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 Electrical and Electronics engineering

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)
iii.	Master of Technology (Power Electronics and Drives) (Full 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 **Green 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
B.Tech -EEE-FT			
Calculus and Linear Algebra	XMA101	**2007-08**	*****
Electrical and Electronics Engineering Systems	XBE102	**2007-08**	**Entrepreneurship**-Assignment, Seminar, Poster Presentation
Applied Chemistry for Engineers	XAC 103	**2007-08**	**Entrepreneurship**-Assignment, Seminar, Poster Presentation
Engineering Graphics and Design	XEG 104	**2007-08**	**Employability**-Drawing Assignment, Model Making
Speech Communication	XGS 105	**2007-08**	**Skill Development**- Quiz, Test, Assignment Seminar
Constitution of India	XUM 106	**2007-08**	**Skill Development**- Quiz, Test, Assignment Seminar
Electrical and Electronics Engineering Systems Laboratory	XBE107	**2007-08**	**Entrepreneurship**-Assignment, Seminar, Poster Presentation
Applied Chemistry for Engineers Laboratory	XAC 108	**2007-08**	**Entrepreneurship**-Assignment, Seminar, Poster Presentation
Calculus, Ordinary Differential Equations and Complex Variable	XMA 201	**2007-08**	*****
Programming for Problem Solving	XCP 202	**2018-19**	**Entrepreneurship**-Test, Assignment, Problem Solving Exercises
Applied Physics for Engineers	XAP 203	**2007-08**	**Entrepreneurship**-Assignment, Seminar, Poster Presentation
Technical Communication	XGS 204	**2007-08**	**Skill Development**- Quiz, Test, Assignment, Seminar
Workshop Practices	XWP 205	**2007-08**	**Entrepreneurship**-Machining Processes, Model Making
Engineering Mechanics	XEM 206	**2007-08**	**Employability**-Drawing Assignment, Model Making
Programming for Problem Solving Laboratory	XCP 207	**2007-08**	**Entrepreneurship**-Test, Assignment, Problem Solving Exercises
Applied Physics for Engineers Laboratory	XAP 208	**2007-08**	**Entrepreneurship**-Test, Assignment, Problem Solving Exercises
Transforms and Partial Differential Equations	XMA301	**2007-08**	*****
Electromagnetic Fields	XEE302	**2007-08**	**Employability**-Quiz, Test, Problem Solving Assignment

Digital Logic Circuits	XEE303	**2007-08**	**Employability**-Quiz, Test, Problem Solving Assignment
Electrical Circuit Analysis	XEE304	**2007-08**	**Employability**-Quiz, Test, Problem Solving Assignment
Electrical Machines – I	XEE305	**2007-08**	**Employability**-Problem Solving Assignment, Test, Seminar
Entrepreneurship Development	XUM306	**2007-08**	**Entrepreneurship**-Assignment, Seminar, Poster Presentation
Universal Human Values 2: Understanding Harmony and Gender	XUM307	**2021-22**	**Employability**-Assignment, Test, Seminar
Electrical Circuit Analysis Laboratory	XEE308	**2007-08**	**Entrepreneurship**-Mini Project, Viva Voce
Electrical Machines - I Laboratory	XEE309	**2007-08**	**Entrepreneurship**-Mini Project, Viva Voce
In-plant Training – I	XEE310	**2007-08**	**Employability**-Industrial visit, Viva Voce
Probability and Statistics	XMA401	**2007-08**	*****
Analog Electronics	XEE402	**2007-08**	**Employability**-Assignment, Test, Seminar
Control Systems	XEE403	**2007-08**	**Employability**-Assignment, Test, Seminar, Problem Solving Assignment
Electrical Machines – II	XEE404	**2007-08**	**Employability**-Quiz, Test, Problem Solving Assignment
Economics for Engineers	XUM405	**2013-14**	**Entrepreneurship**-Quiz, Test, Assignment, Seminar, Group Discussion
Disaster Management	XUM406	**2015-16**	**Employability**-Assignment, Test, Seminar
Analog Electronics Laboratory	XEE407	**2007-08**	**Employability**- Mini Project, Viva Voce
Control Systems Laboratory	XEE408	**2007-08**	**Employability**- Mini Project, Viva Voce
Electrical Machines – II Laboratory	XEE409	**2007-08**	**Employability**- Mini Project, 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
Open Elective - 1	X** OE*	**2007-08**	*****
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
Economics for Engineers	XUM601	**2013-14**	*****
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
Open Elective - 2	X**OE*	**2013-14**	*****
Disaster Management	XUM606	**2015-16**	**Employability**-Assignment, Test, Seminar
Minor Course - II	XEEM02	**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
Open Elective – I *****	X**OE*	**2013-14**	*****
Open Elective – II	X**OE*	**2013-14**	*****
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
Cyber Security	XUM 801	**2013-14**	**Employability**-Assignment, Test, Seminar
Electrical and Hybrid Vehicles	XEEE51	**2013-14**	**Employability**-Assignment, Test, Seminar
Open Elective (Intellectual Property Rights)	X**OE*	**2013-14**	*****
Project Phase – II	XEE 804	**2013-14**	**Employability**-Assignment, Test, Seminar
B.Tech -EEE-PT			
Transmission and Distribution	PEE 301	**2007-08**	**Employability**-Assignment, Test, Seminar
Entrepreneurship Development	PEE 302	**2007-08**	**Entrepreneurship**-Test, Assignment, Seminar
Digital Electronics	PEE 303	**2007-08**	**Employability**-Quiz, Test, Problem Solving Assignment
Electrical Machines-II	PEE 304	**2007-08**	**Employability**-Assignment, Test, Seminar, Problem Solving Assignment
Electrical Machines-II Laboratory	PEE 305	**2007-08**	**Employability**- Mini Project, Viva Voce

Microprocessors and Microcontrollers	PEE401	**2007-08**	**Employability**-Quiz, Test, Problem Solving Assignment
Economics for Engineers	PEE402	**2007-08**	**Employability**-Assignment, Test, Seminar
Professional Elective - 1	PEEE1*	**2007-08**	**Employability**-Assignment, Test, Seminar
Control Systems	PEE404	**2007-08**	**Employability**-Assignment, Test, Seminar
Microprocessors & Control Systems Laboratory	PEE405	**2007-08**	**Employability**-Quiz, Test, Assignment, Mini Project, Viva Voce
Power system – I (Apparatus and Modelling)	PEE 501	**2007-08**	**Employability**-Assignment, Test, Seminar
Bio Medical Instrumentation	PEE E31	**2007-08**	**Employability**-Assignment, Test, Seminar
Industrial Economics and Foreign Trade	PEE 503	**2007-08**	**Employability**-Assignment, Test, Seminar
Control Systems	PEE 504	**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
Power Plant Engineering	PEE E41	**2015-16**	**Employability**-Assignment, Test, Seminar
Electrical Drives	PEE E51	**2007-08**	**Employability**-Assignment, Test, Seminar
HVDC Transmission Systems	PEE E61	**2007-08**	**Employability**-Assignment, Test, Seminar
Main Project	PEE 704	**2007-08**	**Employability**-Presentation, Viva Voce
M.Tech -PED -FT			
Analysis of Electrical Machines	YPE101	**2022-23**	**Employability**-Case Study, Viva Voce
Analysis of Power Converters	YPE102	**2022-23**	**Employability**-Case Study, Viva Voce
Modeling and Design of SMPS	YPE103	**2022-23**	**Employability**-Case Study, Viva Voce
Elective - I	YPEE11	**2022-23**	**Employability**-Case Study, Viva Voce
Elective - II	YPEE21	**2022-23**	**Employability**-Case Study, Viva Voce

English for Research Paper Writing	YEGOE1	**2022-23**	**Skill Development**- Assignment, Seminar, Case Study
Research Methodology and IPR	YRM107	**2022-23**	**Employability**-Case Study, Viva Voce
Design and Simulation of Power Electronic Circuits Laboratory	YPE108	**2022-23**	**Employability**-Mini Project, Viva Voce
Modeling of Electrical Machines Laboratory	YPE109	**2022-23**	**Employability**- Mini Project, Viva Voce
Analysis of Electrical Drives	YPE201	**2022-23**	**Employability**-Case Study, Viva Voce
Special Electrical Machines	YPE202	**2022-23**	**Employability**-Case Study, Viva Voce
Electric Vehicles and Power Management	YPE203	**2022-23**	**Employability**-Case Study, Viva Voce
Elective - III	YPEE31	**2022-23**	**Employability**-Case Study, Viva Voce
Elective – IV	YPEE41	**2022-23**	**Employability**-Case Study, Viva Voce
Power Electronics and Drives Laboratory	YPE206	**2022-23**	**Employability**- Mini Project, Viva Voce
Mini Project	YPE207	**2022-23**	**Employability**-Presentation, Viva Voce
Constitution of India	YPSOE1	**2022-23**	**Skill Development**- Assignment, Seminar, Case Study

SYLLABUS FOR B.TECH EEE (FT)
ACADEMIC YEAR 2022-23

COURSE CODE	COURSE NAME	L	T	P	C
XMA 101	CALCULUS AND LINEAR ALGEBRA	3	1	0	4
Prerequisites	**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 - SkewSymmetric 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 ANDVECTOR 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 andtheir 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, Pearson Reprint,02
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

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

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
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, 6-101-5 → 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
XAC 103	APPLIED CHEMISTRY FOR ENGINEERS	3	1	0	4
Prerequisites	**Physics**	**L**	**T**	**P**	**H**
C : P : A		3	1	0	4
2.5 : 1 : 0.5					

Course Outcomes :		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 Psychomotor	Remembering Perception

CO2	**Interpret** the types of corrosion, use and measure its control by various methods including protective techniques. **Relate** the Nernst equation to determine cell potentials under nonstandard conditions.	Cognitive Psychomotor	Understanding Set
CO3	**Interpret** bulk properties and processes using thermodynamic and kinetic considerations. Explain and **Measure** microscopic chemistry in terms of atomic, molecular orbitals and intermolecular forces.	Cognitive Psychomotor Affective	Applying Mechanism Receive
CO4	**Apply, Measure** and **Distinguish** the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques. **Infer** the properties of complexes in terms of splitting of the d orbitals into different energy levels of coordination compounds.	Cognitive Psychomotor Affective	Remembering Analyzing Perception Responding
CO5	**Describe** and **Illustrate** the chemical reactions that are used in the synthesis of molecules. **Discuss** the different kinds of isomers, identify stereogenic centres in organic molecules, aware of structural, geometric, optical isomerism concepts	Cognitive Psychomotor	Remembering, Applying Mechanism

UNIT - I: PERIODIC PROPERTIES AND WATER CHEMISTRY	**8L + 3T**
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 parametersDefinition and explanation of hardness, determination of hardness by EDTA method-Introduction to alkalinity.	
UNIT - II: USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA	**12L + 3T**
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	**10L + 3T**
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	**7L + 3T**

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	**8L + 3T**

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**	**TOTAL**
	45	**15**	**60**

TEXT BOOKS:

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", Vishalpublishing 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-REFERENCES:

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 with GA

CO Vs GA	CO1	CO2	CO3	CO4	CO5	Total	Scaled to 0,1,2 and 3
GA_1	2	2	2	2	2	10	2

GA_2	2	2	2	2	2	10	2
GA_3	2	0	2	1	1	6	1
GA_4	2	1	1	2	3	9	2
GA_5	1	1	1	1	1	5	1
GA_6	2	0	2	2	2	8	2
GA_7	1	0	0	1	0	2	0
GA_8	1	0	0	1	0	2	0
GA_9	1	0	0	1	0	2	0
GA_{10}	0	0	0	0	0	0	0
GA_{11}	1	0	0	1	1	3	1
GA_{12}	1	1	1	1	1	5	1

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEG 104	**ENGINEERING GRAPHICS AND DESIGN**	**2**	**0**	**1**	**3**
Prerequisites	**NIL**	**L**	**T**	**P**	**H**
C : P : A		**2**	**0**	**2**	**4**
1.75 : 1 : 0.25					

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 and Affective	Understanding, Mechanism and Responds to Phenomena
CO3	*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
CO4	*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
CO5	*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 line.

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	**PRACTICAL**	**TOTAL**
	30	**60**	**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

REFERENCE BOOKS:

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. 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/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	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	-

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
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	Remembering
CO2	**Apply** the techniques in public speaking.	Cognitive	Applying
CO3	**Identify** the common patterns in organizing a speech.	Cognitive	Remembering
CO4	**Construct** the nature and style of speaking.	Cognitive	Remembering
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.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO2	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO3	1	0	0	0	0	0	1	0	1	0	0	0	0	0
CO4	2	0	0	0	0	0	1	0	1	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7	0	0	0	0	0	6	0	4	0	0	0	0	0
Scaled Value	2	0	0	0	0	0	2	0	1	0	0	0	0	0
	1	0	0	0	0	0	1	0	1	0	0	0	0	0

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XAC 103	**APPLIED CHEMISTRY FOR ENGINEERS**	**3**	**1**	**0**	**4**
Prerequisites	**Physics**	**L**	**T**	**P**	**H**
C : P : A		**3**	**1**	**0**	**4**
2.5 : 1 : 0.5					

Course Outcomes :		**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 Psychomotor	Remembering Perception

CO2	**Interpret** the types of corrosion, use and measure its control by various methods including protective techniques. **Relate** the Nernst equation to determine cell potentials under nonstandard conditions.	Cognitive Psychomotor	Understanding Set
CO3	**Interpret** bulk properties and processes using thermodynamic and kinetic considerations. Explain and **Measure** microscopic chemistry in terms of atomic, molecular orbitals and intermolecular forces.	Cognitive Psychomotor Affective	Applying Mechanism Receive
CO4	**Apply, Measure** and **Distinguish** the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques. **Infer** the properties of complexes in terms of splitting of the d orbitals into different energy levels of coordination compounds.	Cognitive Psychomotor Affective	Remembering Analyzing Perception Responding
CO5	**Describe** and **Illustrate** the chemical reactions that are used in the synthesis of molecules. **Discuss** the different kinds of isomers, identify stereogenic centres in organic molecules, aware of structural, geometric, optical isomerism concepts	Cognitive Psychomotor	Remembering, Applying Mechanism

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 Function.	
UNIT - III:	**10**
Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of Rajya SabhaLegislative Procedure in India- Important Committes of LokSabha- Speaker of the LokSabha.	
UNIT - IV:	**09**
The Union Judiciary- Powers of the Supreme Court- Original Jurisdiction- AppeletejurisdictionsAdvisory Jurisdiction-Judicial review.	
UNIT - V:	**09**
Centre State relations- Political Parties- Role of governor, powers and functions of Chief MinisterLegislative Assembly-State Judiciary-Powers and Functions of the High Courts.	

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

TEXT BOOKS:

1.W.H.Morris Shores- Government and politics of India,New Delhi,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,New Delhi,1995.
6.B.C.Rout- Democractic Constitution of India.
7.GopalK.Puri-Constitution of India,India 2005.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	0	0	1	0	0	0	0	0	0	0	0	0	0
CO2	2	0	0	1	0	0	0	0	0	0	0	0	0	0
CO3	2	0	0	1	0	0	0	0	1	0	0	0	0	0
CO4	2	0	0	1	0	0	0	1	1	0	0	0	0	0
CO5	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 Value	2	1	0	1	0	0	0	1	1	0	0	0	0	0

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**
XBE107	**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.	Psychomotor	Set
CO2	**Implement** and **execute** the different types of wiring connections.	Psychomotor	Set
CO3	**Demonstrate** the Fluorescent lamp connection with choke.	Psychomotor	Set
CO4	**Characterize** and **display** the basic knowledge on the working of PN junction and Zener diode.	Psychomotor	Set
CO5	**Implement** and **execute** the various digital electronic circuits such as Adders and Subtractors.	Psychomotor	Set

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 inbreadboard 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

COURSE CODE	COURSE NAME	L	T	P	C
XAC108	**APPLIED CHEMISTRY FOR ENGINEERS LABORATORY**	**3**	**1**	**1**	**5**
Prerequisite	**Physics**	**L**	**T**	**P**	**H**
C : P : A		**3**	**1**	**3**	**7**
3.5 : 1.0 : 0.5					

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

List of Experiments:

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

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.

	PRACTICAL	**TOTAL**
	30	**30**

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

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

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

XMA 201	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'sseries, 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:

1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 40th 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 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
CO1	3	2	0	0	2	0	0	0	0	1	0	2
CO2	3	1	0	0	0	0	0	0	0	1	0	1
CO3	3	1	0	0	0	0	0	0	0	1	0	1
CO4	3	2	0	0	0	0	0	0	0	1	0	1
CO5	3	2	0	0	1	0	0	0	0	1	0	2
Total	**15**	**8**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**5**	**0**	**7**
Scaled	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XCP 202	**PROGRAMMING FOR PROBLEM SOLVING**	**3**	**0**	**0**	**3**
Prerequisites	**Basic Understanding Skills**	**L**	**T**	**P**	**H**
C : P : A		**3**	**0**	**0**	**3**
3 : 0 : 0					

Course Outcomes :	**Domain**	**Level**
CO1	**Define** programming fundamentals and **Solve** simple programs using I/O statements	Cognitive	Applying
CO2	**Define** syntax and **write simple programs** using control structures and arrays	Cognitive	Applying
CO3	**Explain** and **write simple programs** using functions and pointers	Cognitive	Applying
CO4	**Explain** and **write simple programs** using structures and unions	Cognitive	Applying

CO5	**Explain** and **write simple programs** using files and **Build** simple projects	Cognitive	Applying

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 - Passing a functions – Recursion - Programs using arrays and functions. Pointers - Pointer declaration - Address - Pointer expressions & pointer arithmetic - Pointers and function - Call by value - Call by Reference to arrays - Use of Pointers in self-referential structures-Notion of linked list.	
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.	

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

TEXT BOOKS:

1. Byron Gottfried, "Programming with C", III Edition, (Indian Adapted Edition), TMH publications, 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 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	3	0	0	0	0	0	2	3
CO 2	3	2	0	0	2	0	0	0	0	0	2	3

CO 3	2	2	1	2	2	0	0	0	0	0	2	2
CO 4	2	2	1	2	2	0	0	0	0	0	2	2
CO 5	2	2	1	0	2	0	0	1	0	2	2	2
Total	**12**	**10**	**3**	**4**	**11**	**0**	**0**	**1**	**0**	**2**	**10**	**12**
Scaled	**3**	**2**	**1**	**1**	**3**	**0**	**0**	**1**	**0**	**1**	**2**	**3**

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XAP 203	**APPLIED PHYSICS FOR ENGINEERS**	**3**	**1**	**0**	**4**
Prerequisite	**Basic Physics in HSC Level**	**L**	**T**	**P**	**H**
C : P : A		**3**	**1**	**0**	**4**
2.8 : 0.8 : 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 fiber optics.	Cognitive Psychomotor Affective	Understand Apply Mechanism Receive
CO4	**Analyze** 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**

Mechanics: Force - Newton's laws of motion - work and energy - impulse and momentum - torque lawof 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 nonuniform 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 dispersivepower 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 acceptanceangle - 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 anamplifier 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.

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

TEXT BOOKS:

2. Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publications, 2009.
3. 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:

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

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**
CO1	3	2	2	2	1	0	0	0	1	0	0	1
CO2	3	0	1	0	1	0	0	0	0	0	0	1
CO3	3	2	2	2	1	0	0	0	1	0	0	1

CO4	3	2	2	2	1	0	0	0	1	0	0	1
CO5	3	0	2	0	0	0	0	0	0	0	0	1
Total	**15**	**6**	**9**	**6**	**4**	**0**	**0**	**0**	**3**	**0**	**0**	**5**
Scaled	**3**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XGS 204	**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	Remembering
CO2	**Apply** the techniques in writing.	Cognitive	Applying
CO3	**Identify** communicative styles.	Cognitive	Remembering
CO4	**Construct** the nature of writing.	Cognitive	Remembering

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.

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	0	0	0	0	0	2	0	1	0	0	0	0	0
CO2	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO3	1	0	0	0	0	0	1	0	1	0	0	0	0	0
CO4	2	0	0	0	0	0	1	0	1	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**7**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**4**	**0**	**0**	**0**	**0**	**0**
Scaled	**2**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSE CODE			**COURSE 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 **relates**Casting 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
CO5:	**Illustrate**the, electrical and electronics basics and **Makes** appropriate connections**.**	Cognitive Psychomotor	Understanding Origination

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												

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSE CODE	XEM206	L	T	P	C
COURSE NAME	ENGINEERING MECHANICS	3	0	0	3
PREREQUISITES	NIL	L	T	P	H
C:P:A= 3:0:0		3	0	0	3

COURSE OBJECTIVES

Upon successful completion of the course, student will have:

- Ability to apply knowledge of mathematics, science, and engineering.
- Ability to design as well as to analyse and inter pre-data.
- Ability to identify, formulates, and solves engineering problems.
- Ability to apply techniques and resources to solve complex mechanical engineering activities with an understanding of the limitations.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	**Explain** the principles forces, laws and their applications.	Cognitive	Applying
CO2	**Classification** of friction, and **apply** the forces in Trusses and beams.	Cognitive	Applying
CO3	**Explain** and **Apply** moment of Inertia and Virtual work	Cognitive	Applying
CO4	**Outline** and **Examine** Dynamics	Cognitive	Applying
CO5	**Explain** free and forced vibration	Cognitive	Understanding

UNIT I	INTRODUCTION TO ENGINEERING MECHANICS	9

Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static indeterminacy.

UNIT II	FRICTION AND BASIC STRUCTURAL ANALYSIS	9

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines.

UNIT III	CENTROID , CENTRE OF GRAVITY AND VIRTUAL WORK AND ENERGY METHOD	9

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

UNIT IV	REVIEW OF PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS OF RIGID BODIES	9

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

UNIT V	MECHANICAL VIBRATIONS	9
Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums.		

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

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

E-REFERENCES	
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/

LECTURE: 45	TUTORIAL: 0	PRACTICAL: 0	TOTAL:45

Mapping of COs with GAs

	PROGRAM OUTCOMES											
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	1	3	1	1	2	3	2	1	3
CO2	3	2	1	1	3	1	1	2	3	2	1	3
CO3	3	2	1	1	3	1	1	2	3	2	1	3
CO4	3	2	1	1	3	1	1	2	3	2	1	3
CO5	2	2	2	1	3	1	1	3	3	3	1	3

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSE CODE	COURSE NAME	L	T	P	C
XCP 207	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	0	0	1	1

Prerequisites	Basic Understanding Skills	L	T	P	H
C : P : A		0	0	2	2
0.75 : 0.25 : 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 Outcomes:		Domain	Level
CO1	**Solve** simple programs using I/O statements.	Psychomotor	Responding
CO2	**Solve** programs using control structures and arrays.	Psychomotor	Responding
CO3	**Solve** programs using functions and pointers.	Psychomotor	Responding
CO4	**Solve** programs using structures.	Psychomotor	Responding
CO5	**Solve** programs using files.	Psychomotor	Responding

Sl. 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
	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	2	0	0	3	0	0	0	0	0	2	3

CO 2	3	2	0	0	2	0	0	0	0	0	2	3
CO 3	2	2	1	2	2	0	0	0	0	0	2	2
CO 4	2	2	1	2	2	0	0	0	0	0	2	2
CO 5	2	2	1	0	2	0	0	1	0	2	2	2
Total	**12**	**10**	**3**	**4**	**11**	**0**	**0**	**1**	**0**	**2**	**10**	**12**
Scaled	**3**	**2**	**1**	**1**	**3**	**0**	**0**	**1**	**0**	**1**	**2**	**3**

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XAP 208	**APPLIED PHYSICS FOR ENGINEERS LABORATORY**	**0**	**0**	**1**	**1**
Prerequisite	**Basic Physics in HSC level**	**L**	**T**	**P**	**H**
C : P : A		**0**	**0**	**2**	**2**
0 : 1.5 : 0.5					

Course Outcomes:		**Domain**	**Level**
CO1	**Identify** the basics of mechanics, and **determine** its significance in engineering systems and technological advances.	Psychomotor	Mechanism
CO2	**Use** and **locate** basic applications of electromagnetic induction to technology.	Psychomotor	Mechanism
CO3	**Describe** the working principle and application of various lasers and fibre optics.	Psychomotor	Mechanism
CO4	**Analyze** energy bands in solids, **discuss** and **use** physics principles of latest technology using semiconductor devices.	Psychomotor	Mechanism

List of Experiments:

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.

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	2	2	2	1	0	0	0	1	0	0	1
CO 2	3	0	1	0	1	0	0	0	0	0	0	1
CO 3	3	2	2	2	1	0	0	0	1	0	0	1
CO 4	3	2	2	2	1	0	0	0	1	0	0	1
CO 5	3	0	2	0	0	0	0	0	0	0	0	1
Total	**15**	**6**	**9**	**6**	**4**	**0**	**0**	**0**	**3**	**0**	**0**	**5**
Scaled	**3**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSE CODE	**XMA 301**	**L**	**T**	**P**	**C**
COURSE NAME	**Transforms and Partial Differential Equations**	**3**	**0**	**0**	**3**
PREREQUISITES	Algebra , Calculus and Laplace Transforms	**L**	**T**	**P**	**C**
C:P:A	**2.5 : 0: 0.5**	**3**	**0**	**0**	**3**

Learning Objectives

1. Introduction of methods to solve linear partial differential equations of second order and higher order.
2. Find the solutions of pde's are determined by conditions at the boundaries of the spatial domain and initial conditions at time zero.
3. Provide sufficient knowledge to engineering students in the specific mathematical tools and techniques such as Fourier series, Fourier transform and Z transform.
4. To enable students to use Fourier series method both in the solution of pde and other wider context.

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	**Solve** standard types of first order and second order partial differential equations with constant coefficients. Elimination of arbitrary constants and functions.	Cognitive	Applying
CO2	**State** Dirichlet's condition. **Explain** general Fourier series of the curve y = f(x) in the interval (0,2π) (-π, π), (0, 2 ℓ), (ℓ-ℓ) , (0, π) and (0, ℓ). Perform harmonic analysis.	Cognitive Psychomotor	Understanding Guided Response
CO3	**Solve** one dimensional Wave equation and Heat flow equation by Fourier series method in Cartesian coordinates. Classify second order quasi pde.	Cognitive Affective	Applying Receiving
CO4	**Find** the Fourier transform and Fourier sine and cosine transforms of simple functions **using** definition and its properties.	Cognitive	Applying
CO5	**Apply** the properties of Z transform to **find** the Z transform and inverse Z transform of sequence and functions, and to solve the difference equation using them.	Cognitive	Applying

UNIT I	**PARTIAL DIFFERENTIAL EQUATIONS**	**9**

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

UNIT II	**FOURIER SERIES**	**9**

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

UNIT III APPLICATIONS TO BOUNDARY VALUE PROBLEMS	9
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state conditions (zero Boundary conditions only).	
UNIT IV FOURIER TRANSFORM	**9**
Fourier transform pairs – Fourier Sine and Cosine transforms – properties – Transforms of simple functions – Parseval's identity.	
UNIT V Z TRANSFORM AND DIFFERENCE EQUATIONS	**9**
Z-transform – Elementary properties – Inverse Z – transform – Convolution theorem - Solution of difference equations using Z-transform.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
HOURS	**45**	**-**	**-**	**45**

TEXT BOOKS

1. Grewal, B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, New Delhi (2012).
2. Veerarajan. T., "Engineering Mathematics Volume III", Second reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.

REFERENCES

1. Churchill, R.V. and Brown, J.W., "Fourier Series and Boundary Value Problems", Fourth Edition, McGraw Hill Book Co., Singapore (1987).
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics Volume III", S. Chand & Company Ltd., New Delhi (1996).
3. Bali N.P. and Manish Goyal, "A Text Book of Engineering Mathematics" 7th Edition Lakshmi Publications (P) Limited, New Delhi (2007).
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Narayanan, S., ManicavachagomPillay, T.K. and Ramaniah, G., "Advanced Mathematics for Engineering Students", Volume: II and III, S.Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai (2002).

E-REFERENCES

nptel:Advanced Engineering Mathematics, Prof. Jitendra Kumar, Department of Mathematics, Indian Institute of Technology, Kharagpur, India.

Table 1: Mapping of Cos with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	3	2			2					1		2
CO2	3	1								1		1
CO3	3	1								1		1
CO4	3	2								1		1
CO5	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	COURSE NAME	L	T	P	C
XEE302	ELECTROMAGNETIC FIELDS	3	1	0	4
C : P : A		L	T	P	H
3 : 0 : 0		3	1	0	4

Course Outcomes:		Domain	Level
CO1	To understand the basics of vector and outline different coordinate system.	Cognitive	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	Understanding
CO5	Recall the concept of magnetization and magnetic field configuration using boundary condition.	Cognitive	Understanding

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 Conditions. 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

TEXT BOOKS:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. 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.

REFERENCE BOOKS:

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.

E-RESOURCES:

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**

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
XEE303	**DIGITAL LOGIC CIRCUITS**	**3**	**0**	**0**	**3**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**0**	**0**	**3**

Course Outcomes:		**Domain**	**Level**
CO1	Ability to design combinational and sequential Circuits.	Cognitive	Understanding

CO2	Ability to study various number systems and simplify the logical expressions using Boolean functions.	Cognitive	U ıderstanding
CO3	Ability to design various synchronous and asynchronous circuits.	Cognitive	Understanding
CO4	Ability to introduce asynchronous sequential circuits andPLDs.	Cognitive	Understanding
CO5	Ability to introduce digital simulation for development of application oriented logic circuits.	Cognitive	Understanding

UNIT – I: NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES	**9**
Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families - operation, characteristics of digital logic family.	
UNIT – II: COMBINATIONAL CIRCUITS	**9**
Combinational logic - representation of logic functions-SOP and POS forms, K-map representations minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.	
UNIT – III: SYNCHRONOUS SEQUENTIAL CIRCUITS	**9**
Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models- Counters, state diagram; state reduction; state assignment.	
UNIT – IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES	**9**
Asynchronous sequential logic circuits-Transition tability, flow tability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.	
UNIT – V: VHDL	**9**
RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).	

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

TEXT BOOKS:

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3. Comer "Digital Logic & State Machine Design, Oxford, 2012.

REFERENCE BOOKS:

1. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
3. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
4. Charles H.Roth, Jr, Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.
5. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.

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**

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**
XEE 304	**ELECTRICAL CIRCUIT ANALYSIS**	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**1**	**0**	**4**

Course Outcomes:		**Domain**	**Level**
CO1	**Illustrate** network theorems for the analysis of electrical circuits.	Cognitive	Applying
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	Analyzing
CO4	**Analysis** of AC circuits using Laplace transforms.	Cognitive	Analyzing
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**
XEE 305	**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	Understanding
CO2	Understand the winding concepts of DC machine.	Cognitive	Understanding
CO3	Understand the motoring and generating concepts of DC machine	Cognitive	Understanding

CO4	Analyse single phase and three phase transformers circuits.	Cognitive	Analyzing
CO5	Understand the various loss in magnetic circuits	Cognitive	Understanding

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: AUTOTRANSFORMERS	**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**
XUM306	**ENTREPRENEURSHIP DEVELOPMENT**	**2**	**0**	**0**	**2**
PREREQUISITES	**NIL**	**L**	**T**	**SS**	**H**
C:P:A= 3:0:0		**2**	**0**	**1**	**3**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	**Recognise** and **describe** the role of innovation and motivation for an entrepreneur.	Cognitive	Understanding
CO2	**Self-assess** and **appraise** your entrepreneurship interest with your chosen entrepreneur.	Cognitive	Evaluating
CO3	**Outline** the importance of generation of new ideas for entrepreneurship and **illustrate** market assessment.	Cognitive	Analyzing
CO4	**Explain** the competition in business and **sketch/demonstrate/ comply** business model for dealing with competition.	Cognitive	Understanding,
CO5	**Describe** and **Explain** venture creation and launching of small business and its management.	Cognitive	Understanding
CO6	**Describe** and **Discuss** various government policies and global opportunities for Entrepreneurship Development	Cognitive	Understanding

UNIT I	**INNOVATION AND ENTREPRENEURSHIP**	**5**

Definition of Innovation, Creativity and Entrepreneurship; role of innovation in entrepreneurship development (2)- Entrepreneurial motivation (1)-Competencies and traits of an entrepreneur (1)-Role of Family and Society; Entrepreneurship as a career and its role in national development (1)

UNIT II	**SELF ASSESSMENT OF ENTREPRENEURIAL INCLININATION**	**4**

Self-assessment of entrepreneurial inclination (1)-Presentation by students on their entrepreneurial inclination rating (2)-Case study of successful entrepreneurs (1)

UNIT III	**NEW IDEA GENERATION TO MARKET ASSESSMENT**	**9**

Importance of Idea generation-filtering-refinement (1)-opportunity recognition (1)- Description of chosen idea - value proposition, customer-problem-Solution statement) (1)-benefits; development status; IP ownership (1)-Market Validation- Technology/ user/decision makers/ partners (1)-market need; segmentation (1)-market TAM,SAM and SOM (1)-case study on market segmentation by popular companies (1)

UNIT IV	**CUSTOMER – COMPETITION- BUSINESS MODEL**	**9**

Customer-Target primary customer research, Decision making unit/ process-Beach head market; Cost of Customer Acquisition (2)-Competition- comparative analysis, competitive advantages-; (2)-Business model (1) -Financial planning (1)-Pitch documentation and presentation (3)

UNIT V	**VENTURE CREATION AND LAUNCHING OF SMALL BUSINESS AND ITS MANAGEMENT**	**9**

New enterprise creation - organizational and legal matters (1)-Operational plan (1)-Sales and distribution plan (1)-Accounting (1)-Team recruitment and management (1)-Fund raising and management (1)-Profile of a startup – case studies (2)

UNIT VI	**GOVERNMENT INITIATIVES AND GLOBAL OPPORTUNITIES**	**9**

Incubators and accelerators - capacity building (2)-Startup policies- Startup India (2)-Support for MSME; GeM Portal(2) Funding–national and international sources(2)-Bilateral programmes by Govt. of India -Global reach for promoting cross-cultural entrepreneurship (1)			
LECTURE: 45	**TUTORIAL: 0**	**PRACTICAL:0**	**TOTAL: 45**

REFERENCE

1.	A.P.Aruna, " Lecture Notes on Entrepreneurship Development" , available as softcopy @ www.brain.net
2.	Thomas W. Zimmerer, Norman M. Scarborough, "Essentials of Entrepreneurship and Small Business Management", Pearson; 3rd edition, 2001.
3.	John Burnett, "Introducing Marketing", Open Text Book available at http://solr.bccampus.ca:8001/bcc/file/ddbe3343-9796-4801-a0cb7af7b02e3191/1/Core%20Concepts%20of%20Marketing.pdf
4.	Toubia, Olivier. "Idea Generation, Creativity, and Incentives", Marketing Science. Vol. 25. pp.411-425. 10.1287/mksc.1050.0166, 2006.
5.	Alexander Osterwalder and Yves Pigneur, "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", Wiley; 1st edition, 2010.
6.	Gerardus Blokdyk,"3C's model The Ultimate Step-By-Step Guide"5starcooks, 2018.

Mapping of COs with POs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA 10	GA 11	GA 12
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

1-5 1, 6-10 2, 11-15 3

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

XUM307	**Universal Human Values 2: Understanding Harmony and Gender**	**L**	**T**	**P**	**C**
		2	1	0	3
		L	**T**	**P**	**H**
		2	1	0	3
Pre-requisites (if any)	**None. Universal Human Values-I (Desirable)**				
C:P:A= 3:0:0					

S. No	**COURSE OUTCOMES**	**DOMAIN**	**LEVEL**
CO1	***Explore*** about the need of value education.	Cognitive	Understanding

CO2	***Interpret*** self and body needs and responses to ensure harmony within self.	Cognitive	Understanding
CO3	***Explore*** the harmony in the family and society	Cognitive	Understanding
CO4	***Explore*** about the harmony in the nature / existence	Cognitive	Understanding
CO5	***Discuss*** about the holistic understanding.	Cognitive	Understanding

Module 1 – Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture1: Understanding Value Education
Lecture2: Self-exploration as the Process for Value Education
Tutorial 1: Practice Session *PS1* *Sharing about Oneself*
Lecture3: Continuous Happiness and Prosperity– the Basic Human Aspirations
Lecture 4: Right Understanding, Relationship and Physical Facility
Tutorial 2: PracticeSessionPS*2* *Exploring Human Consciousness*
Lecture 5: Happiness and Prosperity– Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS*3* *Exploring Natural Acceptance*

Module 2 – Harmony in the Human Being (6 lectures and 3 tutorials for practice session) **Lecture7:** Understanding Human being as the Co-existence of the Self and the Body
Lecture8: Distinguishing between the Needs of the Self and the Body
Tutorial 4: Practice Session PS*4* *Exploring the difference of Needs of Self and Body*
Lecture9: The Body as an Instrument of the Self
Lecture10: Understanding Harmony in the Self
Tutorial 5: Practice Session PS*5* *Exploring Sources of Imagination in the Self*
Lecture11: Harmony of the Self with the Body
Lecture12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS*6* *Exploring Harmony of Self with the Body*

Module 3 – Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture13: Harmony in the Family –the Basic Unit of Human Interaction
Lecture14: Values in Human-to-Human Relationship
Lecture 15: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS *7* *Exploring the Feeling of Trust*
Lecture16: 'Respect'–as the Right Evaluation
Tutorial 8: Practice Session PS *8* *Exploring the Feeling of Respect*
Lecture17: Understanding Harmony in the Society
Lecture18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS *9* *Exploring Systems to fulfill Human Goal*

Module 4 – Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature
Tutorial 10: Practice Session PS*10 Exploring the Four Orders of Nature*
Lecture21: Realizing Existence as Co-existence at All Levels
Lecture22: The Holistic Perception of Harmony in Existence
Tutorial11: Practice Session PS *11Exploring Co-existence in Existence*

Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics (6lectures and 3 tutorials for practice session)

Lecture23: Natural Acceptance of Human Values
Lecture24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS *12 Exploring Ethical Human Conduct*

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture26: Competence in Professional Ethics

Tutorial 13: Practice Session PS*13 Exploring Humanistic Models in Education*

Lecture 27: Holistic Technologies, Production Systems and Management ModelsTypical Case Studies

Lecture28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS *14 Exploring Steps of Transition towards Universal Human Order*

READINGS:

Text Book and Teachers Manual

a. The Textbook

A Foundation Course in Human Values and Professional Ethics, R R Gaur, RAsthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN978-93-87034-47-1

b. The Teacher's Manual Teachers' Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, NewDelhi 2019.ISBN978-93-87034-53-2

Reference Books

1. Jeevan Vidya:EkParichaya, A Nagaraj, Jeevan VidyaPrakashan,Amarkantak,1999.
2. HumanValues, A.N. Tripathi, NewAge Intl.Publishers, NewDelhi,2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth-by Mohandas Karam chand Gandhi
5. Small is Beautiful -E. F Schumacher.
6. Slow is Beautiful-Cecile Andrews
7. Economy of Permanence-JC Kumarappa
8. Bharat Mein Angreji Raj –Pandit Sunderlal
9. Rediscovering India- by Dharampal
10. Hind Swarajor Indian Home Rule-by Mohandas K.Gandhi
11. India Wins Freedom-Maulana Abdul Kalam Azad
12. Vivekananda-Romain Rolland (English)
13. Gandhi-Romain Rolland(English)

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	0	2	1	0	0	2	2	3	0	0	0	2	0	0
CO2	0	2	1	0	0	2	2	3	0	0	0	2	0	0
CO3	0	2	1	0	0	2	2	3	0	0	0	2	0	0
CO4	0	2	1	0	0	2	2	3	0	0	0	2	0	0
CO5	0	2	1	0	0	2	2	3	0	0	0	2	0	0
Total	0	10	5	0	0	10	10	15	0	0	0	10	0	0
Scaling	0	2	1	0	0	2	2	3	0	1	2	2	0	0

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
XEE 308	ELECTRICAL CIRCUIT ANALYSI S LABORATORY	0	0	1	1
C : P : A		L	T	P	H
0 : 1: 0		0	0	2	2

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

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE 309	**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.	Psychomotor	Perception
CO2	Understand the winding concepts of DC machine.	Psychomotor	Complex Overt Response
CO3	Understand the motoring and generating concepts of DC machine.	Psychomotor	Set
CO4	Analyse single phase and three phase transformers circuits.	Psychomotor	Set
CO5	Understand the various loss in magnetic circuits.	Psychomotor	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 selfexcited 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

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XMA 401	**PROBABILITY AND STATISTICS**	**3**	**0**	**0**	**3**
C : P : A		**L**	**T**	**P**	**H**
3.5 : 2.5 : 2.5		**3**	**0**	**0**	**3**

Course Outcomes:		**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
CO3	**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
CO4	**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
CO5	**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

UNIT - I: BASIC PROBABILITY	**9**
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	9
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	**9**
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	**9**
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	**9**
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chisquare test for goodness of fit and independence of attributes.	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT BOOKS:

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.

REFERENCE BOOKS:

1. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 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.

E-RESOURCES:

nptel

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

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	1	0	0	0	0	0	1	1	0	1
CO 2	3	2	1	0	0	0	0	0	1	1	0	1
CO 3	3	2	1	1	0	0	0	0	1	1	0	1
CO 4	3	2	1	1	1	1	0	0	1	1	1	1
CO 5	3	2	1	1	1	1	1	0	1	1	1	1
Total	**15**	**10**	**5**	**3**	**2**	**2**	**1**	**0**	**5**	**5**	**2**	**5**
Scaled	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**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
XEE402	ANALOG ELECTRONICS	3	0	0	3
C : P : A		L	T	P	H
3 : 0 : 0		3	0	0	3

Course Outcomes:		Domain	Level
CO1	Understand the characteristics of diodes, Zener and Special diodes and their applications.	Cognitive	Understanding
CO2	Understand the characteristics of transistor.	Cognitive	Understanding
CO3	Understand the working of MOSFET and its characteristics.	Cognitive	Understanding
CO4	Classify and explain different types of amplifier.	Cognitive	Understanding
CO5	Recall and explain linear and non-linear application of OP-Amp.	Cognitive	Understanding

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 AND NONLINEAR APPLICATIONS 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

TEXT BOOKS:

1. Electronic Devices and Circuits theory – Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson.
2. Malvino A. and D. J. Bates, Electronic Principles 7/e, Tata McGraw Hill, 2010.
3. Millman J. and C. C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw Hill, 2010.

REFERENCE BOOKS:

1. Floyd T. L., Fundamentals of Analog Circuits, Pearson Education, 2012.
2. Bell D. A., Electronic Devices and Circuits, Prentice Hall of India, 2007.
3. Electronics circuits and applications, Md H Rashid, Cengage 2014.
4. Robert T. Paynter and John Clemons, Paynter's Introductory Electronic Devices & Circuits, Prentice Hall Career & Technology, New Jersey.
5. Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar, A Vallvaraj, 5th Edition, McGraw Hill Education.
6. Gayakward R. A., Op-Amps and Linear Integrated Circuits, PHI Learning Pvt. Ltd., 2012.
7. Choudhury R., Linear Integrated Circuits, New Age International Publishers. 2008.

E-RESOURCES:

1. www.nptel.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	0	0	0	0	0	0	0	0	1	0	1	3	3
CO2	3	0	0	0	0	0	0	0	0	1	0	1	3	3
CO3	3	2	0	0	0	0	0	0	0	1	1	2	3	3
CO4	2	2	0	0	1	0	0	0	0	1	1	1	3	3
CO5	0	0	0	0	0	0	0	0	0	0	0	0	3	3
Total	**11**	**4**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**4**	**2**	**5**	**15**	**15**
Scaled	**2**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**3**	**3**

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
XEE 403	**CONTROL SYSTEMS**	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**1**	**0**	**4**

Course Outcomes:	**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	Understanding
CO2	**Explain** the performance of First and Second order system with static and dynamic error coefficients.	Cognitive	Understanding
CO3	**Describe** the frequency domain specifications and show the response of frequency response.	Cognitive	Understanding
CO4	**Determine** the stability of the systems and **Design** the suitable compensator and controller for the given performance criteria of the control system.	Cognitive	Understanding
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

UNIT - I: SYSTEMS AND THEIR REPRESENTATION	**9 + 3**
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.	
UNIT – II: TIME RESPONSE ANALYSIS	**9 + 3**
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.	
UNIT - III: FREQUENCY-RESPONSE ANALYSIS	**9 + 3**
Frequency domain specification – Bode plot – Polar plot – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.	
UNIT – IV: STABILITY ANALYSIS AND CONTROLLER DESIGN	**9 + 3**
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 + 5**
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values 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.	

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

TEXT BOOKS:

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.

REFERENCE BOOKS:

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 McGrowHill, Inc., 2013.

E-RESOURCES:

1. NTPEL, Control Systems Engineering (Web Course), Prof. M. Gopal, 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
CO1	2	3	2	1	0	0	1	1	1	0	0	1	0	0
CO2	2	3	1	0	2	1	1	1	1	1	0	2	2	1
CO3	3	3	3	2	0	0	1	0	3	0	0	0	2	0
CO4	1	2	2	3	2	2	1	1	2	1	1	2	1	0
CO5	2	1	1	1	2	1	1	1	2	1	0	1	2	0
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**

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
XEE 404	**ELECTRICAL MACHINES – II**	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3:0:0		**3**	**1**	**0**	**4**

Course Outcomes:		**Domain**	**Level**
CO1	To Understand the fundamentals of different types of slots and windings used for AC machines.	Cognitive	Understanding
CO2	To Understand the concepts of pulsating and revolving magnetic fields.	Cognitive	Understanding
CO3	To Understand the operation of induction machines, ttorque slip characteristics, equivalent circuit and its phasor diagram.	Cognitive	Understanding
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	Understanding

CO5	To Understand the operation of single-phase induction motors and its performance parameters.	Cognitive	Understanding

UNIT – I: FUNDAMENTALS OF AC MACHINE WINDINGS	**9 + 3**
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.	
UNIT – II: PULSATING AND REVOLVING MAGNETIC FIELDS	**9 + 3**
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.	
UNIT – III: INDUCTION MACHINES	**12 + 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 –Selfexcitation– Doubly-Fed Induction Machines.	
UNIT – IV: SINGLE PHASE INDUCTION MOTORS	**6 + 3**
Constructional details of single-phase induction motor – Double revolving field theory and operation – Equivalent circuit – Determination of parameters – Split-phase starting methods and applications.	
UNIT – V: SYNCHRONOUS MACHINES	**9 + 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)	

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

TEXT BOOKS:

1. I. J. Nagrath and D. P. Kothari, ‘Electric Machines’, Tata McGraw Hill Publishing Company Ltd, 2017.
2. M. G. Say, ‘Performance and Design of AC Machines’, CBS Publishers, 2013
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.

REFERENCE BOOKS:

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.

E-RESOURCES:

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	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	1	0	0	0	0	0	0	2	2	1
CO2	3	2	2	2	1	0	0	0	0	0	0	1	2	1
CO3	3	2	2	2	1	0	0	0	0	0	0	1	1	1
CO4	2	2	1	3	2	0	0	0	0	0	0	1	1	1
CO5	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**

1-5 1, 6-10 2, 11-15 3

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

COURSE CODE	**XUM 405**	**L**	**T**	**P**	**C**
COURSE NAME	**ECONOMICS FOR ENGINEERS**	**3**	**0**	**0**	**3**
PREREQUISITES		**L**	**T**	**P**	**H**
C:P:A	**3:0:0**	**3**	**0**	**0**	**3**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	***Explain*** the concepts of economics in engineering and ***identify*** element of cost to prepare cost sheet	Cognitive	Understanding
CO2	***Calculate and Explain*** the Break-even point and marginal costing	Cognitive	Understanding
CO3	***Summarize***and ***Use*** value engineering procedure for cost analysis	Cognitive	Understanding
CO4	***Estimate*** replacement problem	Cognitive	Understanding
CO5	***Compute, Explain*** and ***make Use of*** different methods of depreciation	Cognitive	Understanding

UNIT I INTRODUCTION TO ECONOMICS	**08**
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	**07**

Replacement analysis –Types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset.			
UNIT V DEPRECIATION			**08**
Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation.			
	LECTURE	**TUTORIAL**	**TOTAL**
HOURS	**45**	**0**	**45**
TEXT BOOKS			
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. PanneerSelvam, 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			

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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}
CO1	1	2	0	1	0	0	1	1	1	2	2	3
CO2	2	2	1	2	0	0	2	1	1	2	3	3
CO3	2	2	1	3	0	0	2	2	1	2	2	3
CO4	1	2	1	2	0	0	0	1	1	1	2	3
CO5	1	2	0	1	0	0	1	1	0	1	2	3
Scaled	1	2	1	2	0	0	1	1	1	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		**:**	**XUM406**	**L**	**T**	**P**	**C**
Course Name		**:**	**DISASTER MANAGEMENT**	**3**	**0**	**0**	**3**
Prerequisite		**:**	**NIL**				
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0**	**0**		**3**	**0**	**0**	**3**

Course Outcome: After the completion of the course, students will be able to		**Domain**	**Level**
CO1	Understand the concepts of disasters, their significance and types	Cognitive	Understanding

CO2	Understand the relationship between vulnerability, disasters, disaster prevention and risk reduction	Cognitive	Understanding
CO3	Able to understanding of preliminary approaches of Disaster Risk Reduction (DRR)	Cognitive	Understanding
CO4	Develop awareness of institutional processes in the country	Cognitive	Applying
CO5	Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity	Cognitive	Applying

COURSE CONTENT

UNIT I	**INTRODUCTION TO DISASTERS**	**6**
	Importance &Significance, Types of Disasters, Climate Change, DM cycle	
UNIT II	**RISK ASSESSMENT**	**12**
	Risk, Vulnerability, Types of Risk, Risk identification, Emerging Risks, Risk Assessment, Damage Assessment, Risk modeling.	
UNIT III	**DISASTER MANAGEMENT**	**10**
	Phases, Cycle of Disaster Management, Institutional Framework, Incident Command System, DM Plan, Community Based DM, Community health and safety, Early Warning and Disaster Monitoring, Disaster Communication, Role of GIS and Remote Sensing, Do's and Don'ts in various disasters.	
UNIT IV	**DISASTER RISK MANAGEMENT IN INDIA**	**10**
	Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness), Disaster Management Act and Policy – Other related policies,	
	plans, programmes and legislation	
UNIT V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES**	**7**
	Landslide Hazard Zonation, Earthquake Vulnerability Assessment of Buildings and Infrastructure, Drought Assessment, Coastal Flooding, Forest Fire, Man Made disasters, Space Based Inputs for Disaster Mitigation and Management, Cast Study	

L	**T**	**P**	**Total**
45	**0**	**0**	**45**

TEXT BOOKS

1. Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361)
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. KapurAnu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010

REFERENCE BOOKS

1. Siddhartha Gautam and K Leelakrisha Rao, “Disaster Management Programmes and Policies”, Vista International Pub House, 2012
2. Arun Kumar, “Global Disaster Management”, SBS Publishers, 2008
3. Pardeep Sahni, Alka Dhameja and Uma medury, “Disaster mitigation: Experiences and reflections”, PHI, 2000
4. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
5. Government of India, National Disaster Management Policy, 2009

E-REFERENCES

- NIDM Publications at http://nidm.gov.in- Official Website of National Institute of Disaster Management (NIDM), Ministry of Home Affairs, Government of India
- http://cwc.gov.in , http://ekdrm.net , http://www.emdat.be , http://www.nws.noaa.gov , http://pubs.usgs.gov , http://nidm.gov.ini http://www.imd.gov.ini

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

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
XEE 407	ANALOG ELECTRONICS LABORATORY	0	0	1	1
C : P : A		L	T	P	H
1 : 0 : 0		0	0	2	2

COURSE OBJECTIVES:

- To introduce the different types of analog and digital modulation and demodulation.
- To convey frequency division multiplexing and demultiplexing.
- To expose the students line coding and decoding.
- To create awareness on the performance of digital modulation techniques in AWGN and Rayleigh channels.

Course Outcomes:	Domain	Level

CO1	**Construct, Demonstrate** and **Simulate** Amplitude Modulation, Demodulation, sensitivity and selectivity of AM receivers.	Psychomotor	Mechanism
CO2	**Construct, Demonstrate** and **Simulate** Frequency Modulation, Demodulation, sensitivity and selectivity of FM receivers.	Psychomotor	Mechanism
CO3	**Construct,** and **Demonstrate** Frequency Division Multiplexing and demultiplexing.	Psychomotor	Mechanism
CO4	**Build**, **Demonstrate** and **Simulate** various types of analog and digital Pulse Modulations using trainer kits.	Psychomotor	Mechanism
CO5	**Simulate** performance of digital modulation techniques in AWGN and Rayleigh channels.	Psychomotor	Mechanism

Sl. No.	**List of Experiments**	**COs**
1.	Design of full wave rectifier with and without filter.	**CO1**
2.	Design of bridge rectifier circuits using with and without filter.	**CO1**
3.	Conduct an experiment to test clipping and clamping circuits.	**CO1**
4.	Design of BJT common emitter amplifier using voltage divider bias with and without feedback.	**CO2**
5.	Plot the drain and transfer characteristics of MOSFET.	**CO3**
6.	Conduct experiment on differential amplifier	**CO4**
7.	Design of Phase shift and Wien bridge oscillators using OP-AMP.	**CO5**
8.	Conduct experiment on Inverting, Non inverting amplifier using OP-AMP.	**CO5**
9.	Conduct experiment on astable and monostable multivibrator using OP-AMP.	**CO5**
10.	Conduct experiment on integrator and differentiator circuit using OP-AMP.	**CO5**
11.	Conduct experiment on Schmitt trigger circuit using OP-AMP.	**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									1		1	3	3
CO2	3									1		1	3	3
CO3	3	2								1	1	2	3	3
CO4	2	2			1					1	1	1	3	3
CO5													3	3
Total	**11**	**4**			**1**					**4**	**2**	**5**	**15**	**15**
Scaled	**2**	**1**			**1**					**1**	**1**	**1**	**3**	**3**

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
XEE 408	CONTROL SYSTEMS LABORATORY	0	0	1	1
C : P : A		L	T	P	H
0 : 1 : 0		0	0	2	2

COURSE OBJECTIVES:

- Control Systems is the engineering discipline that applies control theory to design systems with desired behaviours.
- 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 Outcomes:		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.	Psychomotor	Set
CO2	**Explain** the performance of First and Second order system with static and dynamic error coefficients.	Psychomotor	Set
CO3	**Describe** the frequency domain specifications and show the response of frequency response.	Psychomotor	Set
CO4	**Determine** the stability of the systems and **Design** the suitable compensator and controller for the given performance criteria of the control system	Psychomotor	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.	Psychomotor	Perception

Sl. No.	List of Experiments	COs
1.	Transfer function and modelling of separately excited DC Generator.	CO1
2.	Transfer function and modelling of Armature & field-controlled DC Motor.	CO1
3.	Transfer function of AC Servomotor.	CO1
4.	Analysis of Synchro Transmitter and Receiver.	CO2
5.	Performance of DC Stepper Motor.	CO2
6.	Digital simulation of I order and II order system by using Scilab.	CO2
7.	Frequency response of Lag, Lead & Lag – Lead networks.	CO3
8.	Determination of Phase margin and Gain margin of the Bode plot using Scilab.	CO3
9.	Transfer function and modelling of Ward – Leonard speed control system applied to DC motor.	CO5
10.	DC Position using feedback Control system.	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	2	3	2	1	0	0	1	1	1	0	0	1	0	0
CO2	2	3	1	0	2	1	1	1	1	1	0	2	2	1
CO3	3	3	3	2	0	0	1	0	3	0	0	0	2	0
CO4	1	2	2	3	2	2	1	1	2	1	1	2	1	0
CO5	2	1	1	1	2	1	1	1	2	1	0	1	2	0
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**

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
XEE 409	ELECTRICAL MACHINES – II 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 AC motor and generator.
- To analysis the various characteristics of performance Induction and synchronous machines.
- To expose the students to practical implementations of real time applications.

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

Sl. No.	List of Experiments	COs
1.	Load test on three phase squirrel cage induction motor.	**CO1**
2.	Load test on three phase slip ring induction motor.	**CO1**

3.	Load test of a three-phase alternator.	**CO2**
4.	No load and blocked rotor test on three phase induction motor.	**CO3**
5.	Study of induction motor starters.	**CO4**
6.	Load test on single-phase induction motor.	**CO4**
7.	No load and blocked rotor test on single phase induction motor.	**CO4**
8.	Regulation of three phase alternator by EMF /MMF methods.	**CO5**
9.	OCC and load characteristics of three phase alternator	**CO5**
10.	V and inverted V curves of three phase synchronous motor.	**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	0	0	0	2	2	1
CO2	3	2	2	2	1	0	0	0	0	0	0	1	2	1
CO3	3	2	2	2	1	0	0	0	0	0	0	1	1	1
CO4	2	2	1	3	2	0	0	0	0	0	0	1	1	1
CO5	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**

1-5 1, 6-10 2, 11-15 3

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

(V SEM -R-2018)

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 a power 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 is subjected to a fault.	Cognitive psychomotor	Understanding Evaluating Perception

Learning Objectives:

Establish and use power system models based on nodal admittance and impedance matrices for the analysis of large-scale power networks. Model generators, transformers, lines and cables in the positive, negative and zero sequence systems as basis for the analysis of symmetrical and unsymmetrical faults. Perform analysis of power systems subject to symmetrical and unsymmetrical faults.

Use simulation tools to perform comprehensive short circuit studies, load flow studies, and optimal power flow studies.

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 Zbus 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-Hill Education; 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 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, 5 **edition** (December 26, 2012)

E REFERENCES

www.nptel.ac.in
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

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 DC generators.	Cognitive Psychomotor	Understanding
CO2	**Explain** the performance of First and Second order 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 **and construct** 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 behaviours. 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
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 McGrowHill, Inc., 2013

E – REFERENCES

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

Mapping of COs with POs

	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	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 MICROCONTROLLERS**	**3**	**0**	**1**	**4**
C:P: A		**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, 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 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

REFERENCES

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	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

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- Fundamental Duties- Directive principles of State Policy.	
UNIT- II:	**9**
The Union Executive- The President of India (powers and functions)- Vice-President of IndiaThe Council of Ministers-Prime Minister- Powers and Functions.	
UNIT- III:	**9**
Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of Rajya Sabha- 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- Appellate jurisdictions- Advisory Jurisdiction- Judicial review.	
UNIT- V:	**9**
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	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.

COs versus POs mapping

	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

ELECTRICAL SAFETY

Course Outcomes (XEE M01):		**Domain**	**Level**
CO1	Describe electrical hazards and safety equipment.	Cognitive	Understanding
CO2	Analyze and apply various grounding and bonding techniques.	Cognitive	Applying
CO3	Select appropriate safety method for low, medium and high voltage equipment.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE M01	**ELECTRICAL SAFETY**	**1**	**0**	**0**	**1**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**1**	**0**	**0**	**1**

Topics **15**

Principles of electric safety - Electricity & Human body - Earthing / Grounding Risk assessment & management - Safety against over voltage, extra-low and residual voltages - Safe practices – RCD, PPE, CB, lockout/tag out -Hazardous areas, Electrical insulation - Electrical fires, Arc flash - Electrical safety in hospitals and Industries. Hazards of electricity - basic physics of electrical hazards - electrical safety equipment safety procedures and methods - grounding and bonding of electrical systems and equipment - electrical maintenance and its Relationship to safety regulatory and legal safety requirements and standards accident prevention, accident investigation, rescue, and first aid - medical aspects of electrical trauma - low-voltage, mediumand high-voltage safety synopsis Human factors in electrical safety.

	LECTURE	**TUTORIAL**	**TOTAL**
	15	**0**	**15**

TEXT BOOKS

1. "Electrical Safety Handbook", John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, McGraw-Hill Education, 4th Edition, 2012.

REFERENCE BOOKS

1. "Electrical Safety- a guide to the causes and prevention of electric hazards", Maxwell Adams.J, The Institution of Electric Engineers, IET 1994(Reprint).
2. "Electrical Safety in the Workplace", Ray A. Jones, Jane G. Jones, Jones & Bartlett Learning, 2000.

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

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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

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 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. Amita Sinvhal, "Understanding earthquake disasters" TMH, 2010.
4. Pardeep Sahni, Alka Dhameja and Uma Medury, "Disaster mitigation: Experiences and reflections", PHI, 2000

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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	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

ENERGY AUDITING

Course Outcomes (XEE M02):		Domain	Level
CO1	Understand the importance of energy auditing & energy management.	Cognitive	Understanding
CO2	Apply their own ideas in optimizing the energy requirements to overcome the demand.	Cognitive	Applying

CO3	Acquire knowledge about energy monitoring and targeting to improve the energy efficiency.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE M02	**ENERGY AUDITING**	**1**	**0**	**0**	**1**
C:P: A		**L**	**T**	**P**	**H**
1:0:0		**1**	**0**	**0**	**1**

Topics **15**

Energy Scenario: energy needs of growing economy, energy pricing, energy sector reforms, Restructuring of the energy supply sector, Energy Conservation Act-2010 and its features - Need for energy audit - Energy management & audit approach: understanding energy, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, energy audit instruments. Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques -energy consumption, production, cumulative sum of differences (CUSUM) - Energy Efficiency in Electrical Utilities: electrical load management and maximum demand control, power factor improvement, energy saving opportunities with energy efficient motors.

	LECTURE	**TUTORIAL**	**TOTAL**
	15	**0**	**15**

TEXT BOOKS

1. "Energy Management Principles: Applications, Benefits, Savings", Craig B. Smith Kelly Parmenter, Elsevier,2nd Edition, 21st November 2015 eBook ISBN: 9780128026441
2. "Industrial Energy Management and Utilization "by L.C. Witte, P.S. Schmidt, D.R. Brown Hemisphere Publication, Washington, 1988, Published online 2010.

REFERENCE BOOKS

1. "Industrial Energy Conservation Manuals" by Elias P. Gyftopoulos, MIT Press, Mass, 1982© 2019 The MIT Press
2. "Energy Conservation guide book" by Patrick/Patrick/Fardo, Prentice hall, Third Edition,2014.
3. "Energy Management Handbook" by Wayne C. **Turner** & Steve Doty", John Wiley and Sons, A Wiley Interscience publication, 6th Edition, 2013.

SEMESTER VII-R-2018 HIGH VOLTAGE ENGINEERING

Course Outcomes (XEE E41):		**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 define **and 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 and Illustrate 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
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.

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
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 multiquadrant 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

HUMAN 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 Maniammai University, Vallam,Thanjavur.
10. Status Report 1976, Govt. of India.

REFERENCES

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

MICROGRIDS

Course Outcomes (XEE M03):		**Domain**	**Level**
CO1	Understand concept of microgrid and implementation issues.	Cognitive	Understanding
CO2	Understand issues related to power electronics interface.	Cognitive	Understanding
CO3	Acquire knowledge about modelling and stability analysis of solving power quality issues in Microgrid.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
XEE M03	**MICROGRIDS**	**1**	**0**	**0**	**1**
C:P: A		**L**	**T**	**P**	**H**
3:0:0		**1**	**0**	**0**	**1**

Topics **15**

Concept and definition of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid: AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, modes of operation and control of microgrid: grid connected and islanded mode, Power quality issues in microgrids- Modelling and Stability analysis of Microgrid, regulatory standards, Microgrid economics.

	LECTURE	**TUTORIAL**	**TOTAL**
	15	**0**	**15**

TEXT BOOKS

1. "Renewable Energy Resources", John Twidell and Tony Weir, Taylor and Francis Publications, 2006.
2. "Microgrids and Active Distribution", S. Chowdhury, S. P. Chowdhury, P. Crossley The Institution of Engineering and Technology (June 24, 2009).

REFERENCE BOOKS

1. "Solar Photo Voltaics", Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi, 2009.
2. "Wind Energy Conversion System", Freris, Prentice Hall, 1990.

SEMESTER VIII
CYBER SECURITY

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

Learning Objectives:

To understand key terms and concepts in cyber law, intellectual property and cybercrimes, trademarks and domain theft. Able to examine secure software development practices. The learner will be able to incorporate approaches for risk management and best practices. To understand the basic knowledge of information security and security threats.

COURSE CODE	COURSE NAME	L	T	P	C
XUM 801	CYBER SECURITY	0	0	0	0
C:P: A		L	T	P	H
3:0:0		0	0	0	3

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	**15**
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

TEXTBOOKS

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

REFERENCES
1. Rick Howard "Cyber Security Essentials" Auerbach Publications 2011. 2. Richard A. Clarke, Robert Knake "Cyberwar: The Next Threat to National Security & What to Do About It" Ecco 2010.
3. Dan Shoemaker Cyber security The Essential Body Of Knowledge, 1st ed. Cengage Learning 2011. 4. Rhodes-Ousley, Mark, "Information Security: The Complete Reference", Second Edition, McGraw-Hill, 2013.
E REFERENCES
1. https://www.coursera.org/specializations/cyber-security 2. www. nptel.ac.in 3. http://professional.mit.edu/programs/short-programs/applied-cybersecurity

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 the different 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 internal combustion 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 -R2021 PART TIME

COURSE CODE	COURSE NAME	L	T	P	C
PEE 301	TRANSMISSION AND DISTRIBUTION	3	1	0	4
C : P : A		L	T	P	H
3 : 0 : 0		3	1	0	4

Course Outcomes:		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
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 type's underground cables..	Cognitive	Understanding
CO5	**Summarize** the latest technologies in the field of distribution systems..	Cognitive	Understanding

UNIT - I: TRANSMISSION LINE PARAMETERS	**9 + 3**
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 + 3**
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, DeMultiplexer /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.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 + 3**
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 + 3**
comparison with overhead line – Types of cables – insulation resistance – potential gradient – capacitance of single-core and three-core cables	
UNIT - V: DISTRIBUTION SYSTEM	**9 + 3**
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	**15**	**60**

TEXT BOOKS:

1. D.P. Kothari and I.J. Nagrath, 'Power System Engineering', Tata McGraw–Hill,2 nd 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.

REFERENCE BOOKS:

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-RESOURCES:

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**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	3	0	0	0	0	0	0	0	1	0	2	2	1
CO2	1	3	1	0	1	0	0	0	0	0	0	1	3	1
CO3	1	0	0	1	1	0	0	0	0	1	0	0	2	1
CO4	1	2	0	0	0	0	0	0	0	0	1	1	2	1
CO5	1	2	0	0	0	0	0	0	0	0	0	1	2	1
Total	**5**	**10**	**1**	**1**	**2**	**0**	**0**	**0**	**0**	**2**	**1**	**5**	**11**	**5**
Scaled	**2**	**3**	**1**	**1**	**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
PEE 303	DIGITAL ELECTRONICS	3	1	0	4
C : P : A		L	T	P	H
3 : 0 : 0		3	1	0	4

Course Outcomes:		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 application	Cognitive	Understanding

UNIT - I: FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES	9 + 3
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 + 3**
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, DeMultiplexer /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 + 3**
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: UNDERGROUND CABLES	**9 + 3**
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 + 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.

	LECTURE	TUTORIAL	TOTAL
	45	15	60

TEXT BOOKS:

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

REFERENCE BOOKS:

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-RESOURCES:

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
CO1	2	1	3	-	-	1	1	1	-	1	-	2	2	1
CO2	3	2	1	-	-	2	0	2	1	-	-	2	1	2
CO3	2	2	1	-	-	1	2	2	1	1	-	1	2	2
CO4	2	2	3	-	-	1	1	1	-	-	1	1	1	2
CO5	3	2	2	-	-	0	1	1	1	1	1	2	2	2
Total	**12**	**9**	**10**	**-**	**-**	**4**	**5**	**7**	**3**	**3**	**2**	**8**	**8**	**9**
Scaled	**3**	**2**	**2**			**1**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**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
PEE 304	**ELECTRICAL MACHINES II**	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**1**	**0**	**4**

Course Outcomes:		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, torque 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

UNIT – I: FUNDAMENTALS OF AC MACHINE WINDINGS	**9 + 3**
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.	
UNIT – II: PULSATING AND REVOLVING MAGNETIC FIELDS	**9 + 3**
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.	
UNIT – III: INDUCTION MACHINES	**9 + 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 – Selfexcitation– Doubly-Fed Induction Machines.	
UNIT – IV: SINGLE PHASE INDUCTION MOTORS	**9 + 3**
Constructional details of single-phase induction motor – Double revolving field theory and operation – Equivalent circuit – Determination of parameters – Split-phase starting methods and applications.	
UNIT – V: SYNCHRONOUS MACHINES	**9 + 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)	

	LECTURE	TUTORIAL	TOTAL
	45	15	60

TEXT BOOKS:

1. I. J. Nagrath and D. P. Kothari, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2017.
2. M. G. Say, 'Performance and Design of AC Machines', CBS Publishers, 2013
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.

REFERENCE BOOKS:

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.

E-RESOURCES:

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	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	1	0	0	0	0	0	0	2	2	1
CO2	3	2	2	2	1	0	0	0	0	0	0	1	2	1
CO3	3	2	2	2	1	0	0	0	0	0	0	1	1	1
CO4	2	2	1	3	2	0	0	0	0	0	0	1	1	1
CO5	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**

→ 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
PEE 305	**ELECTRICAL MACHINES – II 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 AC motor and generator.
- To analysis the various characteristics of performance Induction and synchronous machines.
- To expose the students to practical implementations of real time applications.

Course Outcomes:		**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, torque 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

Sl.No.	**List of Experiments**	**COs**
1.	Load test on three phase squirrel cage induction motor.	**CO1**
2.	Load test on three phase slip ring induction motor.	**CO2**
3.	Load test of a three-phase alternator.	**CO3**
4.	No load and blocked rotor test on three phase induction motor.	**CO4**
5.	Study of induction motor starters.	**CO4**
6.	Load test on single-phase induction motor.	**CO4**
7.	No load and blocked rotor test on single phase induction motor.	**CO5**
8.	Regulation of three phase alternator by EMF /MMF methods.	**CO5**
9.	OCC and load characteristics of three phase alternator	**CO5**
10.	V and inverted V curves of three phase synchronous motor.	**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	0	0	0	2	2	1

CO2	3	2	2	2	1	0	0	0	0	0	0	1	2	1
CO3	3	2	2	2	1	0	0	0	0	0	0	1	1	1
CO4	2	2	1	3	2	0	0	0	0	0	0	1	1	1
CO5	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**

→ → →

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
PEE 401	**MICROPROCESSORS AND MICROCONTROLLERS**	**3**	**0**	**0**	**3**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**0**	**0**	**3**

Course Outcomes:		**Domain**	**Level**
CO1	To Understand the fundamentals of microcontrollers and embedded systems.	Cognitive	Understanding
CO2	To explain the architecture, Timing diagrams and Execution. cycles of 8051	Cognitive	Understanding
CO3	To identify the types of addressing modes, recall Instruction types and to understand the basic concepts of programming	Cognitive	Understanding
CO4	To understand interfacing design of peripherals like I/O, A/D,D/A, timer etc.	Cognitive	Understanding
CO5	To identify and explain various communication protocols and interfacing with external devices..	Cognitive	Understanding

UNIT - I: FUNDAMENTALS OF MICROPROCESSORS	**9**
Fundamentals of Microprocessor Architecture,Comparison of 8-bit microcontrollers,16-bit and32-bitmicrocontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. 8085 Hardware Architecture, – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Programming concepts with 8085.	
UNIT - II: THE 8051ARCHITECTURE	**9**
Overview of the 8051 family-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
8051 Instruction syntax, Data types, Subroutines, Addressing modes, 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.	
UNIT - IV: MEMORY AND I/O INTERFACING	**9**
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 and memory devices. Parallel Peripheral Interface8255, Interrupt Controller 8259, Timer / Counter 8254, Keyboard Display Controller 8279.	
UNIT - V: EXTERNAL COMMUNICATION INTERFACE AND APPLICATIONS	**9**
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, Application to automated systems Introduction to PIC Microcontroller, ARM Processor, ATMEGA Processor.	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT BOOKS:

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

REFERENCE BOOKS:

1. D.A.Patterson and J.H.Hennessy, Computer Organization and Design RISC-V Edition The Hardware/Software Interface, 5th ed., Amsterdam; Boston: Elsevier/Morgan Kaufmann, 2017..
2. D.V.Hall, "Microprocessors &Interfacing", McGraw Hill Higher Education, 2005.

E-RESOURCES:

1. www.nptel.ac.in
2. https://onlinecourses.nptel.ac.in/noc19_ee11
3. https://nptel.ac.in/courses/Webcourse contents/IIScBANG/notused/Microprocessors%20 and % 20 Microcontrollers /Learning%20 Material%20 %20 Microprocessors% 20and%20 microcontrollers. Pdf

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	0	2	0	0	0	0	0	0	1	1	0	1	1
CO2	1	2	1	3	1	0	0	0	2	1	2	1	1	1
CO3	0	0	0	0	0	1	2	0	1	2	0	0	1	1
CO4	1	1	2	2	1	0	0	0	2	1	2	1	0	1

CO5	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**

→ → →

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**
PEE402	**ECONOMICS FOR ENGINEERS**	**3**	**0**	**0**	**3**
PREREQUISITES		**L**	**T**	**P**	**H**
C:P:A	**2.64:0.24:0.12**	**3**	**0**	**0**	**3**

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	**Explain** the concepts of economics in engineering and **identify** element of cost to prepare cost sheet	Cognitive Psychomotor	Understand Perception
CO2	**Calculate and Explain** the Break-even point and marginal costing	Cognitive Psychomotor	Understand &Apply Perception
CO3	**Summarize** and **Use** value engineering procedure for cost analysis	Cognitive Affective	Understand Receive
CO4	**Estimate** replacement problem	Cognitive	Understand
CO5	**Compute, Explain** and **make Use of** different methods of depreciation	Cognitive	Understand &Apply

UNIT I INTRODUCTION TO ECONOMICS	**08**
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	**07**
Replacement analysis –Types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset.	

UNIT V DEPRECIATION			`
Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation.			
	LECTURE	**TUTORIAL**	**TOTAL**
HOURS	**45**	**0**	**45**

TEXT BOOKS

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. PanneerSelvam, 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

COURSE CODE	COURSE NAME	L	T	P	C
PEE E11	**SOLID STATE DRIVES**	**3**	**0**	**0**	**3**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**0**	**0**	**3**

Course Outcomes:		**Domain**	**Level**
CO1	**Understand** the fundamentals of Electric Drives and their ratings.	Cognitive	Understanding
CO2	**Express** the various control techniques of DC Drives.	Cognitive	Remembering
CO3	**Analyze** the different speed control methods of Induction motor at stator.	Cognitive	Understanding
CO4	**Formulate** the closed loop control of Induction motor drive.	Cognitive	Remembering
CO5	**Devise** the assorted control strategies of synchronous motor control operation.	Cognitive	Understanding

UNIT – I: DRIVE CHARACTERISTICS	**9**
Fundamentals of Electric Drives – Advantage of Electric Drives – selection of Motor power ratingThermal model of motor for heating and cooling – Classes of duty cycle. Determination of motor rating – Control of Electric drives – modes of operation – speed control and drive classifications.	
UNIT – II: SOLID STATE 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 VVVF control.

UNIT – IV: ROTOR CONTROLLED INDUCTION MOTOR DRIVES	**9**

Rotor resistance control – Slip power recovery schemes–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	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXT BOOKS:

1. Dubey. G.K."Fundamentals of Electrical drives", Narora publications,1995.
2. R. Krishnan,"Electric motor & Drives;Modelling, Analysis and Control", Prentice Hall of India,2001.
3. Gopal K. Dubey, Fundamentals of Electrical Drives, New Delhi, 2nd Edition, Narosa Publishing House, 2001.
4. B.K.Bose,'Power Electronics and AC Drives', Prentice Hall Ongle woodcliffs,NewJersey,1986.

REFERENCE BOOKS:

1. Murphy, J.M.D and Turnbull. F.G., 'Thyristor control of AC Motors',PergamonPress,1988.
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.,1994.
4. Gaekward,"Analog and Digital control systems", Wiley Eastern Ltd,1989.

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE404	**CONTROL SYSTEMS**	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**1**	**0**	**4**

Course Outcomes:		**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
CO2	**Explain** the performance of First and Second order 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 **and construct** and **verify** the canonical state model and Kalman's test for controllability and observability.	Cognitive	Remembering

UNIT - I: SYSTEMS AND THEIR REPRESENTATION	**9 + 3**
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.	
UNIT – II: TIME RESPONSE ANALYSIS	**9 + 3**
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.	
UNIT - III: FREQUENCY-RESPONSE ANALYSIS	**9 + 3**
Frequency domain specification – Bode plot – Polar plot – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.	
UNIT – IV: STABILITY ANALYSIS AND CONTROLLER DESIGN	**9 + 3**
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 + 3**
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values 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.	

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

TEXT BOOKS:

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.

REFERENCE BOOKS:

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-RESOURCES:
2. NTPEL, Control Systems Engineering (Web Course), Prof. M. Gopal, 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
CO1	2	3	2	1	0	0	1	1	1	0	0	1	0	0
CO2	2	3	1	0	2	1	1	1	1	1	0	2	2	1
CO3	3	3	3	2	0	0	1	0	3	0	0	0	2	0
CO4	1	2	2	3	2	2	1	1	2	1	1	2	1	0
CO5	2	1	1	1	2	1	1	1	2	1	0	1	2	0
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**

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1-5 1, 6-10 2, 11-15 3

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 over voltages 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 (APPARATUS AND MODELING)**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**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", 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 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, 5 **edition** (December 26, 2012)

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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	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

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

Course Outcomes:		**Domain**	**Level**
CO1	**Describe** the principles of biomedical measurement systems and apply the signal amplification and processing that is common to many medical Instruments.	Cognitive	Understanding
CO2	**Identify** the origin of bio-potentials and various bioelectric signals that are recorded routinely in modern clinical practice. **Understand** the basic mechanisms involved in the transduction process of bio-potential electrodes and be able to discuss electrical characteristics of electrodes.	Cognitive	Understanding
CO3	**Handle** the various techniques of measuring blood flow, pressure & volume. **Summarize** the concepts and mechanisms of various clinical laboratory instrumentation.	Cognitive	Understanding
CO4	**Describe** and apply the safety issues, safe design, and safe use of medical instrumentation, specifically electrical safety, and learn how to incorporate safety features into the design.	Cognitive	Understanding
CO5	**Design** an instrument that can be used to analyze heart rate with exercise using appropriate Bio-amplification and filters, bio-potential sensors, and data acquisition programs.	Cognitive	Understanding

UNIT – I: HUMAN SYSTEM AND BIOPOTENTIAL 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, standard12 load system, PQPs waveform. EEG – 10-20 electrode system, brainwaves, recording setup of EEG, EMG, ERG, and EOG – unipolar and bipolar mode.	
UNIT – III: BIOAMPLIFIER AND TRANSDUCER	**9**
Need for Bio-amplifier, power amplifier, isolation amplifier, feedback amplifier. Resistive, Inductive, Capacitive transducer and application, Fibre optic, photo electric 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 safetyelectrical shock hazards.

UNIT – V: MEDICAL DIAGNOSTICS INSTRUMENTS AND SYSTEMS	9
CT scanner–MRI Scanand Ultrasonic scanner–XRay–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',TataMcGrawHill,1989.
2. Arumugam M., 'Bio-Medical Instrumentation', Anuradha Agencies Pub.,2002.
3. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2000.
4. J. Webster, 'Medical Instrumentation', John Wiley & Sons,1995.

REFERENCE BOOKS:

1. Geddes L.A., and Baker, L.E., 'Principles of Applied Bio-medical Instrumentation', 3rd Edition, John Wiley and Sons, 1995.
2. Cromwell, Weibell and Pfeiffer, 'Biomedical Instrumentation and Measurements', 2nd Edition, Prentice Hall of India,1999.
3. Tompkins W.J., Biomedical Digital Signal Processing, Prentice Hall of India, 1998.
4. J. Wilson, J.F.B. Hawkes, 'Laser Principles and Applications', .Prentice-Hall, NewYork, 1987.

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

COURSE CODE	COURSE NAME	L	T	P	C
PEE503	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

-

COs versus POs mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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 **and construct** 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 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 — **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 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, 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 McGraw Hill, Inc., 2013

E – REFERENCES

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	PO 10	PO 11	PO 12	PSO 1	PSO 2
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 POWER SYSTEMS-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: tapchanging 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.

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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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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	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**
PEE602	**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"

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1. e-waste Management: From waste to Resource Klaus Hieronymi, Ramzy Kahnat, 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: Sairudeen Pattazhy

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- www.unep.org
- www.routledge.com
- www.amazon.com
- www.bookdepository.com
- www.ecoactiv.com

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**

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**
CO 1	Understanding the concepts of application of types of disaster preparedness	Cognitive	Application
CO 2	On completion of this course the students will be able to understand planning essentials of disaster.	Cognitive	Analyze
CO 3	Have a good understanding of importance of seismic waves occurring globally	Cognitive	Analyze
CO 4	On completion of this course, the students will be able to perform drill essential for disaster mitigation	Cognitive	Application
CO 5	Have a keen knowledge on essentials of risk reduction	Cognitive	Application

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE603	**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. 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

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	Cognitive	Understanding
	Execution cycles of 8051		
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-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051family.	
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 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**	**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

POWER PLANT ENGINEERING

Course Outcomes (PEE E41):		**Domain**	**Level**
CO1	**Explain** about the various types of the power generation and function of boilers	Cognitive	Understanding
CO2	**Choose** Various Measurements in power plants.	Cognitive	Remembering
CO3	**Illustrate** Various analyzers in power plants, and **identify** the pollution monitoring instruments.	Cognitive	Understanding Applying
CO4	**Infer all** control loops in boiler, and interlocks 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. – non electrical 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.

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1. Power station Engineering and Economy by Bernhardt G.A.Skrotzki and William A.VopatTata 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

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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 (PEE 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**
PEE 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 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 multiquadrant 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,
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.

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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. Gaekward, 'Analog and Digital Control Systems', Wiley Eastern Ltd, 1989.
5. Leonhard. W, 'Control of Electric Drives', Springer Science & Business Media, 2001

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Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**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**
PEE E61	**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. TRANSMISSION TECHNOLOGY	**09**
Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability)- Application of DC Transmission –Types of HVDC Systems –Components of a HVDC System – Line Commutated Converter and Voltage Source Converter Based systems.	
UNIT– II: ANALYSIS OF LINE COMMUTATED AND VOLTAGE SOURCE 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: CONTROL OF HVDC CONVERTERS 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 ENHANCEMENT USING HVDC CONTROL	**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: MTDC LINKS	**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, 'High Voltage Direct Current Transmission',Peter Peregrinus Ltd.,1983.			
REFERENCES:			
1. Kimbark. E.W, 'Direct Current Transmission', 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
Scaling	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

M.TECH (PED) SEMESTER I ANALYSIS OF ELECTRICAL MACHINES

Course Outcomes (YPE 101):		Domain	Level
CO1	Understand the principles of electromechanical energy conversion and characteristics of DC motors	Cognitive	Understanding
CO2	Know the concepts related with AC machines and modelling of 'n' phase machines	Cognitive	Understanding
CO3	Interpret the concepts of reference frame theory.	Cognitive	Understanding
CO4	Apply procedures to develop induction machine model in both machine variable form and reference variable forms	Cognitive	Applying
CO5	Follow the procedures to develop synchronous machine model in machine variables form and reference variable form.	Cognitive	Applying

COURSE CODE	COURSE NAME	L	T	P	C
YPE 101	ANALYSIS OF ELECTRICAL MACHINES	3	1	0	4
C:P: A = 3:0:0		L	T	P	H
		3	1	0	4

UNIT -I ELECTROMECHANICAL ENERGY CONVERSION and DC MACHINES	12
Magnetic circuits, permanent magnet, Energy conservation - stored magnetic energy, co-energy force and torque in singly and doubly excited systems – Elementary DC machine and analysis of steady state operation - Voltage and torque equations – dynamic characteristics - DC motors – Time domain block diagrams - solution of dynamic characteristic by Laplace transformation	
UNIT – II AC MACHINES -CONCEPTS	**12**
Distributed Windings - Winding Functions - Air-Gap Magneto motive Force -Rotating MMF - Flux Linkage and Inductance -Resistance -Voltage and Flux Linkage Equations for Distributed Winding Machines--magnetic noise and harmonics in rotating electrical machines. Modeling of 'n' phase machine.	
UNIT – III REFERENCE FRAME THEORY	**12**
Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame – transformation of balanced set-variables observed from several frames of reference.	
UNIT - IV INDUCTION MACHINES	**12**
Three phase induction machine and doubly fed induction machine- equivalent circuit and analysis of steady state operation – free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – analysis of dynamic performance for load torque variations- Transformation theory for 'n' phase induction machine.	
UNIT – V SYNCHRONOUS MACHINES	**12**
Three phase synchronous machine and analysis of steady state operation - voltage and torque equations in machine variables and rotor reference frame variables (Park's equations) – analysis of dynamic performance for load torque variations –Krons primitive machine.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	0	60

REFERENCES

1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition,2020.
2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition,Power Electronics and Motor Drives, CRC Press, 2011
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, "Analysis of ElectricMachinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.
4. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education, 1st Imprint, 2015.
5. R.Ramanujam, Modeling and Analysis of Electrical Machines, I.k. International Publishing HousePvt.Ltd,2018

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
Total	15	15	15	15	15	10
Scaled	3	3	3	3	3	2

1- Slightly2 – Supportive 3 – Highly related **ANALYSIS OF POWER CONVERTERS**

Course Outcomes (YPE 102):		**Domain**	**Level**
CO1	Acquire and apply knowledge of mathematics in power converter analysis	Cognitive	Applying
CO2	Model, analyze and understand power electronic systems and equipment.	Cognitive	Analyzing
CO3	Formulate, design and simulate phase controlled rectifiers for generic load and for machine loads	Cognitive	Understanding
CO4	Design and simulate switched mode inverters for generic load and for machine loads	Cognitive	Understanding
CO5	Select device and calculate performance parameters of power converters under various operating modes	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE 102	**ANALYSIS OF POWER CONVERTERS**	**3**	**1**	**0**	**4**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**1**	**0**	**4**
UNIT -I SINGLE PHASE AC-DC CONVERTER					**12**

Static Characteristics of power diode, SCR and GTO, half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - inverter operation and its limit –Sequence control of converters – performance parameters – effect of source impedance and overlap-reactive power and power balance in converter circuit.

UNIT – II THREE PHASE AC-DC CONVERTER	**12**

Half controlled and fully controlled converters with R, R-L, R-L-E loads and freewheeling diodes – inverter operation and its limit – performance parameters – effect of source impedance and overlap - 12 pulse converter –Applications - Excitation system, DC drive system.

UNIT – III SINGLE PHASE INVERTERS	**12**

Introduction to self-commutated switches : MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques – Design of UPS - VSR operation

UNIT - IV THREE PHASE INVERTERS	**12**

180 degree and 120-degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques – VSR operation-Application – Induction heating, AC drive system – Current source inverters.

UNIT – V MODERN INVERTERS	**12**

Multilevel concept – diode clamped – flying capacitor – cascaded type multilevel inverters Comparison of multilevel inverters - application of multilevel inverters – PWM techniques for MLI – Single phase &Three phase Impedance source inverters – Filters.

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

REFERENCES

1. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10th Impression 2021.
2. Jai P. Agrawal, “Power Electronics System Theory and Design”, Pearson Education, First Edition, 2015.
3. Bimal.K.Bose “Modern Power Electronics and AC Drives”, Pearson Education, Second Edition, 2003.
4. Ned Mohan, T.M.Undeland and W.P.Robbins, “Power Electronics: converters, Application and design”, 3rd edition Wiley, 2007.
5. Philip T. Krein, “Elements of Power Electronics” Indian edition Oxford University Press-2017.
6. P.C.Sen, “Modern Power Electronics”, S.Chand Publishing 2005.
7. P.S.Bimbra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2003.
8. Bin Wu, Mehdi Narimani, "High-Power Converters and AC Drives", Wiley, 2nd Edition, 2017.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	3	3	2	2
CO2	3	-	3	3	2	2
CO3	3	-	3	3	2	2
CO4	3	-	3	3	2	2

CO5	3	-	3	3	2	2
Total	15	0	15	15	10	10
Scaled	3	0	3	3	2	2

1- Slightly 2 – Supportive 3 – Highly related

MODELING AND DESIGN OF SMPS

Course Outcomes (YPE 103):		**Domain**	**Level**
CO1	Analyze and design Non-Isolated DC-DC converter	Cognitive	Understanding
CO2	Analyze and design Isolated DC-DC converter	Cognitive	Understanding
CO3	Derive transfer function of different converters	Cognitive	Understanding
CO4	Design controllers for DC-DC converters	Cognitive	Understanding
CO5	Design magnetics for SMPS application	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE 103	**MODELING AND DESIGN OF SMPS**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT -I ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS	**08**
Buck, Boost, Buck- Boost and Cuk converters: Principles of operation – Continuous conduction mode– Concepts of volt-sec balance and charge balance – Analysis and design based on steady- state relationships – Introduction to discontinuous conduction mode - SEPIC topology - design examples Applications to Battery operated vehicle, PV system.	
UNIT – II ANALYSIS OF ISOLATED DC-DC CONVERTERS	**08**
Introduction - classification- forward- flyback- pushpull – half bridge – full bridge topologies- design of SMPS - Applications to Battery operated vehicle	
UNIT – III CONVERTER DYNAMICS	**08**
AC equivalent circuit analysis – State space averaging – Circuit averaging – Averaged switch modeling – Transfer function model for buck, boost, buck-boost and cuk converters – Input filters.	
UNIT - IV CONTROLLER DESIGN	**08**
Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for buck, boost, buck-boost and cuk converters	
UNIT – V DESIGN OF MAGNETICS	**13**
Basic magnetic theory revision – Inductor design – Design of mutual inductance – Design of	
transformer for isolated topologies – Ferrite core table and selection of area product – wire table – selection of wire gauge	

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

REFERENCES

1. Robert W. Erickson & Dragon Maksimovic," Fundamentals of Power Electronics", Third Edition, 2020.
2. John G. Kassakian, Martin F. Schlecht, George C. Verghese, "Principles of Power Electronics", Pearson, India, New Delhi, 2010
3. Simon Ang and Alejandra Oliva, "Power-Switching Converters", CRC press, 3rd edition, 2011.
4. Philip T Krein, "Elements of Power Electronics", Oxford University Press, 2017.
5. Ned Mohan, "Power Electronics: A first course", Wiley, 2011, 1st edition.
6. IssaBatarseh, Ahmad Harb, "Power Electronics- Circuit Analysis and Design, Second edition, 2018.
7. V.Ramanarayanan, "Course material on Switched mode power conversion", 2007.
8. Alex Van den Bossche and Vencislav Cekov Valchev, "Inductors and Transformers for Power Electronics", CRC Press, 1st edition, 2005.
9. W. G. Hurley and W. H.Wolfle, "Transformers and Inductors for Power Electronics Theory, Design and Applications", 2013 Wiley, 1st Edition.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	3	3	2	2
CO2	1	-	2	2	3	2
CO3	2	-	2	3	2	1
CO4	3	-	2	1	1	2
CO5	3	-	1	2	1	2
Total	10	0	10	11	9	9
Scaled	2	0	2	3	2	2

1- Slightly 2 – Supportive 3 – Highly related

ELECTIVES - GROUP I
POWER SEMICONDUCTOR DEVICES

Course Outcomes (YPE E11):		**Domain**	**Level**
CO1	To identification of suitable device for the application.	Cognitive	Understanding
CO2	To know the advantages of Silicon Carbide devices and Galium Nitride devices.	Cognitive	Understanding
CO3	To understand the principles and characteristics of Silicon devices, Silicon Carbide devices and Gallium Nitride devices.	Cognitive	Understanding
CO4	To design proper driving circuits and protection circuits.	Cognitive	Understanding
CO5	To construct a proper thermal protective device for power semiconductor devices.	Cognitive	Understanding

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

YPE E11	POWER SEMICONDUCTOR DEVICES	3	0	0	3
C:P: A = 3:0:0		L	T	P	H
		3	0	0	3

UNIT -I INTRODUCTION **09**

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Power diodes - Types, forward and reverse characteristics, switching characteristics – rating. Features and Brief History of Silicon CarbidePromise and Demonstration of SiC Power Devices- Physical Properties of Silicon Carbide devicesUnipolar and Bipolar Diodes- GaN Technology Overview.

UNIT – II CURRENT CONTROLLED DEVICES **09**

BJT's – Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; - Thyristors – Construction, working, static and transient characteristics, types, series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT &Thyristor- Basics of GTO, SiC based Bipolar devices-
Applications- Building a GaN Transistor -GaN Transistor Electrical Characteristics

UNIT – III VOLTAGE CONTROLLED DEVICES **09**

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - and IGCT. New semiconductor materials for devices – Intelligent power modules- study of modules like APTGT100TL170G, MSCSM70TAM05TPAG. Integrated gate commutated thyristor (IGCT) – SiC based unipolar devices-applications

UNIT - IV DEVICE SELECTION, DRIVING and PROTECTING CIRCUITS **09**

Device selection strategy – On-state and switching losses – EMI due to switching. Necessity of isolation, pulse transformer, optocoupler – Gate drive integrated circuit: Study of Driver IC – IRS2110/2113. SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

UNIT - V THERMAL PROTECTION **09**

Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types- switching loss calculation for power device.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

REFERENCES

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Pearson,4th Edition, 10th Impression 2021.
2. Ned Mohan, T.M.Undeland and W.P.Robbins, "Power Electronics: converters, Application and design", 3rd Edition Wiley, 2007.
3. Tsunenobu Kimoto and James A. Cooper, Fundamentals of Silicon Carbide Technology: Growth, Characterization, Devices, and Applications, First Edition, 2014 John Wiley & Sons Singapore Pte Ltd.
4. Alex Lidow, Johan Strydom, Michael de Rooij, David Reusch, GaN TRANSISTORS FOR EFFICIENT POWER CONVERSION, Second Edition,Wiley, 2015.
5. Biswanath Paul, Power Electronics, Universities Press 2019.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6

CO1	2	1	3	2	2	2
CO2	1	0	2	1	3	3
CO3	1	0	2	1	3	3
CO4	2	1	3	2	2	1
CO5	2	2	3	2	2	1
Total	8	4	13	8	12	10
Scaled	2	1	3	2	3	2

1- Slightly 2 – Supportive 3 – Highly related

ELECTIVES - GROUP - II
POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

Course Outcomes (YPE E21):		**Domain**	**Level**
CO1	Ability to understand different renewable energy systems	Cognitive	Understanding
CO2	Ability to design and simulate power electronics converters used for interfacing Renewable energy systems	Cognitive	Understanding
CO3	Ability to design standalone renewable energy system employing embedded energy storage and MPPT strategy.	Cognitive	Understanding
CO4	Ability to design grid connected renewable energy system.	Cognitive	Understanding
CO5	Ability to extract maximum power using different MPPT algorithms	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE E21	**POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**	**3**	**0**	**0**	**3**
C:P:A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT -I INTRODUCTION	**09**
Introduction to renewable energy systems, environmental aspects of electric energy conversion, impacts of renewable energy generation on environment, GHG Effect, Qualitative study of different renewable energy resources Ocean, Biomass, Hydrogen energy systems and Fuel cell.	
UNIT– II POWER ELECTRONIC CONVERTERS FOR RENEWABLE ENERGY	**09**
Solar: Block diagram of solar photo voltaic system: line commutated converters (inversion mode) - Boost and buck-boost converters.Wind: three phase AC voltage controllers- AC-DCAC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.	
UNIT – III PHOTO VOLTAIC ENERGY CONVERSION SYSTEMS	**09**
Introduction, Photo Voltaic (PV) effect, Solar Cell, Types, Equivalent circuit of PV cell, PV cell characteristics (I/V and P/V) for variation of insolation, temperature and shading effect, Standalone PV system, Grid connected PV system, Design of PV system-load calculation, array sizing, selection of converter/inverter, battery sizing.	
UNIT - IV WIND ENERGYCONVERSION SYSTEMS	**09**

Introduction, Power contained in wind, Efficiency limit in wind, types of wind turbines, Wind control strategies, Power curve and Operating area, Types of wind generators system based on Electrical machines-Induction Generator and Permanent Magnet Synchronous Generator(PMSG), Grid Connected-Single and Double output system, Self-excited operation of Induction Generator and Variable Speed PMSG.
UNIT - V HYBRID RENEWABLE ENERGY SYSTEMS AND MPPT **09**
Energy Storage systems, Need for Hybrid Systems, Features of Hybrid Systems, Range and types of Hybrid systems (Wind-Diesel, PV-Diesel and Wind-PV), Case studies of PVMaximum Power Point Tracking (MPPT) and Wind Energy system.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

REFERENCES

1. S.N.Bhadra, D. Kastha and S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
2. Haitham Abu-Rub, Mariusz Malinowski and Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications", IEEE Press and John Wiley & Sons Ltd Press, 2014.
3. Rashid M. H. "power electronics Hand book", Academic Press, 2001.
4. Rai. G.D., "Non-conventional energy sources", Khanna Publishers, 1993.
5. Rai. G.D.," Solar energy utilization", Khanna Publishers, 1993.
6. Gray, L. Johnson, "Wind Energy System", Prentice Hall Inc, 1995.
7. Non-conventional Energy Sources B.H.Khan Tata McGraw-hill Publishing Company, New Delhi.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	3	2	3	2
CO2	2	1	3	2	2	2
CO3	2	1	3	2	2	2
CO4	1	1	3	2	2	2
CO5	1	1	3	2	2	2
Total	7	5	15	10	11	10
Scaled	2	1	3	2	3	2

1- Slightly2 – Supportive3 – Highly related **ENGLISH FOR RESEARCH PAPER WRITING**

Course Outcomes (YEGOE1):		**Domain**	**Level**
CO1	Understand that how to improve your writing skills and level of readability	Cognitive	Understanding
CO2	Learn about what to write in each section	Cognitive	Understanding
CO3	Understand the skills needed when writing a Title	Cognitive	Understanding
CO4	Understand the skills needed when writing the Conclusion	Cognitive	Understanding
CO5	Ensure the good quality of paper at very first-time submission	Cognitive	Understanding

COURSE CODE	COURSE NAME	L	T	P	C
YEGOE1	ENGLISH FOR RESEARCH PAPER WRITING	3	0	0	3
C:P: A = 3:0:0		L	T	P	H
		3	0	0	3

UNIT -I	**08**
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and vagueness	
UNIT – II	**08**
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	
UNIT – III	**08**
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	
UNIT – IV	**08**
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	
UNIT – V	**13**
Skills needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

REFERENCES

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	1	1	1	-	1
CO2	-	1	1	1	-	1
CO3	-	1	1	1	-	1
CO4	-	1	1	1	-	1
CO5	-	1	1	1	-	1
Total	0	5	5	5	0	5
Scaled	0	1	1	1	0	1

1- Slightly 2 – Supportive 3 – Highly related

RESEARCH METHODOLOGY AND IPR

Course Outcomes (YUM 107):		Domain	Level
CO1	Ability to formulate research problem	Cognitive	Understanding

CO2	Ability to carry out research analysis	Cognitive	Understanding
CO3	Ability to follow research ethics	Cognitive	Understanding
CO4	Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity	Cognitive	Understanding
CO5	Ability to understand about IPR and filing patents in R&D.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YUM 107	**RESEARCH METHODOLOGY AND IPR**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT -I	**08**
Meaning of research problem, Sources of research problem, Criteria-Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	
UNIT – II	**08**
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	
UNIT – III	**08**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	
UNIT – IV	**08**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	
UNIT – V	**13**
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	

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

REFERENCES

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 2nd Edition.
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3
Total	15	15	15	15	15	15
Scaled	3	3	3	3	3	3

1- Slightly 2 – Supportive 3 – Highly related

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE 108	**DESIGN AND SIMULATION OF POWER ELECTRONIC CIRCUITS LABORATORY**	**0**	**0**	**1**	**1**
C:P: A = 1:2:0		**L**	**T**	**P**	**CH**
		0	**0**	**2**	**2**

Course Outcomes:		**Domain**	**Level**
CO1	To Observe and analyse the operation and basic characteristics of various types of switching devices	Cognitive Psychomotor	Analyze Complex Overt Response
CO2	To apply knowledge about industrial applications of power electronics converter such as AC-AC and AC-DC converter	Cognitive Psychomotor	Apply Complex Overt Response
CO3	To analyse various firing circuits of thyristor	Cognitive Psychomotor	Analyze Complex Overt Response
CO4	To design and simulate AC/DC and DC/AC converters on MATLAB software	Cognitive Psychomotor	Create Complex Overt Response
CO5	To Simulate DC to DC and AC to AC converters on MATLAB	Cognitive Psychomotor	Apply Complex Overt Response

	LIST OF EXPERIMENTS	
1.	Simulation of Single-phase semi converter with R, RL and RLE loads.	CO1
2.	Simulation of Single-phase full-converter with R, RL and RLE loads.	CO1
3.	Simulation of three phase Semi and Full converter.	CO2

4.	Simulation of MOSFET, IGBT based CLASS A, B, C, D, E Choppers.	CO2
5.	Simulation of Single Phase dual converter fed R, RL and RLE loads.	CO2
6.	Simulation of Single phase IGBT based PWM inverter.	CO3
7.	Simulation of Single-phase semi converter fed DC drives.	CO4
8.	Simulation of Three-phase semi converter fed DC drives.	CO4
9.	Simulation of Single-phase full converter fed DC drives.	CO4
10.	Simulation of closed loop control of chopper fed DC motor.	CO5
11.	Simulation of Single-phase AC voltage controller fed AC drives.	CO5
Total		**30 Hours**

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3
Total	15	15	15	15	15	15
Scaled	3	3	3	3	3	3

1- Slightly 2 – Supportive 3 – Highly related

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE 109	**MODELING OF ELECTRICAL MACHINES LABORATORY**	**0**	**0**	**1**	**1**
C:P: A = 1:2:0		**L**	**T**	**P**	**CH**
		0	**0**	**2**	**2**

Course Outcomes:		**Domain**	**Level**
CO1	Analyse the performance of Permanent Magnet Synchronous Machine in motoring and generating mode.	Psychomotor	Complex Overt Response
CO2	Analyse the characteristics of Switched Reluctance Motor used in Electric Vehicles.	Psychomotor	Complex Overt Response
CO3	Analyse the performance of Brushless Direct Current Machine in Motoring and Generating mode.	Psychomotor	Complex Overt Response

CO4	Apply the stationary reference frame method for modelling of single phase and three phase Induction Machine.	Psychomotor	Complex Overt Response
CO5	Apply the rotor reference frame method for modelling of Three phase synchronous Machine	Psychomotor	Complex Overt Response

	LIST OF EXPERIMENTS	
1.	Design and analyze the performance of PMSM using Ansys Maxwell.	CO1
2.	Design and analyze the performance of SRM using Ansys Maxwell.	CO2
3.	Design and analyze the performance of BLDC motor using Ansys Maxwell.	CO3
4.	Design and analyze the performance of DC motor using Ansys Maxwell.	CO3
5.	Design and analyze the performance of three-phase squirrel cage induction motor using Ansys Maxwell.	CO3
6.	Modeling and Simulation of Single phase Induction in the stationary reference frame using MATLAB/SIMULINK.	CO4
7.	Modeling and Simulation of three phase induction machine in the stationary reference frame using MATLAB/SIMULINK.	CO4
8.	Modeling and Simulation of three phase synchronous machine in the rotor reference frame using MATLAB/SIMULINK.	CO4
9.	Current Regulated PWM inverter fed induction motor drive with indirect field oriented control using MATLAB/SIMULINK	CO5
10.	Modeling and Simulation of permanent magnet synchronous Generator using MATLAB/SIMULINK.	CO5
Total		**30 Hours**

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	3	3	3	3
CO2	3	-	3	3	3	3
CO3	3	-	3	3	3	3
CO4	3	-	3	3	3	3
CO5	3	-	3	3	3	3
Total	15	0	15	15	15	15
Scaled	3	0	3	3	3	3

1- Slightly 2 – Supportive 3 – Highly related

SEMESTER II

ANALYSIS OF ELECTRICAL DRIVES

Course Outcomes (YPE 201):		**Domain**	**Level**
CO1	Able to acquire and apply knowledge of mathematics and converter/machine dynamics in Electrical engineering.	Cognitive	Understanding
CO2	Able to formulate, design, simulate power supplies for generic load and for machine loads.	Cognitive	Understanding
CO3	Able to analyze, comprehend, design and simulate direct current motor based adjustable speed drives.	Cognitive	Understanding
CO4	Able to analyze, comprehend, design and simulate induction motor based adjustable speed drives.	Cognitive	Understanding
CO5	Able to design a closed loop motor drive system with controllers for the current and speed control operations.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE 201	**ANALYSIS OF ELECTRICAL DRIVES**	**3**	**1**	**0**	**4**
C:P:A = 3:0:0		**L**	**T**	**P**	**H**
		3	**1**	**0**	**4**

UNIT -I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS	**12**
DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation - Introduction to high-speed drives and modern drives. Characteristics of mechanical system – Dynamic equations, components of torque, types of load; Requirements of drives characteristics stability of drives–multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.	
UNIT – II CONVERTER AND CHOPPER CONTROL	**12**
Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters –performance parameters, performance characteristics. Introduction to time ratio control and frequency modulation; chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Related problems.	
UNIT – III CLOSED LOOP CONTROL	**12**
Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed DC drive.	
UNIT - IV VSI AND CSI FED STATOR CONTROLLED INDUCTION MOTOR CONTROL	**12**
AC voltage controller – six step inverter voltage control-closed loop variable frequency PWM inverter fed induction motor (IM) with braking-CSI fed IM variable frequency motor drives – pulse width modulation techniques – simulation of closed loop operation of stator controlled induction motor drives.	
UNIT – V ROTOR CONTROLLED INDUCTION MOTOR DRIVES	**12**

Static rotor resistance control - injection of voltage in the rotor circuit – static Scherbius drives – static and modified Kramer drives – sub-synchronous and super-synchronous speed operation of induction machines – simulation of closed loop operation of rotor controlled induction motor drives.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	0	60

REFERENCES

1. Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., New Jersey, 1989.
2. R. Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2010.
3. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia2002.
4. Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, Second Edition, 2009.
5. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw- Hill publishing company Ltd., New Delhi, 2002.
6. P.C Sen "Thyristor DC Drives", John Wiley and sons, New York, 1981.
7. W. Leonhard, "Control of Electrical Drives", Narosa Publishing House, 1992
8. Murphy J.M.D and Turnbull, "Thyristor Control of AC Motors", Pergamon Press, Oxford, 1988.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	3	1	1
CO2	2	0	2	3	1	1
CO3	2	1	2	3	1	2
CO4	1	1	2	3	1	2
CO5	1	1	2	3	1	2
Total	8	4	10	15	5	10
Scaled	2	1	2	3	1	2

1- Slightly 2 – Supportive 3 – Highly related

SPECIAL ELECTRICAL MACHINES

Course Outcomes (YPE 202):		**Domain**	**Level**
CO1	Ability to model and analyze power electronic systems and equipment using computational software.	Cognitive	Understanding
CO2	Ability to optimally design magnetics required in special machines based drive systems using FEM based software tools.	Cognitive	Understanding
CO3	Ability to analyze the dynamic performance of special electrical machines	Cognitive	Understanding
CO4	Ability to understand the operation and characteristics of other special electrical machines.	Cognitive	Understanding

CO5	Ability to design and conduct experiments towards research.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE 202	**SPECIAL ELECTRICAL MACHINES**	**3**	**0**	**0**	**3**
C:P:A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT -I PERMANENT MAGNET BRUSHLESS DC MOTORS	**09**
Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Characteristics and control.	
UNIT – II PERMANENT MAGNET SYNCHRONOUS MOTORS	**09**
Principle of operation – EMF and Torque equations - Phasor diagram - Power controllers – Torque speed characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor.	
UNIT – III SWITCHED RELUCTANCE MOTORS	**09**
Constructional features –Principle of operation- Torque prediction–Characteristics Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.	
UNIT – IV STEPPER MOTORS	**09**
Constructional features –Principle of operation –Types – Torque predictions – Linear and Non- linear analysis – Characteristics – Drive circuits – Closed loop control –Applications.	
UNIT – V OTHER SPECIAL MACHINES	**09**
Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor – Applications.	

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

REFERENCES

1.T.J.E. Miller, “Brushless magnet and Reluctance motor drives”, Claredon press, London, 1989.

2.R. Krishnan, ‘Switched Reluctance motor drives’, CRC press, 2001.

3.T. Kenjo, ‘Stepping motors and their microprocessor controls’, Oxford University press, New Delhi, 2000.

4.T. Kenjo and S. Nagamori, ‘Permanent magnet and Brushless DC motors’, Clarendon press, London, 1988.

5.R. Krishnan, “Electric motor drives”, Prentice Hall of India, 2002.

6.D.P. Kothari and I.J. Nagrath, “Electric machines”, Tata McGraw hill publishing company, New Delhi, Third Edition, 2004.

7.Irving L. Kosow, “Electric Machinery and Transformers” Pearson Education, Second Edition, 2007.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	3	2	2	2
CO2	3	1	3	2	2	2
CO3	3	1	3	2	2	2
CO4	3	1	3	2	2	2
CO5	3	1	3	2	2	2

Total	15	5	15	10	10	10
Scaled	3	1	3	2	2	2

1- Slightly 2 – Supportive 3 – Highly related

ELECTRIC VEHICLES AND POWER MANAGEMENT

Course Outcomes (YPE 203):		**Domain**	**Level**
CO1	Learned the electric vehicle architecture and power train components.	Cognitive	Understanding
CO2	Acquire the concepts of dynamics of electrical vehicles	Cognitive	Understanding
CO3	Able to understand the vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs).	Cognitive	Understanding
CO4	Able to design and select energy storage systems.	Cognitive	Understanding
CO5	Acquire the knowledge of different energy sources and energy management in HEVs.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE 203	**ELECTRIC VEHICLES AND POWER MANAGEMENT**	**3**	**0**	**0**	**3**
C:P:A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT -I HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS	**09**
History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes	
UNIT – II MECHANICS OF HYBRID ELECTRIC VEHICLES	**09**
Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity.	
UNIT – III CONTROL OF DC AND AC MOTOR DRIVES	**09**
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives	
UNIT - IV ENERGY STORAGE SYSTEMS	**09**
Battery: Principle of operation, types, models, estimation of parameters, battery modeling, SOC of battery, Traction Batteries and their capacity for standard drive cycles, Vehicle to Grid operation of EV's. Alternate sources: Fuel cells, Ultra capacitors, Flywheels.	
UNIT – V HYBRID VEHICLE CONTROL STRATEGY AND ENERGY MANAGEMENT	**09**
HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode - energy management of HEV's.	

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

REFERENCES
1.Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2011. 2. Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017. 3. James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, 2012.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	3	2
CO2	3	3	3	2	3	2
CO3	3	3	3	2	3	2
CO4	3	3	3	2	3	2
CO5	3	3	3	2	3	2
Total	15	15	15	10	15	10
Scaled	3	3	3	2	3	2

1- Slightly 2 – Supportive 3 – Highly related **ELECTIVES GROUP – III ENERGY STORAGE TECHNOLOGIES**

Course Outcomes (YPE E31):		**Domain**	**Level**
CO1	Gained knowledge of various storage technologies.	Cognitive	Understanding
CO2	Able to design a thermal storage system.	Cognitive	Understanding
CO3	Ability to model battery storage system.	Cognitive	Understanding
CO4	Learned to analyze the thermodynamics of fuel cell.	Cognitive	Understanding
CO5	Gained Knowledge of various applications of storage technologies and perform the selection based on technoeconomic view point	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE E31	**ENERGY STORAGE TECHNOLOGIES**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT -I INTRODUCTION	**09**
Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.	
UNIT – II THERMAL STORAGE SYSTEM	**09**
Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.	
UNIT – III ELECTRICAL ENERGY STORAGE	**09**

Fundamental concept of batteries – measuring of battery performance, charging and is charging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel-Cadmium, Zinc Manganese dioxide - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.
UNIT - IV FUEL CELL **09**
Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages –Fuel Cell Thermodynamics
UNIT - V ALTERNATE ENERGY STORAGE TECHNOLOGIES **09**
Flywheel , Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

REFERENCES

1. Ibrahim Dincer and Mark A. Rosen, 'Thermal Energy Storage Systems and Applications', JohnWiley & Sons 2002.
2. James Larminie and Andrew Dicks, 'Fuel cell systems Explained', Wiley publications, 2003.
3. Lunardini.V.J, 'Heat Transfer in Cold Climates', John Wiley and Sons1981.
4. Ru-shiliu, Leizhang and Xueliang sun, 'Electrochemical technologies for energy storage and conversion', Wiley publications, 2012.
5. Schmidt.F.W. and Willmott A. J., 'Thermal Storage and Regeneration', Hemisphere Publishing Corporation, 1981.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	0	1	0	0	2	-
CO2	2	1	2	0	3	-
CO3	2	2	2	0	3	-
CO4	3	2	3	0	3	3
CO5	2	2	2	2	2	3
Total	9	8	9	2	13	6
Scaled	2	2	2	1	3	1

1- Slightly 2 – Supportive 3 – Highly related

ELECTIVES GROUP - IV

OPTIMIZATION TECHNIQUES

Course Outcomes (YPE E41):		**Domain**	**Level**
CO1	To learn about different classifications of optimization problems and techniques.	Cognitive	Understanding
CO2	To attain knowledge on linear programming concepts	Cognitive	Understanding

CO3	To understand the application of non-linear programming in optimization techniques	Cognitive	Understanding
CO4	To understand the fundamental concepts of dynamic programming	Cognitive	Understanding
CO5	To gain knowledge about Genetic algorithm and its application to power system optimization.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE E41	**OPTIMIZATION TECHNIQUES**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT -I INTRODUCTION	**09**
Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints.	
UNIT – II LINEAR PROGRAMMING (LP)	**09**
Simplex method of solving LPP, revised simplex method, duality, Constrained optimization, Theorems and procedure, Linear programming, mathematical model, solution technique, duality.	
UNIT – III NON LINEAR PROGRAMMING	**09**
Steepest descent method, conjugates gradient method, Newton's Method, Sequential quadratic programming, Penalty function method, augmented Lagrange multiplier method.	
UNIT - IV DYNAMIC PROGRAMMING (DP)	**09**
Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm	
UNIT - V GENETIC ALGORITHM	**09**
Introduction to genetic Algorithm, working principle, coding of variables, fitness function, GA	
operators; Similarities and differences between Gas and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA, Applications to power system.	

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

REFERENCES

1. S.S. Rao, "Engineering Optimization – Theory and Practice", John Wiley & Sons, Inc., 2009.
2. Hamdy A. Taha, Operations Research: An Introduction, 10th Edition, Pearson, 2016.
3. David G. Luenberger, "Introduction to Linear and Nonlinear Programming", Addison- Wesley, 1973.
4. E. Polak, "Computational methods in Optimization", Academic Press, 1971.
5. Pierre D.A., "Optimization Theory with Applications", Wiley Publications, 1969.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	0	3	0	0	1
CO2	3	0	3	0	0	1
CO3	3	0	3	0	0	1
CO4	3	0	3	0	0	1
CO5	3	0	3	3	0	1

Total	15	0	15	3	0	5
Scaled	3	0	3	1	0	1

1- Slightly 2 – Supportive 3 – Highly related

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE 206	**POWER ELECTRONICS AND DRIVES LABORATORY**	**0**	**0**	**1**	**1**
C:P: A = 1:2:0		**L**	**T**	**P**	**CH**
		0	**0**	**2**	**2**

Course Outcomes:		**Domain**	**Level**
CO1	Ability to formulate, design the speed controller for DC motor-based drive system and conduct load tests in an electrical drive system.	Psychomotor	Complex Overt Response
CO2	Design and simulate various converters.	Psychomotor	Complex Overt Response
CO3	Design and simulate various control strategies used for converters. and various inverters.	Psychomotor	Complex Overt Response
CO4	Ability to formulate, design the speed controller for AC motor-based drive system.	Psychomotor	Complex Overt Response
CO5	Ability to design the control algorithm for the control of an electrical drive using Microcontrollerand Digital signal processor.	Psychomotor	Complex Overt Response

LIST OF EXPERIMENTS

1.	Single phase semi- converter fed DC drive.	
2.	Single phase full converter fed DC drive.	
3.	Three phase Half controlled rectifier fed DC drive	
4.	Three phase fully controlled rectifier fed DC drive.	
5.	Chopper fed DC drives.	
6.	Speed control of three-phase induction motor using PWM inverter.	
7.	DSP based closed loop drive for induction motor	
8.	DSP based Speed control of Brush Less DC motor.	
9.	DSP based Switched Reluctance Motor Drive.	
10.	Three phase AC voltage controller fed AC Drive	
11.	Mini Projects (Related to the above Experiments)	

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3
Total	15	15	15	15	15	15
Scaled	3	3	3	3	3	3

1- Slightly 2 – Supportive 3 – Highly related

CONSTITUTION OF INDIA

Course Outcomes (YPSOE1):		**Domain**	**Level**
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics	Cognitive	Understanding
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	Cognitive	Understanding
CO3	Discuss the various organs of Governance	Cognitive	Understanding
CO4	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.	Cognitive	Understanding
CO5	Discuss the passage of the Hindu Code Bill of 1956.	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPSOE1		**3**	**0**	**0**	**3**

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

UNIT -I HISTORY AND PHIOLOSOPHY	**09**
History of Making of the Indian Constitution: History-Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble-Salient Features	
UNIT – II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES	**09**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies-Directive Principles of State Policy- Fundamental Duties.	
UNIT – III ORGANS OF GOVERNANCE	**09**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, ExecutivePresident- Governor- Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications- Powers and Functions				
UNIT - IV LOCAL ADMINISTRATION				**09**
District's Administration head: Role and Importance, - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy				
UNIT – V ELECTION COMMISSION				**09**
Election Commission: Role and Functioning. - Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.				
	LECTURE	**TUTORIAL**	**PRACTICAL**	**TOTAL**
	45	**0**	**0**	**45**
REFERENCES				
1. The Constitution of India, 1950 (Bare Act), Government Publication. 2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015. 3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.				