arrangements – Areas of improvement – Disaster preparedness – Community based disaster management– Emergency response.	
UNIT- V: SEISMICITY	**9**
Seismic waves – Earthquakes and faults – measures of an earthquake, magnitude and intensity –ground damage – Tsunamis and earthquakes	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXTBOOKS

1. Siddhartha Gautam and K Leelakrishna Rao, "Disaster Management Programmes and Policies", Vista International Pub House, 2012,
2. Arun Kumar, "Global Disaster Management", SBS Publishers, 2008

REFERENCES

1. Encyclopaedia of Disaster Management, Neha Publishers & Distributors, 2008
2. Pradeep Sahni, Madhavi Malalgoda and Ariyabandu, "Disaster risk reduction in South Asia", PHI, 2002
3. Amita Sinvhal, "Understanding earthquake disasters" TMH, 2010.
4. Pardeep Sahni, Alka Dhameja and Uma Medury, "Disaster mitigation: Experiences and reflections", PHI, 2000

E REFERENCES

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1		1	1					1			1	1	2	2
CO 2			2		3						2	2	2	2
CO 3						2	2				1	1		1
CO 4		2	2		1	1	1	2	1	1	3	1	1	
CO 5						2	3	3		2	1	1	2	2
Total	0	3	5	0	4	5	6	6	1	3	8	6	7	7
Scaled	0	1	1	0	1	1	1	1	1	1	2	1	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

SEMESTER VII

COURSE CODE	COURSE NAME	L	T	P	C
XEE E41	HIGH VOLTAGE ENGINEERING	3	0	0	3
C:P: A		L	T	P	H
3:0:0		3	0	0	3

UNIT - I: OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS — **9**

Natural Causes of overvoltage-Lightning phenomena and its effects on power system – Over voltage due to switching surge-power frequency overvoltage-control of overvoltage due to switching – protection of transmission lines against overvoltage –Becoleys lattice diagram.

UNIT- II: ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS — **9**

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-Applications of insulating materials.

UNIT – III: GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS — **9**

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

UNIT – IV: MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS | **9**

Measurement of High direct current voltages – measurement of voltages: alternating and impulse voltages and measurement of currents: direct, alternating and impulse currents. Digital techniques in high voltage measurement

UNIT – V: HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS | **9**

International and Indian standards-Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment. -Insulation co-ordination.

	LECTURE	PRACTICAL	TOTAL
	45	0	45

TEXTBOOKS

1. E. Kuffel and M. Abdullah, 'High Voltage Engineering', Pergamon press, Oxford,2010.
2. M.S. Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 4th Edition, 2004.
3. E. Kuffel and W.S. Zaengl, 'High Voltage Engineering Fundamentals', Pergamon Press, Oxford, London, 2012
4. August F.Metraux. "Some problems and actual limits of test techniques at extra high voltages", Haefely publications EIS 14.

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1. C.L.Wadhwa, 'High Voltage Engineering', New Age International (P) Ltd, 2nd Edition, 2006.
2. Ravindra Arora, Wolfgang Mosch, "High Voltage Insulation Engineering", New Age International (P) Limited, 2011.
3. Chinnappa ,K.M., Need for next higher voltage level in India", National seminar on high voltage AC and Dc Transmission, New Delhi.

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1. Web Content - http://www.library.dce.edu/e-resources/books/ee/
2. NPTEL-High Voltage Engineering, C.L. Wadhwa -IIT Madras.

Mapping of COs with 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	PSO 1	PSO 2
CO1	3	2	2	-	-	1	-	1	-	-	-	2	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	2
CO3	2	2	-	-	1	1	-	1	-	-	-	1	1	1
CO4	2	2	-	-	-	-	1	-	-	-	-	1	2	2
CO5	2	2	-	2	-	1	-	-	-	-	-	2	2	2
Total	12	10	2	2	1	3	1	2	0	0	0	7	8	9
Scaling	3	2	1	1	1	1	1	2	0	0	0	2	2	2

ELECTRICAL DRIVES

Course Outcomes (XEE E51):		**Domain**	**Level**
CO1	**Understand** the characteristics of DC drives and its multi-quadrant operation	Cognitive	Understanding
CO2	**Understand** the various control techniques of DC Drives.	Cognitive	Remembering

CO3	**Categorize** the different speed control methods for an Induction motor drive at stator side.	Cognitive	Understanding
CO4	**Illustrate** the various control techniques of induction motor Drives at rotor side.	Cognitive	Understanding
CO5	**Illustrate** the various control techniques and application of Synchronous motor drives.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE E51	**ELECTRICAL DRIVES**	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**

UNIT- I: DC MOTOR DRIVE CHARACTERISTICS AND ITS MULTI-QUADRANT OPERATIONS — **9**

Fundamentals of Electrical Drives - Advantage of Electrical Drives - Selection of Motor Power Rating - Review of emf and torque equations of DC machine - Review of torque-speed characteristics of separately excited dc motor - Four quadrant operation of dc machine – Steady state operation of multi-quadrant chopper fed dc drive, regenerative braking.

UNIT- II: CONTROL OF DC DRIVES — 9

DC Motor and their Performance - Transient Analysis - Ward Leonard Drives - Steady State Analysis of the Single and Three Phase Fully Controlled Converter Fed Separately Excited DC Motor Drive – Continuous and Discontinuous Mode Chopper Controlled DC Drives - Time Ratio Control and Current Limit Control – Industrial Applications of DC drives

UNIT- III: STATOR CONTROLLED INDUCTION MOTOR DRIVES — **9**

Induction Motor Drives - Stator Control - Stator Voltage and Frequency Control - VSI, CSI and Cycloconverter Fed Induction Motor Drives - Open Loop and Closed Loop V/f Control. Conventional space vector modulation; Steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation - Industrial Applications of Stator controlled Induction Motor drives.

UNIT- IV: ROTOR CONTROLLED INDUCTION MOTOR DRIVES — **9**

Impact of rotor resistance of the induction motor torque-speed curve - Operation of slip-ring induction motor with external rotor resistance, starting torque - Power electronic based rotor side control of slip ring motor - Slip Power Recovery, sub-synchronous and Super Synchronous Operations - Power Factor Improvement - Closed Loop Control- - Industrial Applications of Rotor controlled Induction Motor drives.

UNIT- V: SYNCHRONOUS MOTOR DRIVES — **9**

Separate Controlled Mode - Self Controlled Mode of Synchronous Motor - Constant Marginal Angle Control and Motor Power Factor Control - Cycloconverter Fed Synchronous Motors - Digital Control and Drive Applications.

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXT BOOKS

1. Dubey G.K, ‘Fundamentals of Electrical Drives’, Narosa Publications, 2008.
2. B. K. Bose, ‘Power Electronics and AC Drives’, Prentice Hall Onglewood cliffs, New Jersey, 1998.
3. Krishnan. R, ‘Electric motor& Drives; Modelling, Analysis and Control’, Prentice Hall of India, 2001.
4. Dubey G. K., ‘Power Semiconductor Controlled Drives’, Prentice Hall, 1989.

REFERENCE BOOKS

1. Murphy, J.M.D and Turnbull F.G, 'Thyristor Control of AC Motors', Pergamon Press, 1990.
2. Sen. P.C, 'Thyristor D.C. Drives', John Wiley and Sons, 1981.
3. Vedam Subrahmaniyam, 'Electric Drives Concepts and Applications', Tata McGraw Hill Publishing company Ltd., 2011.
4. Leonhard. W, 'Control of Electric Drives', Springer Science & Business Media, 2001

E-REFERENCES

Lecture Series on Solid State Devices by Prof.S.Karmalkar, Department of Electrical Engineering, IIT Madras.

Mapping of COs with 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	PSO 1	PSO 2
CO1	3	2	1	0	2	0	1	0	0	0	0	0	0	3
CO2	3	1	0	0	2	0	1	0	0	0	0	0	3	2
CO3	1	2	3	0	2	0	0	1	0	0	0	0	1	2
CO4	0	2	0	0	3	0	1	0	0	0	0	0	2	2
CO5	3	1	1	0	0	1	1	1	0	0	0	1	1	2
Total	10	8	5	0	9	1	4	2	0	0	0	1	7	11
Scaled	2	2	1	0	2	1	1	1	0	0	0	1	2	3

UMAN ETHICS, VALUES, RIGHTS AND GENDER

Course Outcomes:		**Domain**	**Level**
CO1	Adapt the human values and Social Justice.	Cognitive Affective	Knowledge and Responding
CO2	Discuss and accept Gender Equality, empowerment and feminism.	Cognitive Affective	Comprehension and Valuing
CO3	Recognize the status of women and analyse the issues related to women.	Cognitive Affective	Comprehension and Valuing
CO4	Demonstrate the human rights and good governance.	Cognitive Affective	Comprehension Responding
CO5	Adapt the human values and Social Justice.	Cognitive Affective	Apply Responding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XUM 703	**HUMAN ETHICS, VALUES, RIGHTS AND GENDER**	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**
UNIT- I: Human Values					**9**

Human Ethics and values - Understanding of oneself and others- Basic instincts, motives and needs- Social service, Social Justice, Dignity and worth, Harmony in human relationship: Family and Society, Integrity and Competence, Caring and Sharing, Honesty and Courage, Valuing Time, Co-operation, Commitment, Sympathy and Empathy, Self-Confidence and Personality- Living in harmony at various levels.	
UNIT- II: Gender Equality	**9**
Gender Equality - Gender Vs Sex -, Concepts, definition, Gender equity, equality, and empowerment. Status of Women in India Social, Economic, Education, Health, Employment, HDI, GDI, GEM. Contributions of Dr.B.R. Ambethkar, Thanthai Periyar and Phule to Women Empowerment.	
UNIT- III: Women issues and Challenges	**9**
Women Issues and Challenges- Female Infanticide, Female feticide, Violence against women, Domestic violence, Sexual Harassment, Trafficking, Access to education, Marriage. Remedial Measures – Acts related to women: Political Right, Property Rights, and Rights to Education, Medical Termination of Pregnancy Act, and Dowry Prohibition Act.	
UNIT- IV: Human Rights	**9**
Human Rights Movement in India – The preamble to the Constitution of India, Human Rights and Duties Universal Declaration of Human Rights (UDHR), Civil, Political, Economic, Social and Cultural Rights, Rights against torture, Discrimination and forced Labour, Rights of Children.	
UNIT- V: Good Governance	**9**
Good Governance - Democracy, People's Participation, Guaranteed Freedoms, Open and Transparency governance, Combating corruption, Fairness in criminal justice administration, Government system of Redressal, Judiciary, National Human Rights Commission and other statutory Commissions, Creation of Human Rights Literacy and Awareness.	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXTBOOKS

1. Alam, Aftab ed., Human Rights in India: 1999Issues and Challenges (New Delhi: Raj Publications,)
2. Bajwa, G.S. and D.K. Bajwa, 1996 Human Rights in India: Implementation and Violations (New Delhi: D.K. Publications,)
3. Chatrath, K. J. S., (ed.), 1998) Education for Human Rights and Democracy (Shimala: Indian Institute of Advanced Studies,).
4. Jagadeesan.P., 1990. Marriage and Social legislations in Tamil Nadu, Elachiapen pub, Chennai,
5. Kaushal, Rachna, 2000 Women and Human Rights in India (New Delhi: Kaveri Books,)
6. Mani. V. S., 1998)Human Rights in India: An Overview (New Delhi: Institute for the World Congress on Human Rights,)
7. Singh Sehgal, B. P. 1999 (ed) Human Rights in India: Problems and Perspectives (New Delhi: Deep and Deep,)
8. Veeramani K. (1996), Periyar on Women Right, Emerald Publishers, Chennai , India.
9. Veeramani.K (2010) (ed) Periyar Feminism.Periyar ManiammaiUniversity,Vallam, Thanjavur.
10. Status Report 1976, Govt. of India.

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1.

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Mapping of COs with 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	PSO 1	PSO 2
CO 1			3		3	2		2						
CO 2			3		1	2		3						
CO 3			2		2	2		3						
CO 4			3		3	3		3						
CO 5			1		1	1		1						
Total			12		10	10		12						
Scaled			3		2	2		3						

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

XUM801 CYBER SECURITY

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XUM801	**CYBER SECURITY**	**3**	**0**	**0**	**3**
C: P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	Able to understand the Cyber Security Policy, Laws and Regulations	Cognitive	Remember
CO2	Able to discuss the Cyber Security Management Concepts	Cognitive	Understand
CO3	Able to understand the Cyber Crime and Cyber welfare	Cognitive	Understand

CO4	Able to discuss on issues related to Information Security Concepts	Cognitive	Understand
CO5	Able to understand various security threats	Cognitive	Understand

UNIT I INTRODUCTION	9
Cyber Security – Cyber Security policy – Domain of Cyber Security Policy – Laws and Regulations – Enterprise Policy – Technology Operations – Technology Configuration - Strategy Versus Policy – Cyber Security Evolution – Productivity – Internet – E commerce – Counter Measures – Challenges	
UNIT II CYBER SECURITY OBJECTIVES AND GUIDANCE	9
Cyber Security Metrics – Security Management Goals – Counting Vulnerabilities – Security Frameworks – E Commerce Systems – Industrial Control Systems – Personal Mobile Devices – Security Policy Objectives – Guidance for Decision Makers – Tone at the Top – Policy as a Project– Cyber Security Management – Arriving at Goals – Cyber Security Documentation – The Catalog Approach – Catalog Format – Cyber Security Policy Taxonomy.	
UNIT III CYBER SECURITY POLICY CATALOG	9
Cyber Governance Issues – Net Neutrality – Internet Names and Numbers – Copyright and Trademarks – Email and Messaging - Cyber User Issues - Malvertising - Impersonation – Appropriate Use – Cyber Crime – Geo location – Privacy - Cyber Conflict Issues – Intellectual property Theft – Cyber Espionage – Cyber Sabotage – Cyber Welfare	
UNIT IV INFORMATION SECURITY CONCEPTS	9
Information Security Overview: Background and Current Scenario - Types of Attacks - Goals for Security - E-commerce Security - Computer Forensics – Steganography	
UNIT V SECURITY THREATS AND VULNERABILITIES	9
Overview of Security threats -Weak / Strong Passwords and Password Cracking - Insecure Network connections - Malicious Code - Programming Bugs - Cyber crime and Cyber terrorism - Information Warfare and Surveillance	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

REFERENCE BOOKS

1.Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs , Jeffrey Schmidt, Joseph Weiss "Cyber Security Policy Guidebook" John Wiley & Sons 2012.

2. Rick Howard "Cyber Security Essentials" Auerbach Publications 2011.

3. Richard A. Clarke, Robert Knake "Cyberwar: The Next Threat to National Security & What to Do About It" Ecco 2010

4. Dan Shoemaker Cyber security The Essential Body Of Knowledge, 1st ed. Cengage Learning 2011

5. Rhodes-Ousley, Mark, "Information Security: The Complete Reference", Second Edition, McGraw-Hill, 2013.

E RESOURCES

1. https://www.coursera.org/specializations/cyber-security
2. www. nptel.ac.in
3. http://professional.mit.edu/programs/short-programs/applied-cybersecurity

Table 1 : Mapping of COs with GAs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1						2		3				
CO2							2		1			
CO3	3					2	3		1			
CO4										2		
CO5	3											

ELECTRICAL AND HYBRID VEHICLES

Course Outcomes (XEE E61):		Domain	Level
CO1	To understand the working and performance of conventional vehicles	Cognitive	Understanding
CO2	To understand Hybrid Electric Vehicles and Drive-trains	Cognitive	Understanding
CO3	To explain basic concepts of Electric Drive Trains	Cognitive	Understanding
CO4	To explain the various types of Energy Storage Systems	Cognitive	Understanding
CO5	To understand different types of Energy management Strategies	Cognitive	Understanding

Learning Objectives:

Understand the models to describe hybrid vehicles and their performance and
Understand thedifferent strategies related to energy storage systems design.

COURSE CODE	COURSE NAME	L	T	P	C
XEE E61	ELECTRICAL AND HYBRID VEHICLES	3	0	0	3
C:P: A		L	T	P	H
3:0:0		3	0	0	3

UNIT- I: INTRODUCTION	**9**
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.	
UNIT – II: HYBRID ELECTRIC VEHICLES	**9**
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	
UNIT – III: ELECTRIC DRIVE TRAINS	**9**
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-Train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switched Reluctance Motor drives, drive system efficiency	
UNIT – IV: ENERGY STORAGE	**9**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of
different energy storage devices. Sizing the drive system: Matching the electric machine and the internalcombustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subject systems

UNIT – V: ENERGY MANAGEMENT STRATEGIES	**9**
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies, Charging Stations. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).	

	LECTURE	**PRACTICAL**	**TOTAL**
	45	**0**	**45**

TEXTBOOKS

1. C. Mi, M.A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S.Onori, L.Serrao and G.Rizzoni,"Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

REFERENCES

1.M. Ehsani, Y.Gao, S.E.Gay and A.Emadi,"Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.
2.T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016

E REFERENCES

www.nptel.ac.in

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3									1		1		2
CO 2	3									1		1		2
CO 3	3	2								1	1	2		2
CO 4	3	2			1					1	1	1		3
CO 5	3	2			1					1	1	1		3
Total	15	6	0	0	2	0	0	0	0	5	3	6		12
Scaled	3	1	0	0	1	0	0	0	0	1	1	1		3

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

B.Tech-EEE(PT)

SEMESTER I

CALCULUS AND LINEAR ALGEBRA

Course Outcomes (PMA 101):	**Domain**	**Level**

CO1	**Apply** orthogonal transformation to reduce quadratic form to canonical forms.	Cognitive	Remembering Applying
CO2	**Apply** power series to tests the convergence of the sequences and series. Half range Fourier sine and cosine series.	Cognitive Psychomotor	Applying Remembering Guided Response
CO3	**Find** the derivative of composite functions and implicit functions. Euler's theorem and Jacobian	Cognitive Psychomotor	Remembering Guided Response
CO4	**Explain** the functions of two variables by Taylors expansion, by finding maxima and minima with and without constraints using Lagrangian Method. Directional derivatives, Gradient, Curl and Divergence.	Cognitive Affective	Remembering Understanding Receiving
CO5	**Apply** Differential and Integral calculus to notions of Curvature and to improper integrals.	Cognitive	Applying

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PMA 101	**CALCULUS AND LINEAR ALGEBRA**	**3**	**1**	**0**	**4**
C:P: A = 3:0:0.5		**L**	**T**	**P**	**H**
PREREQUISITE: Differentiation and Integration		**3**	**1**	**0**	**4**

UNIT- I: MATRICES	**12**
Linear Transformation - Eigen values and Eigen vectors -Properties of Eigen values and Eigen vectors - Cayley-Hamilton Theorem – Diagonalisation of Matrices – Real Matrices: Symmetric - Skew-Symmetric and Orthogonal Quadratic form – canonical form - Nature of Quadratic form and Transformation of Quadratic form to Canonical form (Orthogonal only).	
UNIT – II: SEQUENCES AND SERIES	**12**
Sequences: Definition and examples-Series: Types and convergence- Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test-. Fourier series: Half range sine and cosine series- Parseval's Theorem.	
UNIT- III:MULTIVARIABLE CALCULUS: PARTIAL DIFFERENTIATION	**12**
Limit and continuity –Partial differentiation – Total Derivative – Partial differentiation of Composite Functions: Change of Variables – Differentiation of an Implicit Function - Euler's Theorem- Jacobian.	
UNIT – IV: MULTIVARIABLE CALCULUS: MAXIMA AND MINIMA AND VECTOR CALCULUS	**12**
Taylor's theorem for function of Two variables- Maxima, Minima of functions of two variables: with and without constraints - Lagrange's Method of Undetermined Multipliers – Directional Derivatives - Gradient, Divergence and Curl.	

UNIT - V: DIFFERENTIAL AND INTEGRAL CALCULUS	**12**
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

TEXTBOOKS

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2015**. (Unit I, Unit III and Unit IV).**
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi

Publications, Reprint, 2014. **(Unit II).**
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2010. **(Unit V).**

REFERENCES

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2			2					1		2
CO 2	3	2								1		1
CO 3	3	2								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
Total	15	10	0	0	3	0	0	0	0	5	0	7
Scaled	3	2			1					1		

$1 - 5 \rightarrow 1$ $6 - 10 \rightarrow 2$ $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

APPLIED PHYSICS FOR ENGINEERS

Course Outcomes (PAP102):		**Domain**	**Level**
CO1	**Identify** the basics of mechanics, **explain** the principles of elasticity and **determine** its significance in engineering systems and technological advances.	Cognitive	Remember Understand
CO2	**Illustrate** the laws of electrostatics, magneto-statics and electromagnetic induction; **use** and **locate** basic applications of electromagnetic induction to technology.	Cognitive	Remember Analyze
CO3	**Understand** the fundamental phenomena in optics by measurement and **describe** the working principle and application of various lasers and fiber optics.	Cognitive	Understand Apply
CO4	**Analyze** energy bands in solids, **discuss** and **use** physics principles of latest technology using semiconductor devices.	Cognitive	Understand Analyze
CO5	**Develop** Knowledge on particle duality and **solve**Schrodinger equation for simple potential.	Cognitive	Understand Apply

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PAP102	**APPLIED PHYSICS FOR ENGINEERS**	**3**	**1**	**0**	**4**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
PREREQUISITE:	**Basic Physics in HSC level**	**3**	**1**	**0**	**4**
UNIT- I:MECHANICS OF SOLIDS					**9+3**

Mechanics: Force - Newton's laws of motion - work and energy - impulse and momentum - torque - law of conservation of energy and momentum - Friction.
Elasticity: Stress - Strain - Hooke's law - Stress strain diagram - Classification of elastic modulus - Moment, couple and torque - Torsion pendulum - Applications of torsion pendulum - Bending of beams - Experimental determination of Young's modulus: Uniform bending and non-uniform bending.

UNIT – II:ELECTROMAGNETIC THEORY	**9+3**

Laws of electrostatics - Electrostatic field and potential of a dipole; Dielectric Polarization, Dielectric constant, internal field - Clausius Mossotti Equation - Laws of magnetism - Ampere's Faraday's law; Lenz's law - Maxwell's equation - Plane electromagnetic waves; their transverse nature - expression for plane, circularly and elliptically polarized light - quarter and half wave plates - production and detection of plane, circularly and elliptically polarized light.

UNIT – III:OPTICS, LASERS AND FIBRE OPTICS	**9+3**

Optics: Dispersion- Optical instrument: Spectrometer - Determination of refractive index and dispersive power of a prism- Interference of light in thin films: air wedge - Diffraction: grating. **LASER**: Introduction - Population inversion -Pumping - Laser action - Nd-YAG laser - CO_2 laser – Applications **Fibre Optics:** Principle and propagation of light in optical fibre - Numerical aperture and acceptance angle - Types of optical fibre - Fibre optic communication system (Block diagram).

UNIT- IV:SEMICONDUCTOR PHYSICS	**9+3**

Semiconductors: Energy bands in solids - Energy band diagram of good conductors, insulators and semiconductors - Concept of Fermi level - Intrinsic semiconductors - Concept of holes - doping - Extrinsic semiconductors - P type and N type semiconductors - Hall effect.
Diodes and Transistors: P-N junction diode - Forward bias and reverse bias - Rectification action of diode - Working of full wave rectifier using P N junction diodes - PNP and NPN transistors - Three different configurations - Advantages of common emitter configuration - working of NPN transistor as an amplifier in common emitter configuration.

UNIT- V:QUANTUM PHYSICS	**9+3**

Introduction to quantum physics, black body radiation, Compton effect, de Broglie hypothesis, wave – particle duality, uncertainty principle, Schrodinger wave equation (Time dependent and Time independent), particle in a box, Extension to three dimension - Degeneracy.

TEXT BOOKS

1. Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publications, 2009.
2. Avadhanulu M. N. "Engineering Physics" (Volume I and II), S. Chand & Company Ltd., New Delhi, 2010.

REFERENCE BOOKS

1. Palanisamy P. K., "Engineering Physics", Scitech Publications (India) Pvt. Ltd, Chennai.
2. Arumugam M., "Engineering Physics" (Volume I and II), Anuradha Publishers, 2010.
3. Senthil Kumar G., " Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2011.
4. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2007.

E RESOURCES

NPTEL, Engineering Physics, Prof. M. K. Srivastava, Department of Physics, IIT, Roorkee.

REFERENCE BOOKS

4. Samir Kumar Ghosh, "A text book of Advanced Practical Physics", New Central Agency (P) Ltd, 2008.
5. Arora C.L., "Practical Physics", S. Chand & Company Ltd., New Delhi, 2013.
6. UmayalSundari AR., "Applied Physics Laboratory Manual", PMU Press, Thanjavur, 2012.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	**15**	**0**	**60**

Mapping of COs with 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	PSO 1	PSO 2
CO 1	3	2	2	1					1			1	3	2
CO 2	3		1		1							1	3	3
CO 3	3	2	2	2	1				1			1		
CO 4	3	2	2	2	1				1			1	2	3
CO 5	3		2									1		
Total	15	6	9	6	4				3			5	8	8
Scaled	3	2	2	2	1				1			1	2	2

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

APPLIED CHEMISTRY FOR ENGINEERS

Course Outcomes (PAC 103):		**Domain**	**Level**
CO1	**Identify** the periodic properties such as ionization energy, electron affinity, oxidation states and electro negativity. **Describe** the various water quality parameters like hardness and alkalinity.	Cognitive	Remember
CO2	**Explain** and **Measure** microscopic chemistry in terms of atomic, molecular orbitals and intermolecular forces.	Cognitive	Understand
CO3	**Interpret** bulk properties and processes using thermodynamic and kinetic considerations.	Cognitive	Apply
CO4	**Describe, Illustrate** and **Discuss** the chemical reactions that are used in the synthesis of molecules.	Cognitive	Remember Analyze
CO5	**Apply, Measure** and **Distinguish** the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques	Cognitive	Remember Apply

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PAC103	**APPLIEDCHEMISTRY FOR ENGINEERS**	**3**	**1**	**0**	**4**
PREREQUISITES	**Nil**	**L**	**T**	**P**	**H**
C:P: A = 3:0:0		**3**	**1**	**0**	**4**

UNIT - I: PERIODIC PROPERTIES AND WATER CHEMISTRY	9+3
Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries. **Water Chemistry**-Water quality parameters-Definition and explanation of hardness, determination of hardness by EDTA method-Introduction to alkalinity.	
UNIT – II:USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA	**9+3**
Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion-Types, factors affecting corrosion rate and Control methods. Use of free energy considerations in metallurgy through Ellingham diagrams. Advantages of electroless plating, electroless plating of nickel and copper on Printed Circuit Board (PCB).	

UNIT- III: ATOMIC AND MOLECULAR STRUCTURE	9+3

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Intermolecular forces and potential energy surfaces

Ionic, dipolar and Vander waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

UNIT – IV: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	9+3

Principles of spectroscopy and selection rules. Electronic spectroscopy-chromophore, auxochromes, types of electronic transition and application. Fluorescence and its applications in medicine. Vibrational spectroscopy-types of vibrations, Instrumentation and applications. Rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance spectroscopy-concept of chemical shift and applications-magnetic resonance imaging. Diffraction and scattering.

UNIT – V: STEREOCHEMISTRY AND ORGANIC REACTIONS	9+3

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization reactions and ring opening reactions. Synthesis of a commonly used drug molecule-Aspirin and paracetamol.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	0	60

TEXT BOOKS

9. Puri B.R. Sharma, L.R., Kalia K.K. Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., 1993
10. Lee. J.D. Concise Inorganic Chemistry, UK, Black well science, 2006.
11. Trapp. C, Cady, M. Giunta. C, Atkins's Physical Chemistry, 10th Edition, Oxford publishers, 2014.
12. Glasstone S., Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co. Ltd, 1983.
13. Morrison R.T. and Boyd R.N. Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., 1976.
14. Banwell. C.N, Fundamentals of Molecular Spectroscopy, (3th Edition), McGraw-Hill Book Company, Europe 1983.
15. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (4th edition), S./ Chand & Company Ltd. New Delhi, 1977.
16. P. S. Kalsi, Stereochemistry: Conformation and mechanism, (9th Edition), New Age International Publishers, 2017.

REFERENCE BOOKS

4. Puri B R Sharma L R and Madan S Pathania, "Principles of Physical Chemistry", Vishal publishing Co., Edition 2004
2. Kuriocose, J C and Rajaram, J, "Engineering Chemistry", Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000

E RESOURCES - MOOCS:

7. http://www.moocslist.com/course/chemistry-minor-saylororg
8. https://www.canvas.net/courses/exploring-chemistry
9. http://freevideolectures.com/Course/2263/Engineering-Chemistry-I
10. http://freevideolectures.com/Course/3001/Chemistry-I
11. http://freevideolectures.com/Course/3167/Chemistry-II
12. http://ocw.mit.edu/courses/chemistry/

REFERENCE BOOKS

3. Mendham, Denney R.C. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004.
4. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003.

E RESOURCES - MOOCS:

1.http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques
2. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011
3.http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques

Mapping of COs with POs

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	0	0	0	0	0	2	3	3	0	0	0	1	2
CO2	2	0	0	0	0	0	1	2	2	0	0	0	1	1
CO3	3	0	0	0	0	0	2	3	3	0	0	0	0	0
CO4	3	0	0	0	0	0	3	3	3	0	0	0	0	0
CO5	3	0	0	0	0	0	2	2	3	0	0	0	0	0
Total	14	0	0	0	0	0	10	13	14	0	0	0	2	3
Scaled	3	0	0	0	0	0	2	3	3	0	0	0	1	1

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

0-No Relation, 1- Low Relation, 2-Medium Relation, 3-High Relation

COURSE CODE	COURSE NAME	L	T	P	C
	ELECTRICAL CIRCUIT ANALYSIS	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 1 : 0		**3**	**1**	**0**	**4**

Course Outcomes:		**Domain**	**Level**
CO1	**Illustrate** network theorems for the analysis of electrical circuits.	Cognitive	Apply
CO2	**Obtaining** the transient and steady-state response of R, RL and RLC electrical circuits.	Cognitive	Understanding
CO3	**Analyze** circuits in the sinusoidal steady-state (single-phase and three-phase).	Cognitive	Analyze
CO4	**Analysis** of AC circuits using Laplace transforms.	Cognitive	Analyze
CO5	To **Understand** the behavior of one port and two port network functions.	Cognitive	Understanding

UNIT - I: NETWORK THEOREMS	**9 + 3**

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

UNIT - II: SOLUTION OF FIRST AND SECOND ORDER NETWORKS	**8 + 3**

Solution of first and second order differential equations for Series and parallel R-L, R-C, RL-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT - III: SINUSOIDAL STEADY STATE ANALYSIS	**8 + 3**

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

UNIT - IV: ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS	**8 + 3**

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances.

UNIT- V: NETWORK FUNCTIONS AND TWO PORT NETWORKS	**12 + 3**

Concepts of complex frequency, Transform impedance, Networks function of one port and two port networks, concepts of poles and zeros, property of driving point and transfer function. Two Port Networks, terminal pairs, Relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

TEXT BOOKS:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2019.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 2013.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.

REFERENCE BOOKS:

1. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2013.
2. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.
3. Sudhakar.A and ShyamMohan.S.P, “Circuits and Networks Analysis and Synthesis”, Fourth edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.

E-RESOURCES:

1. NPTEL: http://nptel.ac.in/courses/108102042/
2. MOODLE: http://moodle.cecs.pdx.edu/course/view.php?id=16

Mapping of COs with 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**	**PSO 1**	**PSO 2**
CO1	3	0	0	0	0	0	0	0	0	1	0	1	1	1
CO2	3	0	0	0	0	0	0	0	0	1	0	1	2	1
CO3	3	2	0	0	0	0	0	0	0	1	1	2	3	1
CO4	3	2	0	0	1	0	0	0	0	1	1	1	3	3
CO5	3	2	0	0	1	0	0	0	0	1	1	1	2	2
Total	**15**	**6**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**5**	**3**	**6**	**11**	**8**

Scaled	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**3**	**2**

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2– Medium Relation, 3 – High Relation

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
	ELECTRICAL CIRCUIT ANALYSIS LABORATORY	**0**	**0**	**1**	**1**
C : P : A		**L**	**T**	**P**	**H**
3 : 2 : 1		**0**	**0**	**2**	**2**

Course Outcomes:		**Domain**	**Level**
CO1	To understand & verify the network theorems for the analysis of electrical circuits.	Psychomotor	Understanding Guided Response
CO2	To understand & validate the network theorems for the analysis of electrical circuits.	Psychomotor	Understanding Guided Response
CO3	To understand &analyze electrical circuits in both sinusoidal and transient modes.	Psychomotor	Understanding Guided Response
CO4	To understand &measure the power and inductance of AC circuit.	Psychomotor	Understanding Guided Response
CO5	To understand & analyze the concept of RLC Series and parallel resonance circuits.	Psychomotor	Understanding Guided Response

Sl. No.	**List of Experiments**	**COs**
1.	Verification of KVL and KCL.	**CO1**
2.	Verification of Thevenin theorem.	**CO1**
3.	Verification of Norton theorem.	**CO2**
4.	Verification of Maximum power transfer theorem.	**CO2**
5.	Transient analysis of Series RL, RC circuits.	**CO3**
6.	Sinusoidal analysis of Series RL, RC circuits.	**CO3**
7.	Measurement of active power for star and delta connected balanced loads.	**CO4**
8.	Verification of self, mutual inductance and coefficient of coupling.	**CO4**
9.	Series Resonance Circuit.	**CO5**
10.	Parallel Resonance Circuit.	**CO5**
	PRACTICAL	**TOTAL**
	30	**30**

Mapping of COs with 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	PSO 1	PSO 2
CO1	3	0	0	0	0	0	0	0	0	1	0	1	1	1
CO2	3	0	0	0	0	0	0	0	0	1	0	1	2	1
CO3	3	2	0	0	0	0	0	0	0	1	1	2	3	1
CO4	3	2	0	0	1	0	0	0	0	1	1	1	3	3
CO5	3	2	0	0	1	0	0	0	0	1	1	1	2	2
Total	**15**	**6**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**5**	**3**	**6**	**11**	**8**
Scaled	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**3**	**2**

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

SEMESTER II
CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE

COURSE CODE	COURSE NAME	L	T	P	C
	CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE	**3**	**1**	**0**	**4**
Prerequisite	**Mathematics - I (Calculus and Linear Algebra)**	**L**	**T**	**P**	**H**
C : P : A		**3**	**1**	**0**	**4**
3 : 0 : 0					

Course Outcomes:		**Domain**	**Level**
CO1	**Find** double and triple integrals and to find line, surface and volume of an integral by **Applying** Greens, Gauss divergence and Stokes theorem.	Cognitive	Applying Remembering
CO2	**Solve** first order differential equations of different types which are solvable for p, y, x and Clairaut's type.	Cognitive	Applying
CO3	**Solve** Second order ordinary differential equations with variable coefficients using various methods.	Cognitive	Remembering
CO4	**Use** CR equations to verify analytic functions and to find harmonic functions and harmonic conjugate. Conformal mapping of translation and rotation. Mobius transformation.	Cognitive Psychomotor	Understanding Remembering Guided Response
CO5	**Apply** Cauchy residue theorem to evaluate contour integrals involving sine and cosine function and to state Cauchy integral formula, Liouvilles theorem. Taylor's series, zeros of analytic functions, singularities, Laurent's series.	Cognitive Affective	Applying Receiving

UNIT - I: MULTIVARIABLE CALCULUS (INTEGRATION)	**9 + 3**
Multiple Integration: Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Triple integrals (Cartesian), Scalar line integrals - vector line integrals - scalar surface integrals - vector surface integrals - Theorems of Green, Gauss and Stokes.	

UNIT - II: FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS	9 + 3
Exact - linear and Bernoulli's equations - Euler's equations - Equations not of first degree: equations solvable for p - equations solvable for y- equations solvable for x and Clairaut's type.	
UNIT - III: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS	**9 + 3**
Second order linear differential equations with variable coefficients- method of variation of parameters - Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties.	
UNIT - IV: COMPLEX VARIABLE – DIFFERENTIATION	**9 + 3**
Differentiation – Cauchy - Riemann equations - analytic functions - harmonic functions - finding harmonic conjugate - elementary analytic functions (exponential, trigonometric, logarithm) and their properties - Conformal mappings - Mobius transformations and their properties.	
UNIT - V: COMPLEX VARIABLE – INTEGRATION	**9 + 3**
Contour integrals - Cauchy-Goursat theorem (without proof) - Cauchy Integral formula (without proof)- Liouville's theorem (without proof)- Taylor's series- zeros of analytic functions- singularities- Laurent's series – Residues- Cauchy Residue theorem (without proof)- Evaluation of definite integral involving sine and cosine- Evaluation of certain improper integrals using the Bromwich contour.	

	LECTURE	TUTORIAL	TOTAL
	45	15	60

TEXT BOOKS:

3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40thth Edition, 2008.

REFERENCE BOOKS:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdn. Wiley India, 2009.
4. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
6. E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
7. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., McGraw Hill, 2004.
8. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

Mapping of COs with POs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
TOTAL	15	8			3					5		7
Scaled	3	2	0	0	1	0	0	0	0	1	0	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ANALOG ELECTRONICS

Course Outcomes (PEE 203):		Domain	Level
CO1	Understand the characteristics of diode and analyze the	Cognitive	Understand

	rectifier circuits.		Analyze
CO2	Understand the characteristics of transistor.	Cognitive	Understand
CO3	Understand the concept of MOSFET and analyze the circuits and its characteristics	Cognitive	Understand Analyze
CO4	Classify and explain different types of amplifier	Cognitive	Understand
CO5	Recall and explain linear and non-linear application of OP-Amp	Cognitive	Understand

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE 203	**ANALOG ELECTRONICS**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT –I: DIODE CIRCUITS	**6**
P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, Special diodes, clamping and clipping circuits.	
UNIT – II:BJT CIRCUITS	**8**
Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.	
UNIT - III:MOSFET CIRCUITS	**8**
MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.	
UNIT- IV:DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS	**8**
Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)	
UNIT - V: LINEAR ANDNONLINEARAPPLICATIONS OF OP-AMP	**15**
Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wien bridge and phase shift). Analog to Digital Conversion.Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector, Monoshot.	

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXTBOOKS

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.

REFERENCES

1. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
2. P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.
3.Department Lab Manual.

E REFERENCES
1. www.nptel.ac.in.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3									1		1	3	3
CO 2	3									1		1	3	3
CO 3	3	2								1	1	2	3	3
CO 4	2	2			1					1	1	1	3	3
CO 5													3	3
Total	11	4			1					4	2	5	15	15
Scaled	2	1			1					1	1	1	3	3

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

COURSE CODE	COURSE NAME	L	T	P	C
PEE 202	ELECTROMAGNETIC FIELDS	3	1	0	4
C:P: A = 3:0:0		L	T	P	H
		3	1	0	4

Course Outcomes (PEE 202):		DOMAIN	LEVEL
CO1	To understand the basics of vector and outline different coordinate system.	Cognitive	Remembering Understanding
CO2	To understand the concept of static electric field for simple configuration using Gauss and Coulombs law.	Cognitive	Understanding
CO3	Define the knowledge of electrostatics using, boundary conditions, Poisson's and Laplace equation.	Cognitive	Understanding
CO4	Recall the magnetic field configuration using Different laws and outline time varying electric and magnetic fields using Maxwell's equation.	Cognitive	Remembering Understanding
CO5	Recall the concept of magnetization and magnetic field configuration using boundary condition.	Cognitive	Understanding

UNIT- I: REVIEWOFVECTORCALCULUS	9+3
Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.	
UNIT- II:STATIC ELECTRIC FIELD	**9+3**
Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.	
UNIT – III:CONDUCTORS, DIELECTRICS AND CAPACITANCE	**9+3**
Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two-wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.	
UNIT–IV: STATIC MAGNETIC FIELDS, TIME VARYING FIELDS AND MAXWELL'S EQUATIONS	**9+3**
Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Condit ions. Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic circuits, inductances and mutual inductances.	
UNIT - V:ELECTROMAGNETIC WAVES	**9+3**
Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.	

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXTBOOKS

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, NewDelhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.

4. G. W. Carter, “The electromagnetic field in its engineering aspects”, Longmans, 1954.

REFERENCES

1. W. J. Duffin, “Electricity and Magnetism”, McGraw Hill Publication, 1980.
2. W. J. Duffin, “Advanced Electricity and Magnetism”, McGraw Hill, 1968.
3. E. G. Cullwick, “The Fundamentals of Electromagnetism”, Cambridge University Press,1966.
4. B. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, International Edition, 1971.
5. W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education, 2012.

REFERENCES

1. NPTEL :http://nptel.ac.in/courses

Mapping of COs with 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	PSO 1	PSO 2
CO1	2	2	-	1	-	-	-	-	-	1	-	1	1	1
CO2	1	2	-	1	-	-	-	-	-	-	1	-	2	1
CO3	1	2	-	-	-	-	-	-	-	-	-	1	1	2
CO4	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	2	1	-	-	-	-		-	-	-	1	1	1
Total	6	11	1	3	0	0	0	0	0	1	1	3	7	7
Scaled	2	3	1	1	0	0	0	0	0	1	1	1	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

COURSE CODE	COURSE NAME	L	T	P	C
	ELECTRICAL MACHINES – I	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**1**	**0**	**4**

Course Outcomes:		**Domain**	**Level**
CO1	Understand the operation of DC machines.	Cognitive Psychomotor	Understand Perception
CO2	Understand the winding concepts of DC machine.	Cognitive Psychomotor	Understand Complex Overt Response
CO3	Understand the motoring and generating concepts of DC machine.	Cognitive Psychomotor	Understand Set
CO4	Analyze single phase and three phase transformers circuits.	Cognitive Psychomotor	Analyse Set
CO5	Understand the various loss in magnetic circuits	Cognitive Psychomotor	Understand Set

UNIT - I: INTRODUCTION TO DC MACHINES	**9 + 3**

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil.	
UNIT - II: DC MACHINES – ARMATURE AND WINDING	**9 + 3**
Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.	
UNIT - III: DC MACHINE - MOTORING AND GENERATION	**8 + 3**
Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.	
UNIT - IV: TRANSFORMERS AND TEST	**10 + 3**
Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test- separation of hysteresis and eddy current losses.	
UNIT - V: AUTO TRANSFORMERS	**9 + 3**
Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current.	

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

TEXT BOOKS:

1. A.E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2018.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

REFERENCE BOOKS:

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Mapping of COs with 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**	**PSO 1**	**PSO 2**
CO1	3	2	2	2	1	0	0	0	1	0	0	1	1	0
CO2	3	0	2	1	0	0	0	1	0	0	0	1	0	1
CO3	3	0	0	1	0	0	0	1	0	0	1	0	0	1
CO4	3	2	2	2	1	0	1	0	0	1	0	1	0	1
CO5	3	0	0	1	0	0	0	0	0	1	0	0	0	1
Total	**15**	**4**	**6**	**7**	**2**	**0**	**1**	**2**	**1**	**2**	**1**	**3**	**1**	**4**

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

COURSE CODE	COURSE NAME	L	T	P	C
	ELECTRICAL MACHINES – I LABORATORY	**0**	**0**	**1**	**1**
C : P : A		**L**	**T**	**P**	**H**
0 : 1 : 0		**0**	**0**	**2**	**2**

COURSE OBJECTIVES:

- To introduce the different types of DC motor and generator.
- To analysis the various characteristics of performance machines.
- To expose the students to practical implementations.

Course Outcomes:		**Domain**	**Level**
CO1	Understand the operation of DC machines.	Cognitive Psychomotor	Understand Perception
CO2	Understand the winding concepts of DC machine.	Cognitive Psychomotor	Understand Complex Overt Response
CO3	Understand the motoring and generating concepts of DC machine.	Cognitive Psychomotor	Understand Set
CO4	Analyse single phase and three phase transformers circuits.	Cognitive Psychomotor	Analyze Set
CO5	Understand the various loss in magnetic circuits.	Cognitive Psychomotor	Understand Set

Sl. No.	**List of Experiments**	**COs**
1.	Study of D.C. Motor Starters.	**CO1**
2.	Open Circuit Characteristics (OCC) and load Characteristics of D.C self-excited generator.	**CO2**
3.	Load characteristics of D.C shunt generator.	**CO2**
4.	Load characteristics of D.C. shunt motor.	**CO2**
5.	Load characteristics of D.C series motor.	**CO3**
6.	Speed control of D.C shunt motor.	**CO4**
7.	Load test on single-phase transformer.	**CO5**
8.	Open circuit and short circuit tests on single phase transformer.	**CO5**
	PRACTICAL	**TOTAL**
	30	**30**

Mapping of COs with 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**	**PSO 1**	**PSO 2**
CO1	3	2	2	2	1	0	0	0	1	0	0	1	1	0
CO2	3	0	2	1	0	0	0	1	0	0	0	1	0	1
CO3	3	0	0	1	0	0	0	1	0	0	1	0	0	1

CO4	3	2	2	2	1	0	1	0	0	1	0	1	0	1
CO5	3	0	0	1	0	0	0	0	0	1	0	0	0	1
Total	**15**	**4**	**6**	**7**	**2**	**0**	**1**	**2**	**1**	**2**	**1**	**3**	**1**	**4**

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation,
3 – High Relation

SEMESTER 3

TRANSMISSION AND DISTRIBUTION

Course Outcomes (PEE 301):		**Domain**	**Level**
CO1	**Explain** the major components of Transmission and Distribution Systems (TDS). **Classify** different types of single and three phase transmission line parameters.	Cognitive	Understanding Understanding
CO2	**Outline** the types of transmission line efficiency calculations and its performance	Cognitive	Understanding
CO3	**Explain** the different types of insulators and **solve** for stress and sag in overhead lines.	Cognitive	Understanding Applying
CO4	**Interpret** different types underground cables.	Cognitive	Understanding
CO5	**Summarize** the latest technologies in the field of distribution systems.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE301	**TRANSMISSION AND DISTRIBUTION**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT –I: TRANSMISSION LINE PARAMETERS	**9**
Structure of electric power system: Various levels such as generation, transmission and distribution; – Resistance, Inductance and Capacitance calculations – Single-phase and three-phase lines – double circuit lines – effect of earth on transmission line capacitance.	
UNIT- II: PERFORMANCE OF TRANSMISSION LINES	**9**
Regulation and efficiency – Tuned power lines, Power flow through a transmission line – Power circle diagrams, Introduction to Transmission loss and Formation of corona – critical voltages – effect on line performance – travelling waveform phenomena.	
UNIT –III: MECHANICAL DESIGN OF OVERHEAD LINES	**9**
Line supports – Insulators, Voltage distribution in suspension insulators – Testing of insulators – string efficiency – Stress and sag calculation – effects of wind and ice loading.	
UNIT – IV: UNDERGROUND CABLES	**9**

Comparison with overhead line – Types of cables – insulation resistance – potential gradient – capacitance of single-core and three-core cables.
UNIT –V: DISTRIBUTION SYSTEM **9**
General aspects – Kelvin's Law – A.C. distribution – Single-phase and three phase – Techniques of voltage control and power factor improvement – Introduction to Distribution loss – Recent trends in transmission and distribution systems

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXTBOOKS

1.D.P. Kothari and I.J. Nagrath, 'Power System Engineering', Tata McGrawHill,2nd Edition, 2008.
2.B.R. Gupta, 'Power System Analysis and Design', S.Chand, New Delhi, 2003.
3.S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall India Pvt. Ltd, 2002.

REFERENCES

1.Luces M.Fualkenberry ,Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 1996.
2.Hadisaddak, 'Power System Analysis,' Tata McGraw Hill Publishing Company',2003
3.Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning', New Delhi
4.Tamil Nadu Electricity Board Handbook', 2012.

E REFERENCES

1.NPTEL, Power System Generation, Transmission and Distribution Prof. D. P. Kothari Center for Energy Studies Indian Institute of Technology, Delhi.

Mapping of COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	3								1		2	2	1
CO2	1	3	1		1							1	3	1
CO3	1			1	1					1			2	1
CO4	1	2									1	1	2	1
CO5	1	2										1	2	1
Total	5	10	1	1	1	0	0	0	0	3	1	5	11	5
Scaled	2	3	1	1	1	0	0	0	0	1	1	2	3	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ENVIRONMENTAL SCIENCES

Course Outcomes (PEE 302):		**DOMAIN**	**LEVEL**
CO1	**Describe** the significance of natural resources and **explain** anthropogenic impacts.	Cognitive	Remember Understand
CO2	**Illustrate** the significance of ecosystem, biodiversity and natural geo bio chemical cycles for maintaining ecological balance.	Cognitive	Understand
CO3	**Identify** the facts, consequences, preventive measures of major pollutions and **recognize** the disaster phenomenon	Cognitive Affective	Remember Receive
CO4	**Explain** the socio-economic, policy dynamics and**practice** the control measures of global issues for sustainable development.	Cognitive	Understand Apply
CO5	**Recognize** the impact of population and the concept of various welfare programs, and **apply** themodern technology towards environmental protection.	Cognitive	Understand Analysis

COURSE CODE	COURSE NAME	L	T	P	C
PEE 302	ENVIRONMENTAL SCIENCES	3	0	0	3
C:P: A = 1:0:0		L	T	P	H
		3	0	0	3

UNIT – I:INTRODUCTION TO ENVIRONMENTAL STUDIES AND ENERGY	12
Definition, scope and importance – Need for public awareness – Forest resources: Use, deforestation, case studies. – Water resources: Use and over-utilization of surface and ground water, dams-benefits and problems – Mineral resources: Uses, environmental effects of mining, case studies-iron mining(Goa), bauxite mining(Odisha) – Food resources: effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, 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 – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.	
UNIT – II: ECOSYSTEMS AND BIODIVERSITY	**7**
Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Biogeochemical cycles – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	
UNIT – III:ENVIRONMENTAL POLLUTION	**10**
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management– Role of an individual in prevention of pollution – Pollution case studie eles – Disaster management: flood, earthquake, cyclone and landslide.	
UNIT – IV: SOCIAL ISSUES AND THE ENVIRONMENT	**10**
Rain water harvesting – Resettlement and rehabilitation of people; its problems and concerns, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act–Wildlife Protection Act–Forest Conservation Act – Public awareness.	
UNIT – V: HUMAN POPULATION AND THE ENVIRONMENT	**6**
Population growth, variation among nations – Population explosion– Environment and human health – HIV / AIDS– Role of Information Technology in Environment and human health.	

LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
45	0	0	0	45

TEXT BOOKS

1. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co, USA, 2000.
2. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science, UK, 2003
3. Trivedi R. K and P.K.Goel, Introduction to Air pollution, Techno Science Publications, India, 2003.
4. Disaster mitigation, Preparedness, Recovery and Response, SBS Publishers & Distributors Pvt. Ltd, New Delhi, 2006.
5. Introduction to International disaster management, Butterworth Heinemann, 2006.
6. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, New Delhi, 2004.

REFERENCE BOOKS

1. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media, India, 2009.
2. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
3. S.K.Dhameja, Environmental Engineering and Management, S.K.Kataria and Sons, New Delhi, 2012.
4. Sahni, Disaster Risk Reduction in South Asia, PHI Learning, New Delhi, 2003.
5. Sundar, Disaster Management, Sarup& Sons, New Delhi, 2007.
6. G.K.Ghosh, Disaster Management, A.P.H.Publishers, New Delhi, 2006.

E RESOURCES

1. http://www.e-booksdirectory.com/details.php?ebook=10526
2. https://www.free-ebooks.net/ebook/Introduction-to-Environmental-Science
3. https://www.free-ebooks.net/ebook/What-is-Biodiversity
4. https://www.learner.org/courses/envsci/unit/unit_vis.php?unit=4
5. http://bookboon.com/en/pollution-prevention-and-control-ebook
6. http://www.e-booksdirectory.com/details.php?ebook=8557
7. http://www.e-booksdirectory.com/details.php?ebook=6804
8. http://bookboon.com/en/atmospheric-pollution-ebook
9. http://www.e-booksdirectory.com/details.php?ebook=3749
10. http://www.e-booksdirectory.com/details.php?ebook=2604
11. http://www.e-booksdirectory.com/details.php?ebook=2116
12. http://www.e-booksdirectory.com/details.php?ebook=1026
13. http://www.faadooengineers.com/threads/7894-Environmental-Science

SIGNALS AND SYSTEMS

Course Outcomes (PEE 303):		**Domain**	**Level**
CO1	Understand the concepts of continuous time and discrete time systems.	Cognitive	Understand
CO2	Analyse systems in complex frequency domain.	Cognitive	Analyse
CO3	Learn about Fourier transformation techniques	Cognitive	Remembering
CO4	Learn about Laplace transformation techniques	Cognitive	Remembering
CO5	Learn about Z- transformation techniques	Cognitive	Remembering

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE 303	**SIGNALS AND SYSTEMS**	**2**	**1**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		2	**1**	**0**	**3**

UNIT - I: INTRODUCTION TO SIGNALS AND SYSTEMS — **9**

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability. Examples.

UNIT – II: BEHAVIOUR OF CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS — **9**

Impulse response and step response, convolution, input-output behaviour with aperiodic convergent input, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of

systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its Relation to the impulse response.	
UNIT – III: FOURIER TRANSFORMS	**9**
Fourier series representation of periodic signals, Waveform Symmetries, Fourier Coefficients, harmonic spectrum and THD. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Application to simple circuits.	
UNIT – IV: LAPLACE TRANSFORMS	**6**
Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behaviour. Application to simple circuits.	
UNIT – V: Z - TRANSFORMS AND SAMPLING RECONSTRUCTION	**12**
The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis. The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.	

	LECTURE	**TUTORIAL**	**TOTAL**
	30	**15**	**45**

TEXTBOOKS

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.

REFERENCES

1. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, PrenticeHall, 2009.
2. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education,2007.
3. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

Mapping of COs with POs

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	3	2	2	2	1				1			1	1	0
CO 2	3	3	2	1		3		1				2		1
CO 3	3			1		3		1			1			1
CO 4	3	2	2	2	1		1			2		2		1
CO 5	3			1						2				1
Total	15	7	6	7	2	6	1	2	1	4	1	5	1	4
Scaled	3	2	1	1	1	1	1	1	1	1	1	1	1	1

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ELECTRICAL MACHINES – II

Course Outcomes (PEE 304):		Domain	Level
CO1	To Understand the fundamentals of different types of slots and windings used for AC machines.	Cognitive Psychomotor	Understanding Mechanism
CO2	To Understand the concepts of pulsating and revolving magnetic fields.	Cognitive Psychomotor	Understanding Mechanism
CO3	To Understand the operation of induction machines, ttorque slip characteristics, equivalent circuit and its phasor diagram.	Cognitive Psychomotor	Understanding Mechanism
CO4	To Understand the different typesof starting, braking and speed control for induction motors. React the generator operation, self-excitation and doubly-fed Induction machines.	Cognitive Psychomotor	Understanding Response
CO5	To Understand the operation of single-phase induction motors and its performance parameters.	Cognitive Psychomotor	Understanding Perception

COURSE CODE	COURSE NAME	L	T	P	C
PEE 304	ELECTRICAL MACHINES – II	3	0	1	4
C:P: A = 3:1:0		L	T	P	H
		3	0	2	5

UNIT - I: FUNDAMENTALS OF AC MACHINE WINDINGS **9+6**

Physical arrangement of windings in stator and cylindrical rotor–Slots for windings –Single-turn coil –Active portion and overhang –Full-pitch coils–Types of windings– 3D visualization of the above winding types– Air-gap MMF distribution with fixed current through winding –Winding distribution factor.

List of Experiments

1. Load test on three phase squirrel cage induction motor.
2. Load test on three phase slip ring induction motor.
3. Load test of a three-phase alternator.
4. Load test on single-phase induction motor.

UNIT – II:PULSATING AND REVOLVING MAGNETIC FIELDS **9+6**

Types of magnetic fields –Alternating current in windings with spatial displacement – Magnetic field produced by a single winding – Fixed current and alternating current. Pulsating fields produced by spatially displaced windings– Windings spatially shifted by 90° – Three windings spatially shifted by 120° (carrying three-phase balanced currents) – Revolving magnetic field.

List of Experiments

5. No load and blocked rotor test on single phase induction motor.
6. No load and blocked rotor test on three phase induction motor.

UNIT- III:INDUCTION MACHINES **9+6**

Constructional details –Types of rotors (squirrel cage and slip-ring) – Torque Slip Characteristics – Equivalent circuit – Phasor Diagram– Effect of parameter variation on torque speed characteristics – Methods of starting, braking and speed control for induction motors–Generator operation –Self-excitation– Doubly-Fed Induction Machines.

List of Experiments

13. Regulation of three phase alternator by EMF /MMF methods.
14. V and inverted V curves of three phase synchronous motor.

UNIT – IV:SINGLE PHASE INDUCTION MOTORS	9+6
Constructional details of single-phase induction motor – Double revolving field theory and operation – Equivalent circuit – Determination of parameters – Split-phase starting methods and applications. **List of Experiments** 9. OCC and load characteristics of three phase alternator.	
UNIT – V:SYNCHRONOUS MACHINES	**9+6**
Constructional details – Cylindrical rotor synchronous machine– EMF equation –Equivalent circuit – Phasor diagram–Armature reaction–Voltage regulation– V-curves. Salient pole machine – Two reaction theory –Phasor diagram –Power angle characteristics. Synchronizing and parallel operation. (Basic operation of synchronous motors) **List of Experiments** 10. Study of induction motor starters.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	30	75

TEXTBOOKS

1. I. J. Nagrath and D. P. Kothari, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2010.
2. M. G. Say, 'Performance and Design of AC Machines', CBS Publishers, 2002.
3. P. S. Bimbhra, 'Electrical Machinery', Khanna Publishers, 2011.
4. B.L.Theraja, 'A Textbook of Electrical Technology', Vol. I & II, M/s S.Chand, Delhi,2013.

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1. A. E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', Tata McGraw Hill publishing Company Ltd, 2013.
2. A. S. Langsdorf, 'Alternating Current Machines', Tata McGraw Hill publishing Company Ltd, 1984.
3. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.
4. J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2002.
5. Deshpande M.V., 'Electrical Machines', PHI Learning Pvt Ltd., New Delhi – 2011.
6. A. G. Warren, 'Problems in Electrical Engineering', Parker and Smith Solutions, New York, 1940.
7. K. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt Ltd, 2002.
8. Department Laboratory Manual.

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1. http://freevideolectures.com/Course/2335/Basic-Electrical-Technology35-38, Prof. L. Umanand, IISc Bangalore.

Mapping of COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	2	2	1	0	0	0	0	0	0	2	2	1
CO 2	3	2	2	2	1	0	0	0	0	0	0	1	2	1
CO 3	3	2	2	2	1	0	0	0	0	0	0	1	1	1
CO 4	2	2	1	3	2	0	0	0	0	0	0	1	1	1
CO 5	3	0	0	0	1	0	0	0	0	0	0	1	1	1
Total	14	8	7	9	6	0	0	0	0	0	0	6	7	5

Scaled	3	2	2	2	1	0	0	0	0	0	0	1	2	1

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

SEMESTER IV

DIGITAL ELECTRONICS

Course Outcomes (PEE 401):		**Domain**	**Level**
CO1	Understand numerical values in various number systems and show number conversions between different number Systems.	Cognitive	Understanding
CO2	Analyze Boolean functions and minimization techniques using k –maps and postulates and theorems of Boolean Algebra, minimization of Boolean functions using basic laws.	Cognitive	Analyze
CO3	TO Apply Logic gates and their applications and construct the simple adders and sub tractors using logic gates.	Cognitive	Apply
CO4	To Understand the process of Analog to Digital conversion and its applications.	Cognitive	Understanding
CO5	To Understand the process of Digital to Analog conversion and its applications.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE 401	**DIGITAL ELECTRONICS**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**CH**
		3	**0**	**0**	**3**

UNIT - I: FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES	**9**
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families.	
UNIT – II: COMBINATIONAL DIGITAL CIRCUITS	**9**
Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders Q-M method of function realization.	
UNIT – III: SEQUENTIAL CIRCUITS AND SYSTEMS	**9**
A 1-bit memory, the circuit properties of Bistable latch, JK, SR, D and T types flip-flops, applications of flip-flops, shift registers, applications of shift registers, Asynchronous counters, synchronous counters design using flip flops, special counter IC's, applications of counters.	
UNIT – IV: A/D AND D/A CONVERTERS	**9**
Digital to analog converters: weighted resistor/converter, R-2R Ladder DAC, specifications for D/A converters, examples of DAC lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator ADC, successive approximation ADC, specifications of ADC, example of ADC ICs.	

UNIT – V: SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES	9
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, ROM, RAM, content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, PLA, PAL, CPLDS, and FPGA.	

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXTBOOKS

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

REFERENCES

1. Taub and Schilling, 'Digital Integrated Circuits', McGraw Hill, 2002.
2. Samuel C. Lee “Digital Circuits and Logic Designs” Prentice Hall of India; 2000.
3. Fletcher, W.I., 'An Engineering Approach to Digital Design', Prentice Hall of India, 2002.
4. Anand Kumar, Fundamental of Digital circuits, PHI 2003.

E REFERENCES

1. NPTEL, Digital Logic Circuits, Prof. S.Srinivasan, IIT Madras.
2. NPTEL, Digital Logic Circuits, Prof. D. Roychoudhury, IIT Kharagpur.

Mapping of COs with 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	PSO 1	PSO 2
O1	2	1	3	-	-	1	1	1	-	1	-	2	2	1
O2	3	2	1	-	-	2	0	2	1	-	-	2	1	2
O3	2	2	1	-	-	1	2	2	1	1	-	1	2	2
O4	2	2	3	-	-	1	1	1	-	-	1	1	1	2
O5	3	2	2	-	-	0	1	1	1	1	1	2	2	2
tal	12	9	10	-	-	4	5	7	3	3	2	8	8	9
ale d	3	2	2			1	1	2	1	1	1	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ENERGY AUDITING AND MANAGEMENT

Course Outcomes (PEE E13):		Domain	Level
CO1	Understanding about basic energy auditing and requirements	Cognitive	Understanding
CO2	List the various techniques of the energy auditing techniques and procedures	Cognitive	Remembering
CO3	Understanding about the energy policy and planning	Cognitive	Understanding
CO4	Identify the losses and management improvement systems	Cognitive	Understanding
CO5	Analysis the conservation and saving opportunities	Cognitive	Understanding

Learning Objectives:

Understand about basic of energy auditing and planning. Understand about various techniques of energy auditing and procedures. Understand about analysis and evolution for final reporting.

COURSE CODE	COURSE NAME	L	T	P	C
PEE E13	ENERGY AUDITING AND MANAGEMENT	3	0	0	3
C:P: A		L	T	P	H
3:0:0		3	0	0	3

UNIT- I: INTRODUCTION	9
General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy. Energy Audit: Need, Types, Methodology and Approach. Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.	
UNIT- II: PROCEDURES AND TECHNIQUES	**9**
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. Evaluation of saving opportunities:	
UNIT- III: ENERGY POLICY PLANNING AND IMPLEMENTATION	**9**
Key Elements: Force Field Analysis, Energy Policy-Purpose, Perspective, Contents and Formulation. Format and Ratification, Organizing: Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability. Motivating – Motivation of employees, Requirements for Energy Action Planning. Information Systems: Designing, Barriers, Strategies, Marketing and Communicating Training and Planning.	
UNIT- IV: ENERGY BALANCE & MIS	**9**
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 Modeling and Optimization.	
UNIT- V: EVALUATIONOF SAVING OPPORTUNITIES	**9**
Determining the savings in Rs, Noneconomic factors, Conservation opportunities, estimating cost of implementation. Energy Audit Reporting: The plant energy study report- Importance, contents, effective organization, report writing and presentation	

	LECTURE	PRACTICAL	TOTAL
	45	0	45

TEXT BOOKS

1. Management of Energy Environment Systems -W.K.Foell (John Wiley and Sons).
2. Energy Management and Control Systems -M.C.Macedo Jr. (John Wiley and Sons).

REFERENCE BOOKS

1.Environmental Impact Analysis Handbook -J.G.Rau, D.C.Wood (McGraw Hill).
2.Energy & Environment – J.M. Fowler, (McGrawHill)

Mapping of COs with 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	PSO 1	PSO 2
CO1	1	2	1	0	2	0	1	0	1	0	0	0	0	3
CO2	1	1	0	1	2	0	2	0	0	0	0	0	3	1
CO3	1	2	3	1	2	0	1	1	1	0	0	0	1	2
CO4	0	2	2	1	1	0	1	0	0	0	0	1	0	1
CO5	2	1	1	2	0	1	3	1	1	0	0	1	0	1
Total	5	8	7	5	7	1	8	2	3	0	0	2	4	8
Scaled	1	3	2	2	2	1	3	1	1	0	0	1	2	3

0 - No Relation 1 – Low Relation 2 – Medium Relation3 – High Relation

HIGH VOLTAGE ENGINEERING

Course Outcomes (PEE E21):		**Domain**	**Level**
CO1	**Explain** the different causes of overvoltage and**Illustrate** overvoltage control due to switching. **Classify** the various methods for protection of lightning overvoltage	Cognitive	Understanding
CO2	**Explain** and **Classify** breakdown mechanisms in solid, liquid and gases dielectrics and list out the application of insulating materials	Cognitive	Understanding
CO3	**Able** to defineand **Classify**the different methods to generate the various types of high voltages and high currents	Cognitive	Understanding
CO4	**Classify** and **analyze** the different techniques used to measure the various types of high voltages and high currents.	Cognitive	Understanding Analyzing
CO5	**Recall andIllustrate** the different testing methods to test the various high voltage components of power System and **define** the International, Indian standards and insulation co-ordination.	Cognitive	Remembering Understanding

Learning Objectives:

- Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- Knowledge of generation and measurement of D. C., A.C., & Impulse voltages.
- Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
- Knowledge of how over-voltages arise in a power system, and protection against these over-voltages

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE E21	**HIGH VOLTAGE ENGINEERING**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT – I: OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS	**9**
Natural Causes of overvoltage-Lightning phenomena and its effects on power system – Over voltage due to switching surge-power frequency overvoltage-control of overvoltage due to switching – protection of transmission lines against overvoltage –Becoleys lattice diagram.	
UNIT- II: ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS	**9**

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-Applications of insulating materials.

UNIT – III: GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS | **9**

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

UNIT – IV: MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS | **9**

Measurement of High direct current voltages – measurement of voltages: alternating and impulse voltages and measurement of currents: direct, alternating and impulse currents. Digital techniques in high voltage measurement.

UNIT – V: HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS | **9**

International and Indian standards-Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment. -Insulation co-ordination.

	LECTURE	**TOTAL**
	45	**45**

TEXTBOOKS

1. E. Kuffel and M. Abdullah, 'High Voltage Engineering', Pergamon press, Oxford,2010.
2. M.S. Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill,4th Edition, 2004.
3. E. Kuffel and W.S. Zaengl, 'High Voltage Engineering Fundamentals', Pergamon Press, Oxford, London, 2012
4. August F.Metraux. "Some problems and actual limits of test techniques at extra high voltages",Haefely publications EIS 14.

REFERENCES

1. C.L.Wadhwa, 'High Voltage Engineering', New Age International (P) Ltd, 2nd Edition2006.
2. RavindraArora, Wolfgang Mosch, "High Voltage Insulation Engineering", New AgeInternational (P) Limited, 2011.
3. ChinnappaK.M., "Need for next higher voltage level in India", National seminar on high voltage AC and Dc Transmission,New Delhi

E-REFERENCES

1. Web Content - http://www.library.dce.edu/e-resources/books/ee/
2. NPTEL-High Voltage Engineering, C.L. Wadhwa -IIT Madras.

Mapping of COs with 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**	**PSO 1**	**PSO 2**
CO1	3	2	2	-	-	1	-	1	-	-	-	2	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	2
CO3	2	2	-	-	1	1	-	1	-	-	-	1	1	1
CO4	2	2	-	-	-	-	1	-	-	-	-	1	2	2
CO5	2	2	-	2	-	1	-	-	-	-	-	2	2	2
Total	12	10	2	2	1	3	1	2	0	0	0	7	8	9
Scaled	3	2	1	1	1	1	1	2	0	0	0	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

POWER ELECTRONICS

Course Outcomes (PEE 404):		Domain	Level
CO1	To Understand the structure, operation and characteristics of power switching devices.	Cognitive Psychomotor	Understanding
CO2	Determine the operation, characteristics and performance parameters of controlled rectifiers.	Cognitive Psychomotor	Understanding Response
CO3	Analysis the operation of DC - DC choppers.	Cognitive Psychomotor	Analyzing Mechanism
CO4	Analysis the operation of various inverters and infer the suitable PWM techniques.	Cognitive Psychomotor	Analyzing Mechanism
CO5	To Understand the concept of various types of AC voltage controllers.	Cognitive Psychomotor	Understanding Mechanism

COURSE CODE	COURSE NAME	L	T	P	C
PEE 404	POWER ELECTRONICS	3	0	1	4
C:P: A = 3:1:0		L	T	P	H
		3	0	2	5

UNIT - I: POWER SWITCHING DEVICES	**9+6**
Review on Semiconductor devices – I-V characteristics and Switching Characteristics of power Diodes, SCR, TRIAC, power BJT, power MOSFET and IGBT. Triggering and Commutation Circuits. **List of Experiments** 1. Characteristics of SCR. 2. Characteristics of MOSFET 3. Characteristics of IGBT	
UNIT – II: THYRISTOR RECTIFIERS	**9+6**
ngle phase half-wave and full-wave thyristor rectifiers – Single phase full-bridge thyristor rectifier with R-load and highly inductive load – Three phase full-bridge thyristor rectifier with R-load and highly inductive load. **List of Experiments** Single phase fully controlled rectifier with R, RL load	
UNIT- III: DC TO DC CHOPPERS	**9+6**
Types of Choppers, Class A to E, step-up and step-down choppers – Analysis of Voltage, Current and Load commutated choppers –Introduction to Resonant converters **List of Experiments** 5. BUCK- BOOST converter using MOSFET 6. IGBT based choppers.	
UNIT – IV: INVERTERS	**9+6**
Single phase, Three phase voltage source inverters (Both 120º and 180º mode of conductions) – Bipolar sinusoidal modulation and unipolar sinusoidal modulation, Modulation Index - PWM Techniques- Current Source Inverters. **List of Experiments** 7. Single phase IGBT PWM inverter. 8. Series Inverter/ Parallel Inverter.	
UNIT -V: AC VOLTAGE CONTROLLERS	**9+6**
Single-phase and three phase AC voltage controllers -. Multi-stage sequence control – step-up and	

step-down cycloconverter – Single phase to single phase and Single phase to Three phase cycloconverters.

List of Experiments

9.Single phase AC voltage controller using SCR / TRIAC

10. Single phase cycloconverter

11. Mini project: Design of basic power converter circuits.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	30	75

TEXTBOOKS

1. Rashid, M.H., 'Power Electronics: Circuits, Devices and Applications', Pearson Education India, 2009.
2. Singh, M.D and Kanchandani, 'Power Electronics',Tata McGraw Hill & Hill publication Company Ltd New Delhi, 2009.
3. Bimbhra, P.S., 'Power Electronics', Khanna Publishers, 2007.
4. Ned Mohan, Tore M. Undeland and William P.Robbins, 'Power Electronics:Converters,Applications and Design', New Jersey, John Wiley and Sons, 2007.

REFERENCES

1. Dubey, G.K., Doradia, S.R., Joshi, A. and Sinha, R.M., 'Thyristorised Power Controllers', Wiley Eastern Limited, 1986.
2. Lander,W., 'Power Electronics', McGraw Hill and Company, Third Edition, 2009.
3. Sen.P.C., 'Power Electronics', Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2005.
4. Joseph Vithayathil, 'Power Electronics', McGraw-Hill New York, 1996.
5. Erickson, R.W and Maksimovic, D., 'Fundamentals of Power Electronics', Springer Science & Business Media, 2007.
6. Umanand, L., 'Power Electronics: Essentials and Applications', Wiley India, 2009.
7. Department Laboratory Manual.

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1. Lecture Series on Power Electronics by Prof. B.G. Fernandes, Department of Electrical Engineering, IIT Bombay.
2. http://www.nptel.ac.in/courses/108105066/PDF/L-1(SSG)(PE)%20((EE)NPTEL).pdf

Mapping of COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
O 1	3	2	1	0	0	1	3	0	0	0	0	1	3	1
O 2	2	1	2	1	0	0	1	0	0	0	0	0	2	2
O 3	3	1	1	0	0	0	0	0	0	0	0	0	1	2
O 4	1	3	2	0	0	1	0	0	0	0	0	0	2	1
O 5	1	2	3	1	3	0	1	1	0	0	0	0	3	2
otal	10	9	9	2	3	2	5	1	0	0	0	1	11	8
ale d	2	2	2	1	1	1	1	1	0	0	0	1	3	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

SEMESTER V

POWER SYSTEMS-I
(APPARATUS AND MODELING)

Course Outcomes (PEE 501):		Domain	Level
CO1	Understand the concepts of power systems.	Cognitive	Understand
CO2	Understand the various power system components.	Cognitive	Understand
CO3	Evaluate fault currents for different types of faults.	Cognitive	Evaluate
CO4	Understand the generation of overvoltages and insulation coordination basic protection schemes.	Cognitive	Understand
CO5	Understand concepts of HVDC power transmission and renewable energy generation.	Cognitive	Understand

Learning Objectives: Able to demonstrate the principles and practices of the electrical power industry regarding generation, transmission, distribution and electrical machines and their controls.

COURSE CODE	COURSE NAME	L	T	P	C
PEE 501	POWER SYSTEMS-I	3	0	0	3
C:P: A = 3:0:0	(APPARATUS AND MODELING)	L	T	P	H
		3	0	0	3

UNIT -I: INTRODUCTION	**9**
Need for system analysis in planning and operation of modern power system – per phase analysis - Single line diagram - Per unit representation and Per unit calculations – Change of base – introduction to Electricity Deregulation.	
UNIT –II: MODELLING OF POWER SYSTEM COMPONENTS	**9**
Primitive network and its matrices – bus incidence matrix – bus admittance and bus impedance matrix formation – Z – Bus building algorithm - Modelling of generator, load, transformer, transmission line for different power system studies.	
UNIT – III: FAULT ANALYSIS-UNSYMMETRICAL FAULTS	**9**
Need for short circuit study - basic assumptions in fault analysis of power systems. Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage and currents. Introduction to symmetrical components – sequence impedances – sequence networks Unsymmetrical fault analysis: L-G, L-L and L-L-G faults.	
UNIT –IV: POWER FLOW ANALYSIS	**9**
Need for Power Flow Analysis – bus classification – derivation of power flow equation – solution by Gauss–Seidel, Newton–Raphson and Fast Decoupled Power Flow methods – comparison of three methods	
UNIT–V: STABILITY ANALYSIS	**9**
Types of stability - Swing equation in state space form - equal area criterion - stability analysis of single machine connected to infinite bus by modified Euler's method using classical machine model– critical clearing angle and time. Causes of voltage instability – voltage stability proximity indices for two-bus system – methods of improving power system stability.	

	LECTURE	PRACTICAL	TOTAL
	45	0	45

TEXT BOOKS

1. J.Grainger and W.D.Stevenson,"Power System Analysis", McGraw-Hill Education; 2nd edition (December 28, 2015)
2. O.I.Elgerd, "Electric Energy Systems Theory", Mc Graw Hill Education,1st July 2017.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 2nd Edition, 2009.

REFERENCES

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 4th Edition (29 June 2011)
2. B.M.Weedy, B.J.Cory, N.Jenkins,J.Ekanayake and G.Strbac, "Electric Power Systems", Wiley, 5th edition (December 26, 2012)

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www.nptel.ac.in
https://nptel.ac.in/courses/108104051/
https://nptel.ac.in/courses/108102047/

Mapping of COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3									1		1	3	2
CO 2	3									1		1	3	2
CO 3	3	2								1	1	2	3	2
CO 4	3	2			1					1	1	1	3	2
CO 5	3	2			1					1	1	1	3	2
Total	15	6	0	0	2	0	0	0	0	5	3	6	3	2
Scaled	3	1	0	0	1	0	0	0	0	1	1	1	1	1

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

BIO-MEDICAL INSTRUMENTATION

Course Outcomes(PEE E31):		**Domain**	**Level**
CO1	**Identify** the origin of bio-potentials and various bioelectric signals that are recorded routinely inmodern clinical practice.	Cognitive	Applying
CO2	**Explain** the various techniques of measuring blood flow, pressure & volume.	Cognitive	Understanding
CO3	**Describe** and apply the safety issues, safe design, and safe use of medical instrumentation, specifically electrical safety.	Cognitive	Remembering
CO4	**Choose** the appropriate amplifier and filters for medical instrumentation.	Cognitive	Applying
CO5	**Describe** the parameters constraining the resolution of CT, MRI & Ultrasound image.	Cognitive	Remembering

COURSECODE	COURSE NAME	L	T	P	C
PEE E31	BIO-MEDICAL INSTRUMENTATION	3	0	0	3
C:P: A=3:0:0		L	T	P	H
		3	0	0	3

UNIT-I: HUMAN SYSTEM AND BIO POTENTIAL ELECTRODES	**9**
Different types of human system, origin of bio-potential and its propagation. Electrode-electrolyte interface, electrode-skin interface, half-cell potential, Types of electrode, PH electrode, Recording problems, measurement with two electrodes - human cell structure.	
UNIT-II: ELECTRODE CONFIGURATION	**9**
Bio signals characteristics – frequency & amplitude ranges. ECG –Enthoven's triangle, standard 12 load system, PQPs waveform. EEG – 10-20 electrode system, brain waves, recording setup of EEG, EMG, ERG, and EOG – unipolar and bipolar mode.	
UNIT-III: BIO AMPLIFIER AND TRANSDUCER	**9**
Need for Bio –amplifier, power amplifier, isolation amplifier, feedback amplifier. Resistive, Inductive, Capacitive transducer and application, Fibre optic, photoelectric transducer – description, features applicable for biomedical instrumentation	
UNIT-IV: CARDIAC MEASUREMENTS	**9**
Blood pressure measurement – blood flow measurement – phonocardiography – vector cardiography. Heart lung machine –ventilator – Anesthetic machine – cardiac pacemaker - defibrillator patient safety - electrical shock hazards.	
UNIT-V: MEDICAL DIAGNOSTICS INSTRUMENTS AND SYSTEMS	**9**
CT scanner – MRI Scan and Ultrasonic scanner –X Ray – Laser Equipment and application- bio-telemetry Kidney dialysis machine – electron microscope – blood cell counter-Endoscopy	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT BOOKS

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 2007.
2. ArumugamM., "Bio Medical Instrumentation", Anuradha agencies Pub., 2012. C.Rajarao and S.K. Guha, "Principles of Medical Electronics and Bio-medicalInstrumentation", Universities press (India) Ltd, Orient Longman ltd, 2008.
3. J. Webster, 'Medical Instrumentation', John Wiley & Sons, 2003.

REFERENCE BOOKS

1. Cromwell, Weibeland Pfeiffer, 'Biomedical Instrumentation and Measurements', 2nd Edition, Prentice Hall of India, 2014.
2. Tompkins W.J., Biomedical Digital Signal Processing, Prentice Hall of India, 2008.
3. J. Wilson, J.F.B. Hawkes, 'Laser Principles and Applications', (Prentice-Hall, New York), (2006)

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http://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/Bio medical instrumentation

Mapping of COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	2	1	1	-	-	1	-	1	-	-	-	1	-
CO2	-	-	3	-	-	-	2	2	-	-	2	2	1	-
CO3	-	-	3	-	-	3	3	-	-	-	-	-	3	1
CO4	1	2	-	3		-	2	-	-	2	-	-	2	1
CO5	1	1	-	3	2	-	-	-	-	-	-	-	1	-
Total	4	5	7	6	2	3	8	2	1	2	2	2	8	2
Scaled	1	1	2	2	1	1	2	1	1	1	1	1	2	1

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

INDUSTRIAL ECONOMIICS AND FOREIGN TRADE

Course Outcomes:		**Domain**	**Level**
CO1	States the international trade theory	Cognitive	Remember
CO2	List the international trade policy	Cognitive	Remember
CO3	Outline economic scales	Cognitive	Remember
CO4	Distinguish the Human Aspects and Social Issues in TIM	Cognitive	Understanding
CO5	List the sustainability of technology	Cognitive	Remember

Learning Objectives:

Able to understand international trade theory
Able to know international trade policy
Able to understand the economics scales
Able to know economy macroeconomics
Able to know international monetary system

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
	INDUSTRIAL ECONOMIICS AND FOREIGN TRADE	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**
UNIT- I: INTRODUCTION TO INTERNATIONAL TRADE POLICY					**10**
The Law of Comparative Advantage - The Standard Theory of International Trade - Demand and Supply, Offer Curves, and the Terms of Trade - Factor Endowments and the Heckscher–Ohlin Theory - Economies of Scale, Imperfect Competition, and International Trade - Economic Growth and International Trade					
UNIT- II: INTERNATIONAL TRADE POLICY					**9**
Trade Restrictions: Tariffs - Nontariff Trade Barriers and the New Protectionism - Economic Integration: Customs Unions and Free Trade Areas - International Trade and Economic Development - International Resource Movements and Multinational Corporations					
UNIT- III: ECONOMIC SCALES					**8**

Economies of Scale, Imperfect Competition, and International Trade - Economic Growth and International Trade	
UNIT- IV: ECONOMY MACROECONOMICS	**9**
The Price Adjustment Mechanism with Flexible and Fixed Exchange Rates - The Income Adjustment Mechanism and Synthesis of Automatic Adjustments - Open-Economy Macroeconomics: Adjustment Policies - Prices and Output in an Open Economy: Aggregate Demand and Aggregate Supply	
UNIT- V: INTERNATIONAL MONETARY SYSTEM	**9**
Flexible versus Fixed Exchange Rates, the European Monetary System, and Macroeconomic Policy Coordination 645 21 The International Monetary System: Past, Present, and Future	

LECTURE	TUTORIAL	TOTAL
45	0	45

TEXTBOOKS

1. Dominick Salvatore (2013), "International Economics" John Wiley & Sons, USA

REFERENCES

2.Thomas A Pugel, "International Economics" McGraw Hill Education, 13th Edition, New Delhi

E REFERENCES

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COs versus POs mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	2	2	2	3	3	3	2	2	3					
CO 2	2	2	2	3	3	3	2	2	3					
CO 3	2	2	2	3	3	3	2	2	3					
CO 4	2	2	2	3	3	3	2	2	3					
CO 5	2	2	2	3	3	3	2	2	3					
Total	10	10	10	15	15	15	10	10	15					
Scaled	2	2	2	3	3	3	2	2	3					

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

CONTROL SYSTEMS

Course Outcomes (PEE 504):		**Domain**	**Level**
CO1	**Identify** the basic elements, derive the transfer function and **Compute** the overall gain of the control system **and Construct** the transfer function of DC motors and DC generators.	Cognitive Psychomotor	Understanding Complex or Overt Response
CO2	**Explain** the performance of I and II system with static and dynamic error coefficients.	Cognitive Psychomotor	Understanding Set
CO3	**Describe** the frequency domain specifications and show the response of frequency response.	Cognitive Psychomotor	Remembering Understanding

			Set
CO4	**Determine** the stability of the systems and**Design** the suitable compensator and controller for the given performance criteria of the control system	Cognitive Psychomotor	Understanding Design Perception
CO5	**Describe** State transition matrix. **Explain** State space model **andconstruct** and **verify** the canonical state model and Kalman's test for controllability and observability.	Cognitive	Remembering

Learning Objectives: Control Systems is the engineering discipline that applies control theory to design systems with desired behaviors. To make students understand the concept of system representation for stability analysis and state –space analysis, to design the compensator in time and frequency domain, to design the PID compensator.

COURSE CODE	COURSE NAME	L	T	P	C
PEE 504	CONTROL SYSTEMS	3	0	1	4
C:P: A = 3:1:0		L	T	P	H
		3	0	2	5

UNIT - I: SYSTEMS AND THEIR REPRESENTATION **15**

Basic elements in control systems – Open and closed loop systems – Principles of feedback, Transfer function Block diagram reduction techniques – Signal flow graphs. Mason gain formula, Modeling of electric systems translation and rotational mechanical systems.

List of Experiments

1. Transfer function and modeling of separately excited DC Generator.
2. Transfer function and modeling of Armature & field-controlled DC Motor.
3. Transfer function of AC Servomotor

UNIT – II: TIME RESPONSE ANALYSIS **15**

Time response – Time domain specifications - Standard test signals. Time response of first and second order systems for standard test inputs. Error coefficients – Generalized error series – Steady state error

List of Experiments

4. Analysis of Synchro Transmitter and Receiver.
5. Performance of DC Stepper Motor
6. Digital simulation of I order and II order system by using Scilab.

UNIT - III: FREQUENCY-RESPONSE ANALYSIS **15**

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

List of Experiments

7. Frequency response of Lag, Lead & Lag – Lead networks.
8. Determination of Phase margin and Gain margin of the Bode plot using Scilab.

UNIT - IV: STABILITY ANALYSIS AND CONTROLLER DESIGN **15**

Characteristics equation – Location of roots in S plane for stability –Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition –Nyquist stability criterion. Introduction to design of Proportional, Integral and Derivative Controllers- Lead and Lag compensator- Analog and Digital implementation of controllers.

UNIT – V: STATE VARIABLE ANALYSIS **15**

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Physical variable phase variable and canonical variableforms State Space representation of continuous time system. Transfer function from state variable representation –. Concept of controllability and observability.

List of Experiments

9. Transfer function and modeling of Ward – Leonard speed control system applied to DC motor.
10. DC Position using feedback Control system.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	30	75

TEXTBOOKS

1. I.J. Nagrath& M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003
2. Norman S. Nise, "Control System Engineering"Fifth edition, John Wiley &Sons, Inc, 2007.
3. M. Gopal, 'Control Systems, Principles & Design', Tata McGraw Hill, New Delhi, 2002.
4. Richard C. Dorf& Robert H. Bishop, "Modern Control Systems", Addison– Wesley, 2012.

REFERENCES

1. B.C. Kuo, 'Automatic Control Systems', Prentice Hall of India Ltd., New Delhi, 2014.
2. K. Ogata, 'Modern Control Engineering', 4th edition, Pearson Education, New Delhi, 2003 / PHI.
3. N. Bandyopadhyay, 'Control Engineering Theory and Practice', Prentice Hall of India, 2009
4. John J.D'azzo& Constantine H.Houpis, 'Linear control system analysis and design', Tata McGrawHill, Inc., 2013

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NTPEL, Control Systems Engineering (Web Course), Prof. M. Gopal, IIT Kharagpur.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1			1	1	1			1		
CO2	2	3	1		2	1	1	1	1	1		2	2	1
CO3	3	3	3	2			1		3				2	2
CO4	1	2	2	3	2	2	1	1	2	1	1	2	1	2
CO5	2	1	1	1	2	1	1	1	2	1		1	2	2
Total	10	10	9	7	4	4	5	4	9	3	1	6	7	7
Scaled	2	2	2	2	1	1	1	1	2	1	1	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

SEMESTER VI

POWERSYSTEMS-II
(OPERATION AND CONTROL)

Course Outcomes (PEE 601):		**Domain**	**Level**
CO1	Use numerical methods to analyze a power system in steady state.	Cognitive	Analyze
CO2	Understand stability constraints in a synchronous grid.	Cognitive	Understand
CO3	Understand methods to control the voltage, frequency and power flow	Cognitive	Understand
CO4	Understand the monitoring and control of a power system.	Cognitive	Understand

CO5	Understand the basics of power system economics.	Cognitive	Understand

Learning objectives:

To provide the knowledge of optimization techniques used in the power system and Load Frequency Control (LFC). To provide a solid foundation in mathematical and engineering fundamentals required to control the governing system in Turbine models. To provide the knowledge of Hydrothermal scheduling, reactive power control.

COURSE CODE	COURSE NAME	L	T	P	C
PEE 601	POWER SYSTEMS-II(OPERATION AND CONTROL)	3	0	0	3
C:P: A = 3:0:0		L	T	P	H
		3	0	0	3

UNIT -I: INTRODUCTION **9**

An overview of power system operation and control - system load variation - load characteristics - load curves and load-duration curve - load factor - diversity factor - Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves - Importance of load forecasting - quadratic and exponential curve fitting techniques for forecasting – plant level and system level controls.

UNIT –II: REAL POWER - FREQUENCY CONTROL **9**

Basics of speed governing mechanism and modelling - 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 - two-area system: modelling - static analysis of uncontrolled case - tie line with frequency bias control - state variable model.

UNIT – III: REACTIVE POWER–VOLTAGE CONTROL **9**

Generation and absorption of reactive power - basics of reactive power control - excitation systems– modelling - static and dynamic analysis - stability compensation - methods of voltage control: tap-changing transformer, injection reactive power - SVC (TCR + TSC) and STATCOM – secondary voltage control.

UNIT –IV: UNIT COMMITMENT AND ECONOMIC DISPATCH **9**

Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve - coordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ-iteration method - statement of unit commitment problem – priority-list method -forward dynamic programming.

UNIT – V:COMPUTER CONTROL OF POWER SYSTEMS **9**

Need for computer control of power systems - concept of energy control centre– functions - system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - network topology - state estimation – WLSE - Contingency Analysis - state transition diagram showing various state transitions and control strategies.

	LECTURE	PRACTICAL	TOTAL
	45	0	45

TEXTBOOKS

1. Olle.I.Elgerd, ‘Electric Energy Systems theory - An introduction’, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollenberg, ‘Power Generation, Operation and Control’, John Wiley & Sons, Inc., 3rd Edition , 2013.
3. Kundur P., ‘Power System Stability and Control, Tata McGraw Hill, New Delhi, 5th reprint, 2014.

REFERENCES

1. Nagrath I.J. and Kothari D.P., ‘Modern Power System Analysis’, Tata McGraw-Hill, Fourth Edition,2011.
2. Hadi Saadat, ‘Power System Analysis’, Tata McGraw Hill Education Pvt. Ltd., New Delhi,

21st reprint, 2010.
3. Abhijit Chakrabarti, Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

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www.nptel.ac.in

https://nptel.ac.in/courses/108102047/29

Mapping of COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	2	2	1	1	1	1	-	-	-	1	-	1	2	2
CO 2	3	3	2	2	1	1	1	-	-	1	-	1	1	1
CO 3	2	1	1	2	1	0	-	-	-	1	-	2	1	1
CO 4	1	1	1	1	1	0	1	-	-	1	-	1	2	2
CO 5	2	1	1	1	1	1	-	-	-	1	-	1	1	1
Total	10	8	6	5	5	3	2	0	0	5	0	6	7	7
Scaling	2	2	2	1	1	1	1	0	0	1	0	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

E-WASTE MANAGEMENT

Course Outcomes:		**Domain**	**Level**
CO1	Able to **find** the technologies for waste electrical and electronic equipment	Cognitive	Remember
CO2	Able to **explain** the methods of Mechanical Processing of waste disposal	Cognitive	Remember
CO3	Able to **classify** the sources of Hydrometallurgical Processing	Cognitive	Remember Understand
CO4	Able to **summarize** the Electronic Waste Recycling	Cognitive	Remember Understand
CO5	Able to **demonstrate** the methods for Batteries disposal	Cognitive	Remember Understand

Learning Objectives:

- To classify waste sources
- To identify methods of waste disposal
- To study various energy generation methods
- To analyse recycling of e-waste

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
	E-WASTE MANAGEMENT	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**
UNIT- I: INTRODUCTION					**9**

Introduction, Electronic Waste, Generation and Management, Electronic Waste in the World, The Problem of WEEE, WEEE Management Leaching Processes, Acid and Alkaline Leaching, Leaching Using Supercritical Fluids, Bioleaching.

UNIT- II: MECHANICAL PROCESSING	**9**

Mechanical Processing, Comminution, Size Separation, Density Separation, Separation by Dense Medium, Separation via Suspensions, Jigs, Flowing Film Concentrators, Air Separation, Magnetic Separation, Dry Separators, Wet Separators, Electrostatic Separation, Electrification by Contact or Friction, Electrification by Ion Bombardment, Eddy Current (Foucault Current)

UNIT- III: HYDRO METALLURGICAL PROCESSING	**9**

Hydrometallurgical Processing: Liquid-Liquid Extraction, Supercritical Extraction, Cementation, Electrometallurgical Processing: Pyrometallurgical Processing

UNIT- IV: ELECTRONIC WASTE RECYCLING	**9**

Electronic Waste Recycling: Materials Recycling Considerations, Polymers, Ceramics, Printed Circuit Boards, Mechanical Processing, Hydrometallurgical Processing, Bio hydro metallurgical Processing, Pyro metallurgical Processing, Monitors, Cathode Ray Tube, Liquid Crystal Displays/Light Emitting Diodes

UNIT- V: BATTERIES	**9**

Batteries: Nickel–Cadmium (NiCd) Batteries, Manual Sorting, Component Separation by Unity Operations of Mineral Treatment, Pyro metallurgical Route, Hydrometallurgical Route, Nickel Metal Hydride (NiMH) Batteries, Characteristics of Nickel Metal Hydride Batteries—NiMH, Recycling NiMH Batteries, Lithium Ion Batteries, Constituents of Rechargeable Lithium-Ion Batteries (LIBs), Cathode Materials, Anode Materials, Electrolytes, Separator, Recycling LIBs Batteries, Zinc-Manganese Dioxide Systems

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXTBOOKS

1. Hugo Marcelo Veit Andréa Moura Bernardes, Electronic Waste Recycling Techniques,Springer International Publishing Switzerland 2015.
2. "E-waste in India: Research unit, Rajya Sabha Secretariat, New Delhi, June 2011"

REFERENCES

GOOGLE BOOKS

1. e-waste Management: From waste to Resource Klaus Hieronymi, RamzyKahnat, Eric williams Tech. & Engg.-2013(Publisher: Earthscan 2013).
2. What is the impact of E-waste: Tamara Thompson
3. E-waste poses a Health Hazard: SairudeenPattazhy

E REFERENCES

WEBLINKS:

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- www.routledge.com
- www.amazon.com
- www.bookdepository.com
- www.ecoactiv.com

Mapping of COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	1					2	3	2			1	1	2	1
CO 2			2	1		2	3	2			1	1	1	1
CO 3		1	1	1	2	2	2	2			1	1	2	2
CO 4	1	1	1	1			2	2		2	2	2	2	2
CO 5	2		3	2	2	2	2	2			2	2	3	3
Total	4	2	7	5	4	8	12	10		2	7	7	10	9
Scaled	1	1	2	1	1	2	3	2		1	2	2	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

DISASTER MANAGEMENT

Course Outcomes:		**Domain**	**Level**
CO1	Understanding the concepts of application of types of disaster preparedness	Cognitive	Application
CO2	On completion of this course the students will be able to understand planning essentials of disaster.	Cognitive	Analyze
CO3	Have a good understanding of importance of seismic waves occurring globally	Cognitive	Analyze
CO4	On completion of this course, the students will be able to perform drill essential for disaster mitigation	Cognitive	Application
CO5	Have a keen knowledge on essentials of risk reduction	Cognitive	Application

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
	DISASTER MANAGEMENT	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**

UNIT- I: INTRODUCTION	**9**
Introduction – Disaster preparedness – Goals and objectives of ISDR Programme- Risk identification – Risk sharing – Disaster and development: Development plans and disaster management –Alternative to dominant approach– disaster-development linkages -Principle of risk partnership	
UNIT- II: APPLICATION OF TECHNOLOGY IN DISASTER RISK REDUCTION	**9**
Application of various technologies: Data bases – RDBMS – Management Information systems – Decision support system and other systems – Geographic information systems – Intranets and extranets – video teleconferencing. Trigger mechanism – Remote sensing-an insight – contribution of remote sensing and GIS - Case study	
UNIT- III: AWARENESS OF RISK REDUCTION	**9**
Trigger mechanism – constitution of trigger mechanism – risk reduction by education – disaster information network – risk reduction by public awareness	
UNIT- IV: DEVELOPMENT PLANNING ON DISASTER	**9**

Implication of development planning – Financial arrangements – Areas of improvement – Disaster preparedness – Community based disaster management– Emergency response.			
UNIT- V: SEISMICITY			**9**
Seismic waves – Earthquakes and faults – measures of an earthquake, magnitude and intensity – ground damage – Tsunamis and earthquakes			
	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**
TEXTBOOKS			
1. Siddhartha Gautam and K Leelakrishna Rao, "Disaster Management Programmes and Policies", Vista International Pub House, 2012, 2. Arun Kumar, "Global Disaster Management", SBS Publishers, 2008			
REFERENCES			
1. Encyclopaedia of Disaster Management, Neha Publishers & Distributors, 2008 2. Pradeep Sahni, Madhavi Malalgoda and Ariyabandu, "Disaster risk reduction in South Asia", PHI, 2002 3. AmitaSinvhal, "Understanding earthquake disasters" TMH, 2010. 4. Pardeep Sahni, Alka Dhameja and Uma Medury, "Disaster mitigation: Experiences and reflections", PHI, 2000			

Mapping of COs with POs

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1		1	1					1			1	1	2	2
CO 2			2		3						2	2	2	2
CO 3						2	2				1	1		1
CO 4		2	2		1	1	1	2	1	1	3	1	1	
CO 5						2	3	3		2	1	1	2	2
Total	0	3	5	0	4	5	6	6	1	3	8	6	7	7
Scaled	0	1	1	0	1	1	1	1	1	1	2	1	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

MICROPROCESSORS AND MICROCONTROLLERS

Course Outcomes (PEE 604):		**Domain**	**Level**
CO1	To understand the fundamentals of microprocessors, microcontrollers and embedded systems	Cognitive	Understanding
CO2	To understand the architecture, Timing diagrams and Execution cycles of 8051	Cognitive	Understanding
CO3	To understand the types of addressing modes, Instruction types and to understand the basic concepts of programming	Cognitive Psychomotor Affective	Understanding Set Responding

CO4	To understand interfacing design of peripherals like I/O,A/D,D/A, timer etc.	Cognitive Psychomotor Affective	Understanding Set Responding
CO5	To understand communication protocols and interfacing with external devices	Cognitive Psychomotor Affective	Understanding Set Responding

Learning Outcomes: Able to do assembly language programming, do interfacing design of peripherals like I/O,A/D,D/A, timer etc. and to develop systems using different microcontrollers.

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE 604	**MICROPROCESSORS AND MICROCONTROLLERS**	**3**	**0**	**1**	**4**
C:P: A = 3:1:0		**L**	**T**	**P**	**H**
		3	**0**	**2**	**5**

UNIT -I: FUNDAMENTALS OF MICROPROCESSORS	**9**
Fundamentals of Microprocessor Architecture, 8-bit Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers,16-bit and 32-bitmicrocontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.	
UNIT –II: THE 8051 ARCHITECTURE	**9**
Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.	
UNIT-III: INSTRUCTION SET AND PROGRAMMING	**9+12**
Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compiler Programming and Debugging tools. **List of Experiments** 1. Simple arithmetic operations with 8085 Microprocessors: Multi precision addition / subtraction / multiplication / division. 2. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions. 3. Demonstration of basic instructions with 8051 Micro controller execution, including: a. Conditional jumps, looping b. Calling subroutines. c. Stack parameter testing 4. Design program for code conversions.	
UNIT –IV: MEMORY AND I/O INTERFACING	**9+3**
Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such asGeneral Purpose I/O, ADC, DAC, timers, counters, memory devices. **List of Experiments**	

5. Interfacing Converters of 8-bit D/A and A/D.

UNIT–V: EXTERNAL COMMUNICATION INTERFACE AND APPLICATIONS	**9+15**

Synchronous and Asynchronous Communication. RS232, SPI, I2C.Introduction and interfacingtoprotocolslikeBlue-toothandZig-bee.LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

List of Experiments

6.Interfacing of Keyboard with 8085

7.Interfacing of seven segment display with 8085.

8. Serial communication, I/O Port operations.

9. Design and implementation of Traffic Light control.

10.Design and implementation of Stepper motor control

	LECTURE	**PRACTICAL**	**TOTAL**
	45	**30**	**75**

TEXTBOOKS

1. M.A.Mazidi, J.G.Mazidi and R.D.McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.
2. K.J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.
3. R. Kamal, "Embedded System", McGraw Hill Education, Third Edition, 2017.
4. R.S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 6th Edition, 2013

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1. D.A.Patterson and J.H.Hennessy, "Computer Organization and Design: The Hardware /Software interface", Morgan Kaufman Publishers, 5th Edition, 2013.
2. D.V.Hall, "Microprocessors &Interfacing", McGraw Hill Higher Education,2005.

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Mapping of COs with POs

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	1	0	2	0	0	0	0	0	0	1	1	0	1	1
CO 2	1	2	1	3	1	0	0	0	2	1	2	1	1	1
CO 3	0	0	0	0	0	1	2	0	1	2	0	0	1	1
CO 4	1	1	2	2	1	0	0	0	2	1	2	1	0	1
CO 5	1	2	2	1	0	0	3	0	3	2	1	0	0	1
Total	4	5	7	6	2	1	5	0	8	7	6	2	3	5
Scaled	1	1	2	1	1	1	1	0	2	2	1	1	1	1

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

SEMESTER VII

POWER PLANT ENGINEERING

Course Outcomes (PEE E41):		Domain	Level
CO1	**Explain** about the various types of the power generationand function of boilers	Cognitive	Understanding
CO2	**Choose** VariousMeasurements in power plants.	Cognitive	Remembering
CO3	**Illustrate** Variousanalyzersin power plants, and **identify** thepollution monitoring instruments.	Cognitive	Understanding Applying
CO4	**Infer all** control loops in boiler, andinterlocks in boiler operation-boiler trip protection.	Cognitive	Understanding
CO5	**Explain** about turbine speed vibration – lubricant oil temperature control – cooling system and select the SCADA and other monitoring and control software	Cognitive	Understanding Remembering

COURSE CODE	COURSE NAME	L	T	P	C
PEE E41	POWER PLANT ENGINEERING	3	0	0	3
C:P: A = 3:0:0		L	T	P	H

UNIT- I: OVERVIEW OF POWER GENERATION	**9**
Principle of Power Generation, Brief survey of methods of power generation – hydro, thermal, nuclear, solar, wind and tidal power – importance of instrumentation in power generation– Material handling of power plant equipment thermal power plants – building blocks – details of boiler process UP&I diagram of boiler – cogeneration.	
UNIT- II: MEASUREMENTS IN POWER PLANTS	**9**
Electrical measurements – current, voltage, power, frequency, power – factor etc. – nonelectrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor-emission measurements-performance measurements	
UNIT-III: ANALYZERS IN POWER PLANTS	**9**
Flue gas oxygen analyzer –Demineral - Steam and Water Analysis System (SWAT) analysis of impurities in feed water and steam – dissolved oxygen analyzer – chromatography – PH meter – fuel analyzer – pollution monitoring instruments	
UNIT-IV: CONTROL LOOPS IN BOILER	**9**
Combustion control – air/fuel ratio control – furnace draft control – drum level control – low and high protection- main steam and reheat steam temperature control – super heater control – at temperature – deaerator level control – distributed control system in power plants – interlocks in boiler operation-boiler trip protection	
UNIT- V: TURBINE – MONITORING AND CONTROL SOFTWARE	**9**
Speed, vibration, shell temperature monitoring and control – steam pressure control – lubricant oil temperature control – cooling system and application of SCADA and other monitoring and control software	

	LECTURE	PRACTICAL	TOTAL
	45	0	45

TEXT BOOKS
1. Sam G. Dukelow, "The control of Boilers" Instrument Society of America, 2000. 2. V.K. Mehta and Rohit Mehta "Principles of Power system" S. Chand & Company, New Delhi, 2003 3. Er. R.K. Rajput, A text book of power plant engineering, Fourth edition, 2015. 4. Dr. P. C. Sharma's A Textbook of Power Plant Engineering, published by S. K. Kataria,2013.
REFERENCE BOOKS 1. Power station Engineering and Economy by Bernhardt G.A.Skrotzki and William A.Vopat-Tata McGraw Hill Publishing Company Ltd., New Delhi, 20th reprint 2002 2. R.K.Jain, "Mechanical and Industrial Measurements" Khanna Publishers, New Delhi,2002. 3. Arora Domkundwar, A course in Power Plant engineering,Dhanpat Rai & Co.,2001
E-REFERENCES: www.electrical4u.com

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	1	-	-	1	3	2
CO2	3	1	-	2	1	-	-	-	1	-	-	1	1	2
CO2	3	1	-	2	1	-	-	-	1	-	-	1	1	2
CO3	3	-	1	-	1	-	-	-	1	-	-	1	2	1
CO4	3	2	2	2	1	-	-	-	1	-	-	1	3	1
CO5	3	1	-	-	1	-	-	-	-	-	-	1	2	1
Total	15	6	4	6	5				4			5	11	7
Scaled	3	2	1	2	1				1			1	3	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

ELECTRICAL DRIVES

Course Outcomes (PEEE51):		**Domain**	**Level**
CO1	**Understand**the characteristics of DC drives and its multi-quadrant operation	Cognitive	Understanding
CO2	**Understand**the various control techniques of DC Drives.	Cognitive	Remembering
CO3	**Categorize**the different speed control methods for an Induction motor drive at stator side.	Cognitive	Understanding
CO4	**Illustrate** the various control techniques of induction motor Drives at rotor side.	Cognitive	Understanding
CO5	**Illustrate** the various control techniques and application of Synchronous motor drives.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEEE51	**ELECTRICAL DRIVES**	3	0	0	3
C:P: A		**L**	**T**	**P**	**H**
3:0:0		3	0	0	3

UNIT- I: DC MOTOR DRIVE CHARACTERISTICS AND MULTI-QUADRANT OPERATIONS	9
Fundamentals of Electrical Drives - Advantage of Electrical Drives - Selection of Motor Power Rating - Review of emf and torque equations of DC machine - Review of torque-speed characteristics of separately excited dc motor - Four quadrant operation of dc machine – Steady state operation of multi-quadrant chopper fed dc drive, regenerative braking.	
UNIT- II: CONTROL OF DC DRIVES	**9**
DC Motor and their Performance - Transient Analysis - Ward Leonard Drives - Steady State Analysis of the Single and Three Phase Fully Controlled Converter Fed Separately Excited DC Motor Drive – Continuous and Discontinuous Mode Chopper Controlled DC Drives - Time Ratio Control and Current Limit Control.	
UNIT- III: STATOR CONTROLLED INDUCTION MOTOR DRIVES	**9**
Induction Motor Drives - Stator Control - Stator Voltage and Frequency Control - VSI, CSI and Cycloconverter Fed Induction Motor Drives - Open Loop and Closed Loop V/f Control. Conventional space vector modulation; Steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.	
UNIT- IV: ROTOR CONTROLLED INDUCTION MOTOR DRIVES	**9**
Impact of rotor resistance of the induction motor torque-speed curve - Operation of slip-ring induction motor with external rotor resistance, starting torque - Power electronic based rotor side control of slip ring motor - Slip Power Recovery. sub-synchronous and Super Synchronous Operations - Power Factor Improvement - Closed Loop Control.	
UNIT- V: SYNCHRONOUS MOTOR DRIVES	**9**
Separate Controlled Mode - Self Controlled Mode of Synchronous Motor - Constant Marginal Angle Control and Motor Power Factor Control - Cycloconverter Fed Synchronous Motors - Digital Control and Drive Applications.	

	LECTURE	PRACTICAL	TOTAL
	45	**0**	**45**

TEXT BOOKS

1. Dubey. G.K, ‘Fundamentals of Electrical Drives’, Narosa Publications, 2008.
   B. K. Bos, ‘Power Electronics and AC Drives’, Prentice Hall Onglewood cliffs, New Jersey, 1998.
2. Gopal K. Dubey, ‘Fundamentals of Electrical Drives’, New Delhi, 2nd Edition, Narosa Publishing House, 2001.
3. Krishnan. R, ‘Electricmotor& Drives; Modelling, Analysis and Control’, Prentice Hall of India, 2001.
4. Dubey. G. K, ‘Power Semiconductor Controlled Drives’, Prentice Hall, 1989.

REFERENCE BOOKS

1. Murphy, J.M.D and TurnbullF.G, ‘Thyristor Control of AC Motors’, Pergamon Press,1990.
2. Sen. P.C, ‘Thyristor D.C. Drives’, John Wiley and Sons, 1981.
3. VedamSubrahmaniyam, ‘Electric Drives Concepts and Applications’, Tata McGraw HillPublishing company Ltd., 2011.
4. Gaekward, ‘Analog and Digital Control Systems’, Wiley Eastern Ltd, 1989.
5. Leonhard. W, ‘Control of Electric Drives’, Springer Science & Business Media, 2001

E-REFERENCES
Lecture Series on Solid State Devices by Prof.S.Karmalkar, Department of Electrical Engineering, IIT Madras.

Mapping of COs with 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	PSO 1	PSO 2
CO1	3	2	1	0	2	0	1	0	0	0	0	0	0	3
CO2	3	1	0	0	2	0	1	0	0	0	0	0	3	2
CO3	1	2	3	0	2	0	0	1	0	0	0	0	1	2
CO4	0	2	0	0	3	0	1	0	0	0	0	0	2	2
CO5	3	1	1	0	0	1	1	1	0	0	0	1	1	2
Total	10	8	5	0	9	1	4	2	0	0	0	1	7	11
Scaling	2	2	1	0	2	1	1	1	0	0	0	1	2	3

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation

HVDC TRANSMISSION SYSTEMS

Course Outcomes (PEE E61):		**Domain**	**Level**
CO1	**Understand** the advantages of dc transmission over ac transmission.	Cognitive	Understanding
CO2	**Understand**the operation of Line Commutated Converters and Voltage Source Converters.	Cognitive	Understanding
CO3	**Understand**the control strategies used in HVDC transmission system.	Cognitive	Understanding
CO4	**Understand** the improvement of power system stability using an HVDC system.	Cognitive	Understanding
CO5	**Understand** the concept of MTDC system.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEEE61	**HVDC TRANSMISSION SYSTEMS**	**3**	**0**	**0**	**3**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**3**	**0**	**0**	**3**

UNIT – I: D.C. TRANSMISSIONTECHNOLOGY	**09**
Comparison of AC and DCTransmission (Economics, Technical Performance andReliability)-Application of DC Transmission –Types of HVDC Systems –Components of a HVDC System – Line Commutated Converter and Voltage Source Converter Based systems.	
UNIT–II: ANALYSISOFLINECOMMUTATEDANDVOLTAGESOURCE CONVERTERS	**09**
Line Commutated Converters (LCCs)Six Pulse Converter – Analysis neglecting Commutation Overlap, Harmonics – Twelve Pulse Converters – Inverter Operation –Effect of Commutation Overlap – Effect of Commutation Failure, Misfire and Current Extinction in LCC links. Voltage Source Converters (VSCs): Two and Three-Level VSCs –PWM Schemes: Selective Harmonic Elimination, Sinusoidal Pulse width Modulation. Analysis of a six-pulse converter – Real and Reactive power control using VSC.	

UNIT– III: CONTROLOFHVDCCONVERTERS AND COMPONENTS OF HVDC SYSTEM	09
Principles of Link Control in a LCC HVDC System - Control Hierarchy, Firing Angle Controls – Phase Locked Loop, Current and Extinction Angle Control – Starting and Stopping of a Link - Principles of Link Control in a VSC HVDC system: Power Flow and DC Voltage Control. Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC Systems DC Line, Corona Effects - Insulators, Transient Over-voltages DC Line faults in LCC Systems.	
UNIT – IV: STABILITY ENHANCEMENTUSING HVDCCONTROL	**09**
Basic Concepts: Power System Angular -Voltage and Frequency Stability –Power Modulation: Basic Principles –Synchronous and Asynchronous Links - Voltage Stability Problem in AC/DC Systems.	
UNIT – V: MTDCLINKS	**09**
Multi-Terminal and Multi- Infeed Systems – Series and Parallel MTDC Systems using LCCs - MTDC Systems using VSCs – Modern Trends in HVDC Technology –Introduction to Modular Multi-level Converters.	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXTBOOKS:

1. Padiyar. K. R, 'HVDC Power Transmission Systems', New Age International publishers,2011.
2. Arrillaga. J, 'HighVoltageDirectCurrentTransmission',PeterPeregrinusLtd.,1983.

REFERENCES:

1. Kimbark. E.W, 'Direct CurrentTransmission',Vol.1, Wiley-Interscience,1971.

E-REFERENCES:

1. www.nptel.ac.in

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	1	-	-	1	1	-	1	2	1
CO2	1	1	1	1	-	-	-	-	-	-	1	1	1	2
CO3	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	3	1	1	-	-	-	-	-	-	-	-	2	2
CO5	1	2	-	-	-	-	-		-	-	-	1	1	1
Total	7	10	3	3	0	1	0	0	1	1	1	3	8	8
Scaled	2	3	1	1	0	1	0	0	1	1	1	1	2	2

0 –No Relation 1 – Low Relation 2 – Medium Relation 3 – High Relation