PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

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

Criterion 1 – Curricular Aspects

Key Indicator	1.1	Curriculum Design and Development
Metric	1.1.3	Average percentage of courses having focus on employability/ entrepreneurship/ skill Development offered by the Department of Electrical and Electronics Engineering

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

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

1. List of courses for the programmes in order of

S. No.	Programme Name
1.	Bachelor of Technology (Electrical and Electronics Engineering) (Full Time)
2.	Bachelor of Technology (Electrical and Electronics Engineering) (Part Time)
3.	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

Name of the Course	Course Code	Year of Introduction	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
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 Labaratory	XBE107	2007-08	Entrepreneurship- Assignment, Seminar, Poster Presentation
Applied Chemistry for Engineers Labaratory	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 Labaratory	XCP 207	2007-08	Entrepreneurship- Test, Assignment, Problem Solving Exercises
Applied Physics for Engineers Labaratory	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
FUNDAMENTALS OF ELECTRIC VEHICLES	XEEEV1	2023-24	Employability- Assignment, Test, Seminar
FUNDAMENTALS OF ELECTRIC VEHICLES LABORATORY	XEEEV2	2023-24	Employability- Assignment, Test, Seminar
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
ELECTRIC VEHICLES ARCHITECTURE	XEEEV3	2023-24	Employability- Assignment, Test, Seminar
Transmission and Distribution	XEE501	2007-08	Employability- Assignment, Test, Seminar

Power System Analysis	XEE502	2007-08	Employability- Quiz, Test, Problem Solving Assignment
Digital Electronics	XEE503	2007-08	Employability- Quiz, Test, Problem Solving Assignment
Measurements and Instrumentation	XEE504	2007-08	Employability- Assignment, Test, Seminar
Professional Elective – 1	XEEE1*	2007-08	*****
Open Elective – 1	X**OE*	2007-08	*****
Digital Electronics Laboratory	XEE506	2007-08	Entrepreneurship- Test, Assignment, Problem Solving Exercises
Measurements and Instrumentation Laboratory	XEE507	2007-08	Entrepreneurship- Test, Assignment, Problem Solving Exercises
In-plant Training – II	XEE508	2015-16	Employability- Industrial visit, Viva Voce
Power Electronics	XEE601	2007-08	Employability- Assignment, Test, Seminar
Microprocessors and Microcontrollers	XEE602	2007-08	Employability- Assignment, Test, Seminar
Professional Elective – 2	XEEE2*	2013-14	*****
Open Elective – 2	X**OE*	2013-14	*****
Professional Skills	XGS605	2007-08	Employability- Assignment, Test, Seminar
Cyber Security	XUM606	2015-16	Employability- Assignment, Test, Seminar
Power Electronics Laboratory	XEE607	2007-08	Entrepreneurship- Test, Assignment, Problem Solving Exercises
Microprocessors and Microcontrollers Laboratory	XEE608	2007-08	Entrepreneurship- Test, Assignment, Problem Solving Exercises
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
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
Elective - V	YPE E5*	2022-23	*****
Open Elective	Y** OE*	2022-23	*****
Project Work - I	YPE 303	2022-23	Employability- Case Study,Viva Voce
Project Work - II	YPE 401	2022-23	Employability- Case Study,Viva Voce

2.SYLLABUS

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 implicitfunctions. 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 ofCurvature and to improper integrals.	Cognitive	Applying

UNIT - I: MATRICES	**9 + 3**
Linear Transformation - Eigen values and Eigen vectors -Properties of Eigen values and Eigen vectors - Cayley-Hamilton Theorem – Diagonalisation of Matrices – Real Matrices: Symmetric - Skew-Symmetric and Orthogonal Quadratic form – canonical form - Nature of Quadratic form and Transformation of Quadratic form to Canonical form (Orthogonal only).	
UNIT - II: SEQUENCES AND SERIES	**9 + 3**
Sequences: Definition and examples-Series: Types and convergence- Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test-. Fourier series: Half range sine and cosine series- Parseval's Theorem.	
UNIT - III: MULTIVARIABLE CALCULUS: PARTIAL DIFFERENTIATION	**9 + 3**
Limit and continuity –Partial differentiation – Total Derivative – Partial differentiation of Composite Functions: Change of Variables – Differentiation of an Implicit Function - Euler's Theorem- Jacobian.	
UNIT - IV: MULTIVARIABLE CALCULUS: MAXIMA AND MINIMA 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

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. **Construc**t the different digital circuit.	Cognitive	Understand
CO5	**Label and Outline the** different types of microprocessors and their applications.	Cognitive	Understand

UNIT - I: FUNDAMENTALS OF DC AND AC CIRCUITS, MEASUREMENTS	9 + 3

Fundamentals of DC– Ohm's Law – Kirchhoff's Laws - Sources - Voltage and Current Relations – Star/Delta Transformation - Fundamentals of AC – Average Value, RMS Value, Form Factor - AC power and Power Factor, Phasor Representation of sinusoidal quantities, Simple Series, Parallel, Series Parallel Circuit - Operating Principles of Moving coil and Moving Iron Instruments (Ammeter, Voltmeter) and Dynamometer type meters (Watt meter and Energy meter).

UNIT - II: ELECTRICAL MACHINES	9 + 3
Construction, Principle of Operation, Basic Equations, Types and Application of DC Generators, DC motors - Basics of Single-Phase Induction Motor and Three Phase Induction Motor- Construction, Principle of Operation of Single-Phase Transformer, Three phase transformers, Auto transformer.	
UNIT - III: SEMICONDUCTOR DEVICES	**9 + 3**
Classification of Semiconductors, Construction, Operation and Characteristics: PN Junction Diode – Zener Diode, PNP, NPN Transistors, Field Effect Transistors and Silicon Controlled Rectifier – Applications	
UNIT - IV: DIGITAL ELECTRONICS	**9 + 3**
Basic of Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, Subtractors, multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.	
UNIT - V: MICROPROCESSORS	**9 + 3**
Architecture, 8085, pin diagram of 8085, ALU timing and control unit, registers, data and address bus, timing and control signals, Instruction types, classification of instructions, addressing modes, Interfacing Basics: Data transfer concepts – Simple Programming concepts.	

	LECTURE	TUTORIAL	TOTAL
	45	15	60

TEXT BOOKS:

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

REFERENCE BOOKS:

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

E-REFERENCES:

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

Mapping of COs with GAs

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

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3
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 parameters-Definition 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

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**
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, 2k6
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.,
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	PO11	PO12	PSO1	PSO2
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	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	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

Mapping of COs with POs

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

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

COURSE CODE	COURSE NAME	L	T	P	C
XMA 201	**CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE**	**3**	**1**	**0**	**4**
Prerequisites	**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: equationssolvable 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 kindand 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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems",9thEdn. Wiley India, 2009.
4. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
6. E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.

7. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., McGraw Hill, 2004.
8. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2008.

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 non-uniform bending.	
UNIT – II: ELECTROMAGNETIC THEORY	**9 + 3**
Laws of electrostatics - Electrostatic field and potential of a dipole; Dielectric Polarization, Dielectric constant, internal field - Clausius Mossotti Equation - Laws of magnetism - Ampere's Faraday's law; Lenz's law - Maxwell's equation - Plane electromagnetic waves; their transverse nature - expression for plane, circularly and elliptically polarized light - quarter and half wave plates - production and detection of plane, circularly and elliptically polarized light.	
UNIT – III: OPTICS, LASERS AND FIBRE OPTICS	**9 + 3**
Optics: Dispersion- Optical instrument: Spectrometer - Determination of refractive index and 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.	
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

	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	**2**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**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**
XWP205	**Workshop Practices**	**2**	**0**	**0**	
		L	**T**	**P**	**H**
C : P : A		**1**	**0**	**4**	**5**
1 : 3 : 0					

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

EX.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	PSO1	PSO2
CO1	2	1	2	2	1			1	1		1	2	2	1
CO2	2	1	2	2	1			1	1		1	2	2	1
CO3	2	1	2	2	1			1	1		1	2	2	1
CO4	2	1	2	2	1			1	1		1	2	2	1

CO5	2	1	2	2	1			1	1		1	2	2	1
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
0 – 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.		

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	30	**0**	**0**	**30**

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/

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 technologicaladvances.	Psychomotor	Mechanism
CO2	**Use** and **locate** basic applications of electromagneticinduction 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**	**H**
C:P:A	**2.5 : 0: 0.5**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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 $(0,2\pi)$ $(-\pi, \pi)$, $(0, 2\ell)$, $(-\ell,\ell)$, $(0, \pi)$ and $(0,\ell)$. 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
	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

REFERENCE BOOKS

1.	Churchill, R.V. and Brown, J.W., "Fourier Series and Boundary Value Problems", Fourth Edition, McGraw Hill Book Co., Singapore (1987).
2.	Churchill, R.V. and Brown, J.W., "Fourier Series and Boundary Value Problems", Fourth Edition, McGraw Hill Book Co., Singapore (1987).
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

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

Table 1: 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					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
Total	**15**	**8**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**5**	**0**	**7**
Scaled	**3**	**2**			**1**					**1**		

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

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

COURSECODE	COURSE NAME	L	T	P	C
XEE302	ELECTRO MAGNETIC 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	
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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	1	-	-	-	-	-	1	-	1	1	1
CO2	1	2	-	1	-	-	-	-	-	-	1	-	2	1
CO3	1	2	-	-	-	-	-	-	-	-	-	1	1	2
CO4	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	2	1	-	-	-	-		-	-	-	1	1	1
Total	**6**	**11**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**7**	**7**
Scaled	**2**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**2**

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	Understanding
CO3	Ability to design various synchronous and asynchronouscircuits.	Cognitive	Understanding
CO4	Ability to introduce asynchronous sequential circuits and PLDs.	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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	1	-	-	-	-	-	1	-	1	1	1
CO2	1	2	-	1	-	-	-	-	-	-	1	-	2	1
CO3	1	2	-	-	-	-	-	-	-	-	-	1	1	2
CO4	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	2	1	-	-	-	-		-	-	-	1	1	1
Total	**6**	**11**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**7**	**7**
Scaled	**2**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**2**

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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**
Scaled	3	2	2	2	1	0	0	0	1	0	0	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
XUM306	ENTREPRENEURSHIP DEVELOPMENT	2	0	0	2
PREREQUISITES	NIL	L	T	S	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-a0cb-7af7b02e3191/1/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.

Table 1: 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	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

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

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 Models-Typical 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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
Scaled	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 ANALYSIS 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 forthe 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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 self-excited generator.	CO2
3.	Load characteristics of D.C shunt generator.	CO2
4.	Load characteristics of D.C. shunt motor.	CO2
5.	Load characteristics of D.C series motor.	CO3
6.	Speed control of D.C shunt motor.	CO4
7.	Load test on single-phase transformer.	CO5
8.	Open circuit and short circuit tests on single phase transformer.	CO5
	PRACTICAL	TOTAL
	30	30

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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
Scaled	3	2	2	2	1	0	0	0	1	0	0	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
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 - Chi-square 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).

Table 1: 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

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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 McGrow-Hill, Inc., 2013.

E-RESOURCES:

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

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	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 phasordiagram.	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 –Self-excitation– 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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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**
Scaled	3	2	2	2	1	0	0	0	0	0	0	2	2	1

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			

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	0	1	0	0	1	1	1	2	2	3	1	2
CO2	2	2	1	2	0	0	2	1	1	2	3	3	2	2
CO3	2	2	1	3	0	0	2	2	1	2	2	3	2	2
CO4	1	2	1	2	0	0	0	1	1	1	2	3	1	2
CO5	1	2	0	1	0	0	1	1	0	1	2	3	1	2
Total	**7**	**10**	**3**	**9**	**0**	**0**	**6**	**6**	**4**	**6**	**11**	**15**	**7**	**10**
Scaled	**1**	**2**	**1**	**2**	**0**	**0**	**1**	**1**	**1**	**2**	**2**	**3**	**1**	**2**

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
CO1		1	1					1			1	1	2	2
CO2			2		3						2	2	2	2
CO3						2	2				1	1		1
CO4		2	2		1	1	1	2	1	1	3	1	1	
CO5						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 kit	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 andwithout 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

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

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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
XEE 501	TRANSMISSION AND DISTRIBUTION	3	0	0	3
C : P : A		L	T	P	H
3 : 0 : 0		3	0	0	3

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	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**
Structure of electric power system: Various levels such as generation, transmission and distribution; – Resistance, Inductance and Capacitance calculations – Single-phase and three-phase lines – double circuit lines – effect of earth on transmission line capacitance.	
UNIT - II: PERFORMANCE OF TRANSMISSION LINES	**9**
Regulation and efficiency – Tuned power lines, Power flow through a transmission line – Power circle diagrams, Introduction to Transmission loss and Formation of corona – critical voltages – effect on line performance – travelling waveform phenomena.	
UNIT - III: MECHANICAL DESIGN OF OVERHEAD LINES	**9**
Line supports – Insulators, Voltage distribution in suspension insulators – Testing of insulators – string efficiency – Stress and sag calculation – effects of wind and ice loading.	
UNIT - IV: UNDERGROUND CABLES	**9**
Comparison with overhead line – Types of cables – insulation resistance – potential gradient – capacitance of single-core and three-core cables.	
UNIT - V: DISTRIBUTION SYSTEM	**9**
General aspects – Kelvin's Law – A.C. distribution – Single-phase and three phase – Techniques of voltage control and power factor improvement – Introduction to Distribution loss – Recent trends in transmission and distribution systems.	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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
XEE 502	**POWER SYSTEM ANALYSIS**	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**1**	**0**	**4**

Course Outcomes:		**Domain**	**Level**
CO1	**Demonstrate** the per phase analysis of power system.	Cognitive	Understanding
CO2	**Develop** the model of various components of the power system and **Construct** the Y Bus and Z Bus for a power system.	Cognitive	Applying
CO3	**Analyze** the power system network with symmetrical and unsymmetrical faults. **Calibrate** the fault current in a power	Cognitive	Analyzing
	system.		
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	Evaluating

CO5	**Classify** and **determine** the stability of power system. **Detect** the transient behavior of power system when it is subjected to a fault.	Cognitive	Evaluating

UNIT – I: INTRODUCTION	**10 + 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	**8 + 3**
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 + 3**
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 + 3**
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 + 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.	

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

TEXT BOOKS:

1. Hadi Sadaat, "Power System Analysis", Tata McGraw Hill Publishing Company, 2002.
2. John J. Grainger and Stevenson Jr. W.D., "Power System Analysis", McGraw Hill International Edition, 1994.
3. Nagarat .I.J, Kothari .D.P, "Power system Engineering", Tata McGraw Hill Publishing Company, 1994.
4. Pai. M.A "Computer techniques in Power System Analysis" Tata McGraw Hill Publishing Company, 2007.

REFERENCE BOOKS:

1. Stagg, G.W. and El-Abaid, A. H. "Computer Methods in Power System Analysis", McGraw-Hill International Book Company, 1968.
2. Nagarath, I.J., and Kothari, D.P., 'Modern Power System Analysis', Tata McGraw Hill Publishing Company, 1990.
3. Wadhwa C.L. "Electric Power Systems" Willey Eastern, 2007.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3									1		1	3	2
CO2	3									1		1	3	2
CO3	3	2								1	1	2	3	2
CO4	3	2			1					1	1	1	3	2
CO5	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

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 503	**DIGITAL 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 numerical values in various number systemsand 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	Analyzing
CO3	To Apply Logic gates and their applications and construct the simple adders and sub tractors using logic gates.	Cognitive	Applying
CO4	To Understand the process of Analog to Digital conversionand its applications.	Cognitive	Understanding
CO5	To Understand the process of Digital to Analog conversion and its applications.	Cognitive	Understanding

UNIT - I: FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES	**9**
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families.	
UNIT – II: COMBINATIONAL DIGITAL CIRCUITS	**9**
Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, ALU, elementary ALU design, popular MSI chips, digital	

comparator, parity checker/generator, code converters, priority encoders, decoders Q-M method of function realization.	
UNIT – III: SEQUENTIAL CIRCUITS AND SYSTEMS	**9**
A 1-bit memory, the circuit properties of Bistable latch, JK, SR, D and T types flip-flops, applications of flip-flops, shift registers, applications of shift registers, Asynchronous counters, synchronous counters design using flip flops, special counter IC's, applications of counters.	
UNIT – IV: A/D AND D/A CONVERTERS	**9**
Digital to analog converters: weighted resistor/converter, R-2R Ladder DAC, specifications for D/A converters, examples of DAC lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator ADC, successive approximation ADC, specifications of ADC, example of ADC ICs.	
UNIT – V: SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES	**9**
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, ROM, RAM, content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, PLA, PAL, CPLDS, and FPGA.	

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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
XEE 504	MEASUREMENTS AND 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 different errors in measurements and **Describe** the working principle of different measuring instruments.	Cognitive	Remembering
CO2	**Understanding** about the instruments used for different types of AC measurements. **Carryout** calibration test for measuring electrical instruments.	Cognitive	Understanding
CO3	**Use** different types bridge circuits for the measurements of unknown passive elements. **Relate** the different types of the transducers. **Demonstrate** the use of different bridges and transducers.	Cognitive	Applying
CO4	**Explain** the construction and operation of recording and display instruments. **Establish** Relations between analog and digital signal conversions. Recording and display instruments. **Establish** Relations between analog and digital signal conversions.	Cognitive	Understanding
CO5	**Explain** the construction and working of different types signal conditioners. **Demonstrate** the recent trends in measurement of AC quantities.	Cognitive	Remembering

UNIT - I: INTRODUCTION	**9**
Measurements – Errors & classification, Measurement of voltage & current - permanent magnet moving coil and moving iron meters, Measurement of power and energy - dynamometer and induction instruments, Instrument transformers – Current and Potential transformers.	
UNIT - II: DC AND AC BRIDGES	**9**
Measurement of resistance, inductance and capacitance using dc and ac bridges, Wheatstone bridge, Maxwell bridge, Kelvin's Bridge, Schering Bridge.	
UNIT - III: TRANSDUCERS	**9**
Active and Passive transducers, Piezoelectric transducer, Photoelectric transducers, Thermocouples, Strain gauge transducers, LVDT, differential capacitive transducers, Fiber optic transducers, Resistive, Inductive and capacitive transducers.	
UNIT - IV: SIGNAL CONDITIONING UNITS	**9**
Signal conditioners – Instrumentation amplifiers, voltage–current converters, A/D and D/A converters, voltage-frequency converters, analog multiplexers and de-multiplexers. Microprocessor Based Measurements, Case Studies in Instrumentation.	
UNIT - V: RECORDERS AND DISPLAY	**9**
Signal sources – Oscillators, Function generator and pulse generators. Oscilloscopes - CRO, Digital	

storage and Analog storage Oscilloscope, Digital Phosphor Oscilloscopes. Analog and Digital Recorders and printers. Spectrum Analyzers, Data and Logic Analyzers.

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT BOOKS:

1. K. Sawhney, 'A Course in Electrical and Electronic Measurements and Instrumentation', DhanpatRai & Co., 9th Edition, 2018.
2. Bouwens A. J., 'Digital Instrumentation', Tata McGraw Hill Publications, 16th Reprint (2008).
3. Kalsi H.S, 'Electronic Instrumentation', Tata McGraw-Hill Education, 3rd Edition, 2010.
4. Deobelin, 'Measurements Systems', Tata McGraw Hill Publications, 2nd Edition, 2010.

REFERENCE BOOKS:

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

E-RESOURCES:

1. NTPEL, Electrical Instrumentations (Web Course), Prof. N.K. De, Prof. T.K. Bhattacharyaand Prof. G. D. Roy, IIT Kharagpur.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	1	0	1	1	0	0	3	0	0	2	3
CO2	1	1	0	0	0	0	0	0	0	0	0	1	2	3
CO3	1	0	1	0	1	0	0	2	0	1	0	0	2	2
CO4	1	2	0	0	0	0	0	0	0	0	0	1	2	2
CO5	0	0	0	0	0	0	0	0	1	0	1	1	2	3
Total	**4**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**4**	**1**	**3**	**10**	**13**
Scaled	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**

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
XEE506	**DIGITAL ELECTRONICS LABORATORY**	**0**	**0**	**1**	**1**
C : P : A		**L**	**T**	**P**	**H**
0 : 1 : 0		**0**	**0**	**2**	**2**

COURSE OBJECTIVES:

- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
- To prepare students to perform the analysis and design of various digital electronic circuits.

Course Outcomes:		Domain	Level
CO1	**Assemble code converter and conform the output**	Psychomotor	Mechanism
CO2	**Assemble** Combinational logic circuits and **conform the output**	Psychomotor	Mechanism
CO3	**Assemble** Sequential logic circuits and **conform the output**	Psychomotor	Mechanism
CO4	**Simulate** Counters and Shift register **conform the output** using PSpice.	Psychomotor	Mechanism
CO5	**Develop** VHDL programs for Digital Logic Circuits	Psychomotor	Mechanism

Sl.No	List of Experiments	COs
1.	Study of logic gates.	**CO1**
2.	Design and implementation of code converters using logic gates.	**CO1**
3.	Design and implementation of Adders using logic gates.	**CO1**
4.	Design and implementation Subtractor using logic gates.	**CO1**
5.	Design and implementation of Magnitude Comparators.	**CO2**
6.	Design and implementation of encoder and decoder.	**CO2**
7.	Design and implementation of Multiplexer and De-multiplexer.	**CO2**
8.	Implementation of Flip- flops.	**CO3**
9.	Construction and verification of counter. (Simulation using PSpice).	**CO4**
10.	Construction and verification of shift register. (Simulation using PSpice).	**CO4**
11.	Logic gates using VHDL.	**CO5**
12.	Adder and subtractor using VHDL.	**CO5**

PRACTICAL	TOTAL
30	**30**

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	2	-	2	-	-	-	1	-	3	2	2
CO2	3	2	1	2	-	2	-	-	1	-	-	3	2	2
CO3	2	2	1	2	-	2	-	-	1	1	-	3	2	2
CO4	2	2	3	2	-	2	-	1	-	-	1	3	2	2
CO5	3	2	2	2	-	2	-	1	1	1	1	3	2	2
Total	12	9	10	10	0	10	0	2	3	3	2	15	10	10
Scaled	3	2	2	2	0	2	0	1	1	1	1	3	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 507	MEASUREMENTS AND INSTRUMENTATION LABORATORY	0	0	1	1
C : P : A		L	T	P	H
0 : 1 : 0		0	0	2	2

COURSE OBJECTIVES:

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

Course Outcomes:		Domain	Level
CO1	**Describe** the different errors in measurements and **Describe** the working principle of different measuring instruments.	Psychomotor	Perception
CO2	**Understanding** about the instruments used for different types of AC measurements. **Carryout** calibration test for measuring electrical instruments	Psychomotor	Set
CO3	**Use** different types bridge circuits for the measurements of unknown passive elements. **Relate** the different types of the transducers. **Demonstrate** the use of different bridges and transducers.	Psychomotor	Mechanism
CO4	**Explain** the construction and operation of recording and display instruments. **Establish** Relations between analog and digital signal conversions.	Psychomotor	Set
CO5	**Explain** the construction and working of different types signal conditioners. **Demonstrate** the recent trends in measurement of AC quantities.	Psychomotor	Mechanism

Sl. No.	List of Experiments	COs
1.	Calibration of Current Transformer and Potential transformer.	CO1
2.	Measurement of three phase active, Reactive Power and Power factor	CO1
3.	Calibration of Single phase / Three Phase Energy meter	CO1
4.	Resistance measurement using Wheat stone bridge	CO2
5.	Inductance measurement using Maxwell Bridge	CO2
6.	Capacitance measurement using Schering Bridge	CO2
7.	Study of Transducers	CO3
8.	A/D converter	CO4
9.	D/A converters	CO4
10.	Measurement of Current / Voltage / power / Energy using Arduino board.	CO5

PRACTICAL	TOTAL
30	30

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	1	0	1	1	0	0	3	0	0	2	3
CO2	1	1	0	0	0	0	0	0	0	0	0	1	2	3
CO3	1	0	1	0	1	0	0	2	0	1	0	0	2	2
CO4	1	2	0	0	0	0	0	0	0	0	0	1	2	2
CO5	0	0	0	0	0	0	0	0	1	0	1	1	2	3
Total	**4**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**4**	**1**	**3**	**10**	**13**
Scaled	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**

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

UNIT – I: POWER SWITCHING DEVICES	**9 + 3**
Review on Semiconductor devices – I-V characteristics and Switching Characteristics of power Diodes, SCR, TRIAC, power BJT, power MOSFET and IGBT. Triggering and Commutation Circuits.	
UNIT – II: THYRISTOR RECTIFIERS	**9 + 3**
Single phase half-wave and full-wave thyristor rectifiers – Single phase full-bridge thyristor rectifier with R-load and highly inductive load – Three phase full-bridge thyristor rectifier with R-load and highly inductive load.	
UNIT – III: DC TO DC CHOPPERS	**9 + 3**

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

UNIT – IV: INVERTERS	**9 + 3**

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

UNIT – V: AC VOLTAGE CONTROLLERS	**9 + 3**

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

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

TEXT BOOKS:

1. Rashid, M.H., 'Power Electronics: Circuits, Devices and Applications', Pearson Education India, 2009.
2. Singh, M.D and Kanchandani, 'Power Electronics', Tata McGraw Hill & Hill publication Company Ltd New Delhi, 2009.
3. Bimbhra, P.S, 'Power Electronics', Khanna Publishers, 2007.

REFERENCE BOOKS:

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

E-RESOURCES:

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

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	0	0	1	3	0	0	0	0	1	3	1
CO2	2	1	2	1	0	0	1	0	0	0	0	0	2	2
CO3	3	1	1	0	0	0	0	0	0	0	0	0	1	2
CO4	1	3	2	0	0	1	0	0	0	0	0	0	2	1
CO5	1	2	3	1	3	0	1	1	0	0	0	0	3	2
Total	**10**	**9**	**9**	**2**	**3**	**2**	**5**	**1**	**0**	**0**	**0**	**1**	**11**	**8**
Scaled	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**3**	**2**

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 602	**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 microprocessors, 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 and 32-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%20and%20Microcontrollers-/Learning%20Material%20-%20Microprocessors%20and%20microcontrollers.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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**
	PROFESSIONAL SKILLS	**1**	**0**	**2**	**3**
C : P : A		**L**	**T**	**P**	**H**
2.6 : 0.4 : 0		**1**	**0**	**4**	**5**

Course Outcomes:		**Domain**	**Level**
CO1	**Ability** to understand communications	Cognitive	Remember
CO2	**Apply** the known skills for career	Cognitive	Apply
CO3	**Identify** inner strength	Cognitive	Remember
CO4	**Construct** the attitude as a professional	Cognitive	Create
CO5	**Practicing** Etiquettes	Psychomotor	Guided Response

UNIT – I: Communication	**9**
1.1 – Brainstorming 1.2 – LSRW	
UNIT – II: Career Skills	**9**
2.1 – Resume & CV Preparing Skills 2.2 – Interview Skills 2.3 – Exploring Career Opportunities	
UNIT – III: Team Skills	**9**
3.1 – Listening as a Team Skill 3.2 – Team Building at Work Place	
UNIT – IV: Professional Skills	**9**
4.1 – Attitude and Goal Setting 4.2 – Verbal and Non-Verbal Communications	
UNIT – V: Professional Etiquettes	**9**
5.1 – Social Etiquettes 5.2 – Cultural Ethics at work place	

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

REFERENCE BOOKS:

1. Er. A. K. Jain, Dr. Pravin S. R. Bhatia, Dr. A. M. Sheikh Professional Communication Skills S. Chand Publications, 2015.
2. Alan Pannett. Key Skills for Professionals: How to Succeed in Professional Services, Kogan Page; 1st edition, 2013.

COURSE CODE	COURSE NAME	L	T	P	C
XEE 606	CYBER SECURITY	0	0	0	0
C : P : A		L	T	P	H
3 : 0 : 0		3	0	0	3

Course Outcomes:		Domain	Level
CO1	Understand the fundamentals of Cyber Security and the technologies.	Cognitive	Understanding
CO2	Understand the organizational structure of Cyber security.	Cognitive	Understanding
CO3	Understand the Cyber Security policy development.	Cognitive	Understanding
CO4	Understand the Indian IT act and the initiatives.	Cognitive	Understanding
CO5	Understand and Apply the Cyber security practices.	Cognitive	Applying

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 Frame works – 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- Computer Forensics – Steganography	
UNIT – IV: CYBER SECURITY INITIATIVES AND IT ACT	**9**
Counter Cyber Security Initiatives in India, Cyber Security Exercise, Cyber Security Incident Handling, Cyber Security Assurance, IT Act, Hackers-Attacker-Counter measures, Web Application Security, Digital Infrastructure Security and Defensive Programming. Traditional Problems Associated with Computer Crime, Introduction to Incident Response.	

UNIT – V: SECURITY PRACTICES	9
Guidelines to choose web browsers, Securing web browser, Antivirus, Email security, Guidelines for setting up a Secure password, Two-steps authentication, Password Manager, Wi-Fi Security, Guidelines for social media security, Tips and best practices for safer Social Networking. Basic Security for Windows, User Account Password. Introduction to mobile Smartphone Security, Android Security, IOS Security Online Banking Security, Mobile Banking Security, Security of Debit and Credit Card, UPI Security Security of Micro ATMs e-wallet Security Guidelines Security Guidelines for Point of Sales (POS).	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

REFERENCE BOOKS:

1. Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs , Jeffrey Schmidt, Joseph Weiss "Cyber Security Policy Guidebook" John Wiley & Sons 2012.
2. Rick Howard "Cyber Security Essentials" Auerbach Publications 2011.
3. Cyber Laws & Information Technology, Jothi Rathan,Vijay Rathan,Bhrath Pubishers,7th Edition January 2019.
4. Modern Cyber security Practices by Pascal Ackerman, BPB Publications,2020
5. Dan Shoemaker Cyber security The Essential Body Of Knowledge, 1st ed. Cengage Learning 2011.
6. Rhodes-Ousley, Mark, "Information Security: The Complete Reference", Second Edition, McGraw-Hill, 2013.

E-RESOURCES:

1. https://www.coursera.org/specializations/cyber-security
2. www. nptel.ac.in
3. http://professional.mit.edu/programs/short-programs/applied-cybersecurity
4. https://us.norton.com/internetsecurity-how-to-cyber-security-best-practices-for-employees.html
5. https://www.meity.gov.in/content/cyber-laws

Table 1: 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	0	0	0	0	0	2	0	3	0	0	0	0
CO 2	0	0	0	0	0	0	2	0	1	0	0	0
CO 3	3	0	0	0	0	2	3	0	1	0	0	0
CO 4	0	0	0	0	0	0	0	0	0	2	0	0
CO 5	3	0	0	0	0	0	0	0	0	0	0	0
Total	**6**	**0**	**0**	**0**	**0**	**4**	**5**	**3**	**2**	**2**	**0**	**0**
Scaled	**2**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**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	XEE 607	L	T	P	C
COURSE NAME	Power Electronics Laboratory	0	0	1	1
PREREQUISITES	Electronic Devices and Circuits Analog Electronics	L	T	P	H
C:P:A	0:1:0	0	0	2	2

LEARNING OBJECTIVES

- To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics.
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
- To provide strong foundation for further study of power electronic circuits and systems

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Distinguish the types of power semiconductor devices, and analyze their switching characteristics	Psychomotor	Mechanism
CO2	***Construct*** and ***demonstrate*** the operation of controlled rectifiers, and ***analyze*** its characteristics and performance parameters of controlled rectifiers	Psychomotor	Mechanism
CO3	***Construct*** and ***demonstrate*** the operation of DC-DC switching regulators, and differentiate the switching techniques and basics topologies of DC-DC switching Regulators	Psychomotor	Mechanism
CO4	***Apply*** the different modulation techniques to pulse width modulated inverters and identify the harmonic reduction methods.	Psychomotor	Mechanism
CO5	***Construct*** and ***demonstrate*** the operation of AC voltage controller and ***differentiate*** its various configurations. Associate cyclo-converter and matrix converter in AC-AC applications.	Psychomotor	Mechanism

S.No	List of Experiments	COs
1	Characteristics of SCR	CO1
2	Characteristics of MOSFET	CO1
3	Characteristics of IGBT	CO1
4	Single phase fully controlled rectifier with R, RL load	CO2
5	BUCK- BOOST converter using MOSFET.	CO3
6	IGBT based choppers.	CO3
7	Four quadrant chopper	CO3
8	Single phase IGBT PWM Inverter.	CO4
9	Series Inverter/ Parallel Inverter	CO4

10	Single phase AC voltage controller using SCR / TRIAC.	CO5
11	Single phase cycloconverter.	CO5

	TUTORIAL	PRACTICAL	TOTAL
HOURS	**0**	**30**	**30**

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	0	0	1	3	0	0	0	0	1	3	1
CO2	2	1	2	1	0	0	1	0	0	0	0	0	2	2
CO3	3	1	1	0	0	0	0	0	0	0	0	0	1	2
CO4	1	3	2	0	0	1	0	0	0	0	0	0	2	1
CO5	1	2	3	1	3	0	1	1	0	0	0	0	3	2
Total	**10**	**9**	**9**	**2**	**3**	**2**	**5**	**1**	**0**	**0**	**0**	**1**	**11**	**8**
Scaled	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**3**	**2**

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 608	**MICROPROCESSORS AND MICROCONTROLLERS LABORATORY**	**0**	**0**	**1**	**1**
Prerequisite	**Digital Electronics**	**L**	**T**	**P**	**H**
C : P : A		**0**	**1**	**2**	**2**
0 : 1 : 0					

Course Outcomes:		**Domain**	**Level**
CO1	**Write** Assembly Language Programs for Arithmetic operations and Data Transfer.	Psychomotor	Guided Response
CO2	**Write** Assembly Language Programs using conditional jump group of instructions and Subroutines.	Psychomotor	Guided Response
CO3	**Write** Assembly Language Programs for Interfacing Converters of 8-bit D/A and A/D as well as Keyboard with 8085.	Psychomotor	Guided Response
CO4	**Program** for Serial communication implementation and I/O interface.	Psychomotor	Guided Response
CO5	**Program** and **execute** simple applications using microprocessor trainer kits.	Psychomotor	Guided Response

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 executions, including:
   a. Conditional jumps, looping.
   b. Calling subroutines.
   c. Stack parameter testing.
4. Design program for code conversions.
5. Interfacing Converters of 8-bit D/A and A/D.
6. Interfacing of Keyboard with 8085
7. Interfacing of seven segment display with 8085.
8. Serial communication and I/O Port operations.
9. Design and implementation of Traffic Light control.
10. Design and implementation of Stepper motor control.

PRACTICAL	TOTAL
30	30

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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**	**2**	**1**	**1**	**1**	**0**	**2**	**2**	**2**	**1**	**1**	**1**

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

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

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.

REFERENCES

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	1	-	1	-	-	-	2	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	2
CO3	2	2	-	-	1	1	-	1	-	-	-	1	1	1
CO4	2	2	-	-	-	-	1	-	-	-	-	1	2	2
CO5	2	2	-	2	-	1	-	-	-	-	-	2	2	2
Total	12	10	2	2	1	3	1	2	0	0	0	7	8	9
Scaled	3	2	1	1	1	1	1	2	0	0	0	2	2	2

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

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

ELECTRICAL DRIVES

Course Outcomes (XEE E51):		Domain	Level
CO1	**Understand** the characteristics of DC drives and its multi-quadrant operation	Cognitive	Understanding
CO2	**Understand** the various control techniques of DC Drives.	Cognitive	Remembering
CO3	**Categorize** the different speed control methods for an Induction motor drive at stator side.	Cognitive	Understanding
CO4	**Illustrate** the various control techniques of induction motor Drives at rotor side.	Cognitive	Understanding
CO5	**Illustrate** the various control techniques and application of Synchronous motor drives.	Cognitive	Understanding

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

UNIT- I: DC MOTOR DRIVE CHARACTERISTICS AND ITS MULTI-QUADRANT OPERATIONS	**9**
Fundamentals of Electrical Drives - Advantage of Electrical Drives - Selection of Motor Power Rating - Review of emf and torque equations of DC machine - Review of torque-speed characteristics of separately excited dc motor - Four quadrant operation of dc machine – Steady state operation of multi-quadrant chopper fed dc drive, regenerative braking.	
UNIT- II: CONTROL OF DC DRIVES	9
DC Motor and their Performance - Transient Analysis - Ward Leonard Drives - Steady State Analysis of the Single and Three Phase Fully Controlled Converter Fed Separately Excited DC Motor Drive – Continuous and Discontinuous Mode Chopper Controlled DC Drives - Time Ratio Control and Current Limit Control – Industrial Applications of DC drives	
UNIT- III: STATOR CONTROLLED INDUCTION MOTOR DRIVES	**9**
Induction Motor Drives - Stator Control - Stator Voltage and Frequency Control - VSI, CSI and Cycloconverter Fed Induction Motor Drives - Open Loop and Closed Loop V/f Control. Conventional space vector modulation; Steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation - Industrial Applications of Stator controlled Induction Motor drives.	
UNIT- IV: ROTOR CONTROLLED INDUCTION MOTOR DRIVES	**9**
Impact of rotor resistance of the induction motor torque-speed curve - Operation of slip-ring induction motor with external rotor resistance, starting torque - Power electronic based rotor side control of slip ring motor - Slip Power Recovery, sub-synchronous and Super Synchronous Operations - PowerFactor 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, IITM

Mapping of COs with POs

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

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

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

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

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.

Mapping of COs with POs

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

1-5 >1, 6-10 >2, 11-15 > 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.

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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

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www.nptel.ac.in

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3									1		1		2
CO2	3									1		1		2
CO3	3	2								1	1	2		2
CO4	3	2			1					1	1	1		3
CO5	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

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
PEE501	POWER SYSTEM ANALYSIS	3	1	0	4
C : P : A		L	T	P	H
2.5 : 0.5 : 0.5		3	1	0	4

Course Outcomes:		Domain	Level
CO1	**Demonstrate** the per phase analysis of power system.	Cognitive	Understanding
CO2	**Develop** the model of various components of the power system and **Construct** the Y Bus and Z Bus for a power system.	Cognitive	Understanding Applying
CO3	**Analyze** the power system network with symmetrical and unsymmetrical faults. **Calibrate** the fault current in a power System.	Cognitive	Understanding Analyzing
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	Understanding Evaluating Perception
CO5	**Classify** and **determine** the stability of power system **Detect** the transient behavior of power system when it is subjected to a fault.	Cognitive	Understanding Evaluating Perception

UNIT – I: INTRODUCTION	**10 + 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	**8 + 3**
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 + 3**
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 + 3**
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 + 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.	

	LECTURE	TUTORIAL	TOTAL
	45	15	60

TEXT BOOKS:

1. Hadi Sadaat, "Power System Analysis", Tata McGraw Hill Publishing Company, 2002.
2. John J. Grainger and Stevenson Jr. W.D., "Power System Analysis", McGraw Hill International Edition, 1994.
3. Nagarat .I.J, Kothari .D.P, "Power system Engineering", Tata McGraw Hill Publishing Company, 1994.
4. Pai. M.A "Computer techniques in Power System Analysis" Tata McGraw Hill Publishing Company,2007

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1. Stagg, G.W. and El-Abaid, A. H. "Computer Methods in Power System Analysis", McGraw-Hill International Book Company, 1968.
2. Nagarath, I.J., and Kothari, D.P., 'Modern Power System Analysis', Tata McGraw Hill Publishing Company, 1990.
3. Wadhwa C.L. "Electric Power Systems" Willey Eastern, 2007.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	0	0	1	3	0	0	0	0	1	3	1
CO2	2	1	2	1	0	0	1	0	0	0	0	0	2	2
CO3	3	1	1	0	0	0	0	0	0	0	0	0	1	2
CO4	1	3	2	0	0	1	0	0	0	0	0	0	2	1
CO5	1	2	3	1	3	0	1	1	0	0	0	0	3	2
Total	**10**	**9**	**9**	**2**	**3**	**2**	**5**	**1**	**0**	**0**	**0**	**1**	**11**	**8**
Scaled	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**3**	**2**

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 E33	**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.	Cognitive	Understanding

	Understand the basic mechanisms involved in the transduction process of bio-potential electrodes and be able to discuss electrical characteristics of electrodes.		
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 safety-electrical shock hazards.	
UNIT – V: MEDICAL DIAGNOSTICS INSTRUMENTS AND SYSTEMS	**9**
CTscanner–MRIScanandUltrasonicscanner–XRay–LaserEquipmentandapplication- 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.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	0	0	1	3	0	0	0	0	1	3	1
CO2	2	1	2	1	0	0	1	0	0	0	0	0	2	2
CO3	3	1	1	0	0	0	0	0	0	0	0	0	1	2
CO4	1	3	2	0	0	1	0	0	0	0	0	0	2	1
CO5	1	2	3	1	3	0	1	1	0	0	0	0	3	2
Total	**10**	**9**	**9**	**2**	**3**	**2**	**5**	**1**	**0**	**0**	**0**	**1**	**11**	**8**
Scaled	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**3**	**2**

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

COURSECODE	**COURSE NAME**	**L**	**T**	**P**	**C**
PEE504	**POWER ELECTRONICS**	**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 structure, operation and characteristics of power switching devices.	Cognitive	Understanding
CO2	Determine the operation, characteristics and performance parameters of controlled rectifiers.	Cognitive	Understanding
CO3	Analysis the operation of DC - DC choppers.	Cognitive	Analyzing
CO4	Analysis the operation of various inverters and infer the suitable PWM techniques.	Cognitive	Analyzing
CO5	To Understand the concept of various types of AC voltage controllers.	Cognitive	Understanding

UNIT – I: POWER SWITCHING DEVICES	**10 + 3**
Review on Semiconductor devices – I-V characteristics and Switching Characteristics of power Diodes, SCR, TRIAC, power BJT, power MOSFET and IGBT. Triggering and Commutation Circuits.	
UNIT – II: THYRISTOR RECTIFIERS	**8 + 3**

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

UNIT – III: FAULT ANALYSIS – UNSYMMETRICAL FAULTS **9 + 3**

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 + 3**

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 + 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.

	LECTURE	TUTORIAL	TOTAL
	45	15	60

TEXT BOOKS:

1. Hadi Sadaat, "Power System Analysis", Tata McGraw Hill Publishing Company, 2002.
2. John J. Grainger and Stevenson Jr. W.D., "Power System Analysis", McGraw Hill International Edition, 1994.
3. Nagarat .I.J, Kothari .D.P, "Power system Engineering", Tata McGraw Hill Publishing Company, 1994.
4. Pai. M.A "Computer techniques in Power System Analysis" Tata McGraw Hill Publishing Company,2007

REFERENCE BOOKS:

2. Stagg, G.W. and El-Abaid, A. H. "Computer Methods in Power System Analysis", McGraw-Hill International Book Company, 1968.
2. Nagarath, I.J., and Kothari, D.P., 'Modern Power System Analysis', Tata McGraw Hill Publishing Company, 1990.
3. Wadhwa C.L. "Electric Power Systems" Willey Eastern, 2007.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	0	0	1	3	0	0	0	0	1	3	1
CO2	2	1	2	1	0	0	1	0	0	0	0	0	2	2
CO3	3	1	1	0	0	0	0	0	0	0	0	0	1	2
CO4	1	3	2	0	0	1	0	0	0	0	0	0	2	1

CO5	1	2	3	1	3	0	1	1	0	0	0	0	3	2
Total	**10**	**9**	**9**	**2**	**3**	**2**	**5**	**1**	**0**	**0**	**0**	**1**	**11**	**8**
Scaled	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**3**	**2**

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

Sl. No.	**List of Experiments**	**COs**
1.	Characteristics of SCR.	**CO1**
2.	Characteristics of MOSFET.	**CO1**
3.	Characteristics of IGBT.	**CO1**
4.	Single phase fully controlled rectifier with R, RL load.	**CO2**
5.	BUCK- BOOST converter using MOSFET.	**CO3**
6.	IGBT based choppers.	**CO3**
7.	Four quadrant chopper.	**CO3**

8.	Single phase IGBT PWM Inverter.	**CO4**
9.	Series Inverter/ Parallel Inverter.	**CO4**
10.	Single phase AC voltage controller using SCR / TRIAC.	**CO5**
11.	Single phase cycloconverter.	**CO5**

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

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	0	0	1	3	0	0	0	0	1	3	1
CO2	2	1	2	1	0	0	1	0	0	0	0	0	2	2
CO3	3	1	1	0	0	0	0	0	0	0	0	0	1	2
CO4	1	3	2	0	0	1	0	0	0	0	0	0	2	1
CO5	1	2	3	1	3	0	1	1	0	0	0	0	3	2
Total	**10**	**9**	**9**	**2**	**3**	**2**	**5**	**1**	**0**	**0**	**0**	**1**	**11**	**8**
Scaled	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**3**	**2**

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**
PEE601	**POWER SYSTEMS OPERATION AND CONTROL**	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**1**	**0**	**4**

Course Outcomes:		**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	Understanding Applying
CO4	**Formulate** economic dispatch and unit commitment problem and its solution.	Cognitive	Understanding Applying
CO5	**Apply** computer control methods for power system operation and control	Cognitive	Understanding

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

Power scenario in Indian grid – National and Regional load dispatching centers – requirements of good power system- 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 + 3**

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 + 3**

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

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

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

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.

REFERENCE BOOKS:

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

E-RESOURCES:

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

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**
PEE604	**MEASUREMENTS AND INSTRUMENTATION**	**3**	**1**	**0**	**4**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**1**	**0**	**4**

Course Outcomes:		**Domain**	**Level**
CO1	**Describe** the different errors in measurements and **Describe** the working principle of different measuring instruments.	Cognitive Psychomotor	Remembering Perception
CO2	**Understanding** about the instruments used for different types of AC measurements. **Carryout** calibration test for measuring electrical instruments.	Cognitive Psychomotor	Understanding Set
CO3	**Use** different types bridge circuits for the measurements of unknown passive elements. **Relate** the different types of the transducers. **Demonstrate** the use of different bridges and transducers.	Cognitive Psychomotor	Applying Mechanism
CO4	**Explain** the construction and operation of recording and display instruments. **Establish** Relations between analog and digital signal conversions. Recording and display instruments. **Establish** Relations between analog and digital signal conversions.	Cognitive Psychomotor	Understanding Set
CO5	**Explain** the construction and working of different types signal conditioners. **Demonstrate** the recent trends in measurement of AC quantities.	Cognitive Psychomotor	Remembering Mechanism

UNIT - I: INTRODUCTION	**9 + 3**
Measurements – Errors & classification, Measurement of voltage & current - permanent magnet moving coil and moving iron meters, Measurement of power and energy - dynamometer and induction	

instruments, Instrument transformers – Current and Potential transformers.	
UNIT - II: DC AND AC BRIDGES	**9 + 3**
Measurement of resistance, inductance and capacitance using dc and ac bridges, Wheatstone bridge, Maxwell bridge, Kelvin's Bridge, Schering Bridge.	
UNIT - III: TRANSDUCERS	**9 + 3**
Active and Passive transducers, Piezoelectric transducer, Photoelectric transducers, Thermocouples, Strain gauge transducers, LVDT, differential capacitive transducers, Fiber optic transducers, Resistive, Inductive and capacitive transducers.	
UNIT - IV: SIGNAL CONDITIONING UNITS	**9 + 3**
Signal conditioners – Instrumentation amplifiers, voltage–current converters, A/D and D/A converters, voltage-frequency converters, analog multiplexers and de-multiplexers. Microprocessor Based Measurements, Case Studies in Instrumentation.	
UNIT - V: RECORDERS AND DISPLAY	**9 + 3**
Signal sources – Oscillators, Function generator and pulse generators. Oscilloscopes - CRO, Digital storage and Analog storage Oscilloscope, Digital Phosphor Oscilloscopes. Analog and Digital Recorders and printers. Spectrum Analyzers, Data and Logic Analyzers.	

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

TEXT BOOKS:

1. K. Sawhney, 'A Course in Electrical and Electronic Measurements and Instrumentation', DhanpatRai & Co., 9th Edition, 2018.
2. Bouwens A. J., 'Digital Instrumentation', Tata McGraw Hill Publications, 16th Reprint (2008).
3. Kalsi H.S, 'Electronic Instrumentation', Tata McGraw-Hill Education, 3rd Edition, 2010.
4. Deobelin, 'Measurements Systems', Tata McGraw Hill Publications, 2nd Edition, 2010.

REFERENCE BOOKS:

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

E-RESOURCES:

1. NTPEL, Electrical Instrumentations (Web Course), Prof. N.K. De, Prof. T.K. Bhattacharyaand Prof. G. D. Roy, IIT Kharagpur.

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	0	0	1	0	1	1	0	0	3	0	0	2	3
CO2	1	1	0	0	0	0	0	0	0	0	0	1	2	3
CO3	1	0	1	0	1	0	0	2	0	1	0	0	2	2
CO4	1	2	0	0	0	0	0	0	0	0	0	1	2	2
CO5	0	0	0	0	0	0	0	0	1	0	1	1	2	3
Total	**4**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**4**	**1**	**3**	**10**	**13**
Scaled	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**

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
PEE605	MEASUREMENTS AND INSTRUMENTATION LABORATORY	0	0	1	1
C : P : A		L	T	P	H
0 : 1 : 0		0	0	2	2

COURSE OBJECTIVES:

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

Course Outcomes:		Domain	Level
CO1	**Describe** the different errors in measurements and **Describe** the working principle of different measuring instruments.	Cognitive Psychomotor	Remembering Perception
CO2	**Understanding** about the instruments used for different types of AC measurements. **Carryout** calibration test for measuring electrical instruments	Cognitive Psychomotor	Understanding Set
CO3	**Use** different types bridge circuits for the measurements of unknown passive elements. **Relate** the different types of the transducers. **Demonstrate** the use of different bridges and transducers.	Cognitive Psychomotor	Applying Mechanism
CO4	**Explain** the construction and operation of recording and display instruments. **Establish** Relations between analog and digital signal conversions.	Cognitive Psychomotor	Understanding Set
CO5	**Explain** the construction and working of different types signal conditioners. **Demonstrate** the recent trends in measurement of AC quantities.	Cognitive Psychomotor	Remembering Mechanism

Sl. No.	List of Experiments	COs
1.	Calibration of Current Transformer and Potential transformer.	CO1
2.	Measurement of three phase active, Reactive Power and Power factor	CO1
3.	Calibration of Single phase / Three Phase Energy meter	CO1
4.	Resistance measurement using Wheat stone bridge	CO2
5.	Inductance measurement using Maxwell Bridge	CO2
6.	Capacitance measurement using Schering Bridge	CO2
7.	Study of Transducers	CO3
8.	A/D converter	CO4

9.	D/A converters	**CO4**
10.	Measurement of Current / Voltage / power / Energy using Arduino board.	**CO5**
	PRACTICAL	**TOTAL**
	30	**30**

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	0	0	1	0	1	1	0	0	3	0	0	2	3
CO2	1	1	0	0	0	0	0	0	0	0	0	1	2	3
CO3	1	0	1	0	1	0	0	2	0	1	0	0	2	2
CO4	1	2	0	0	0	0	0	0	0	0	0	1	2	2
CO5	0	0	0	0	0	0	0	0	1	0	1	1	2	3
Total	**4**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**4**	**1**	**3**	**10**	**13**
Scaled	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**

1-5 >1, 6-10 >2, 11-15 > 3
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.
   Dr. P. C. Sharma's A Textbook of Power Plant Engineering, published by S. K. Kataria, 2013.

REFERENCE BOOKS

1. Power station Engineering and Economy by Bernhardt G.A.Skrotzki and William A.Vopat-Tata McGraw Hill Publishing Company Ltd., New Delhi, 20th reprint 2002
2. R.K.Jain, **"**Mechanical and Industrial Measurements**"** Khanna Publishers, New Delhi,2002.Arora Domkundwar, A course in Power Plant engineering, Dhanpat Rai & Co.,2001

E-REFERENCES:

www.electrical4u.com

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	1	-	-	-	1	-	-	1	3	2
CO2	3	1	-	2	1	-	-	-	1	-	-	1	1	2
CO3	3	1	-	2	1	-	-	-	1	-	-	1	1	2
CO4	3	-	1	-	1	-	-	-	1	-	-	1	2	1
CO5	3	2	2	2	1	-	-	-	1	-	-	1	3	1
Total	**3**	**1**	-	-	**1**	-	-	-	-	-	-	**1**	**2**	**1**
Scaled	**15**	**6**	**4**	**6**	**5**				**4**			**5**	**11**	**7**

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

ELECTRICAL DRIVES

Course Outcomes (PEE E51):		Domain	Level
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 multi-quadrant chopper fed dc drive, regenerative braking.	
UNIT- II: CONTROL OF DC DRIVES	**9**
DC Motor and their Performance - Transient Analysis - Ward Leonard Drives - Steady State Analysis of the Single and Three Phase Fully Controlled Converter Fed Separately Excited DC Motor Drive – Continuous and Discontinuous Mode Chopper Controlled DC Drives - Time Ratio Control and Current Limit Control.	
UNIT- III: STATOR CONTROLLED INDUCTION MOTOR DRIVES	**9**
Induction Motor Drives - Stator Control - Stator Voltage and Frequency Control - VSI, CSI and Cycloconverter Fed Induction Motor Drives - Open Loop and Closed Loop V/f Control. Conventional space vector modulation; Steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.	
UNIT- IV: ROTOR CONTROLLED INDUCTION MOTOR DRIVES	**9**

Impact of rotor resistance of the induction motor torque-speed curve - Operation of slip-ring induction motor with external rotor resistance, starting torque - Power electronic based rotor side control of slip ring motor - Slip Power Recovery. sub-synchronous and Super Synchronous Operations - Power Factor Improvement - Closed Loop Control.	
UNIT- V: SYNCHRONOUS MOTOR DRIVES	**9**
Separate Controlled Mode - Self Controlled Mode of Synchronous Motor - Constant Marginal Angle Control and Motor Power Factor Control - Cycloconverter Fed Synchronous Motors - Digital Control and Drive Applications.	

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

TEXT BOOKS

1. Dubey. G.K, 'Fundamentals of Electrical Drives', Narosa Publications, 2008.B. K. Bos, 'Power Electronics and AC Drives', Prentice Hall Onglewood cliffs, New Jersey, 1998.
2. Gopal K. Dubey, 'Fundamentals of Electrical Drives', New Delhi, 2nd Edition, Narosa Publishing House,
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. Gaekward, 'Analog and Digital Control Systems', Wiley Eastern Ltd, 1989.
5. Leonhard. W, 'Control of Electric Drives', Springer Science & Business Media, 2001

E-REFERENCES

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

Mapping of COs with POs

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

1-5 >1, 6-10 >2, 11-15 > 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**
Scaled	**2**	**3**	**1**	**1**	**0**	**1**	**0**	**0**	**1**	**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**
PEE701	**INDUSTRIAL AUTOMATION**	**3**	**0**	**0**	**3**
C : P : A		**L**	**T**	**P**	**H**
3 : 0 : 0		**3**	**0**	**0**	**3**

Course Outcomes:		**Domain**	**Level**
CO1	Able to **define** and **explain** the fundamentals of Pneumatics, hydraulics and electrical drives. **List** out the advantages, disadvantages and its application.	Cognitive	Understand
CO2	**Understand** the electrical ladder diagrams for hydraulic and pneumatic system and able to **explain** pressure, proximity switches and intelligent Relays.	Cognitive	Understand

CO3	**Explain** and **categorize** different types of Sensors and their application.	Cognitive	Understand
CO4	**Illustrate** the knowledge in the PLC logic, Architecture and **design** the industrial automated system for specific applications and **apply** the knowledge of PLC programming to interface pneumatics.	Cognitive	Understand
CO5	**Outline** the overview of robotics and their application. **Understand** the operation of robots.	Cognitive	Understand

UNIT – I: INTRODUCTION TO AUTOMATION	**9**
Introduction to Automation - Hydraulic Systems - Pneumatics Systems - Electro pneumatics – Advantages and disadvantages – Applications.	
UNIT – II: APPLICATIONS OF RELAYS	**9**
Introduction to Process Control Philosophies: type of relays, ladder logic methodology, ladder symbols. Essential qualities of relays- NO & NC contacts– Electrical Ladder Diagrams for Pneumatic system and Hydraulic system-pressure switches- Intelligent Relays.	
UNIT – III: SENSORS AND TIMERS IN CONTROLLERS	**9**
Introduction to sensors- proximity sensors -characteristics- types of sensors-resistive - inductive-capacitive- magnetic- ultrasonic - photoelectric-applications of sensors.	
UNIT – IV: PROGRAMMABLE LOGIC CONTROLLERS	**9**
Evolution of PLC – Sequential and Programmable controllers – Architecture–Programming of PLC – Relay logic and Ladder logic – role of timers and counters - Applications – PLC interface to pneumatics.	
UNIT – V: ROBOTICS	**9**
Introduction and overview of Robotics – Terms and Definitions related robotics, classification and configuration of robots, Basic components - Drives, controller gripper, application- programming in Robotics.	

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

TEXT BOOKS:

1. Industrial Automation Technologies, Edited By Chanchal Dey, Sunit Kumar Sen ISBN 9780367260422 Published June 10, 2020 by CRC Press.
2. James Dally, W., "Instrumentation for Engineering Measurements", John Wiley & sons.
3. JOHN WEBB: Programmable Logic Controllers Principles & applications, PHI.
4. Programmable Logic Controllers, Sixth Edition, William Bolton, 2015.
5. Patranabis, D., "Sensors and Transducers", Wheeler Publishing, 2000.
6. Harry Colestock, Industrial Robotics, McGraw Hill Book Co., New Delhi, 2005.

REFERENCE BOOKS:

1. Anthony Esposito, Fluid Power with Applications, Pearson Education, 7th Edition, New Delhi, 2014.
2. S. R. Mujumdar, "Pneumatic system", Tata McGraw Hill. ISBN: 0074602314.
3. Stuart A. Boyer., SCADA: Supervisory Control and Data Acquisition, 3rd Edition, The instrumentation systems and Automation Society,2009.
4. W Bolton., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering"

Prentice-Hall. ISBN: 0131216333.
5. Micro-sensors; principles andapplications-J.W.Gardner.
6. Semiconductor sensors and itsapplication-S.M.Sze.

E-RESOURCES:

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

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	2	1	1	1	0	0	1	1	0		
CO2	3	2	0	0	1	1	0	1	0	1	3	2		
CO3	2	3	0	0	1	1	1	0	0	0	0	1		
CO4	2	1	3	0	0	1	0	1	1	0	0	1		
CO5	2	2	0	0	1	0	0	2	0	0	0	1		
Total	**12**	**10**	**3**	**2**	**4**	**4**	**2**	**4**	**1**	**2**	**4**	**5**		
Scaled	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**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
PEE702	**ELECTRICAL AND HYBRID VEHICLES**	**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 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

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	TUTORIAL	TOTAL
	45	0	45

TEXT BOOKS:

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

REFERENCE BOOKS:

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

E-RESOURCES:

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	0	0	0	0	0	0	1	0	1	0	2
CO2	3	0	0	0	0	0	0	0	0	1	0	1	0	2
CO3	3	2	0	0	0	0	0	0	0	1	1	2	0	2
CO4	3	2	0	0	1	0	0	0	0	1	1	1	0	3
CO5	3	2	0	0	1	0	0	0	0	1	1	1	0	3
Total	**15**	**6**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**5**	**3**	**6**	**0**	**12**
Scaled	**3**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**3**

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

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

DISTRIBUTED GENERATION AND MICRO GRID

Course Outcomes (YPE E51):		**Domain**	**Level**
CO1	To Understand the concepts of Distributed Generation and Microgrids.	Cognitive	Understanding
CO2	To Gain Knowledge about the various DG resources	Cognitive	Understanding
CO3	To Familiarize with the planning and protection schemes of Distributed Generatio	Cognitive	Understanding
CO4	To Learn the concept of Microgrid and its mode of operation	Cognitive	Understanding
CO5	To Acquire knowledge on the impacts of Microgrid	Cognitive	Understanding

COURSE CODE	**COURSE NAME**	**L**	**T**	**P**	**C**
YPE E51	**DISTRIBUTED GENERATION AND MICRO GRID**	**3**	**0**	**0**	**3**
C:P: A = 3:0:0		**L**	**T**	**P**	**H**
		3	**0**	**0**	**3**

UNIT -I INTRODUCTION TO DISTRIBUTED GENERATION	**09**
DG definition - Reasons for distributed generation-Benefits of integration - Distributed generation and the distribution system - Technical, Environmental and Economic impacts of distributed generation on the distribution system - Impact of distributed generation on the transmission system-Impact of distributed generation on central generation	
UNIT – II DISTRIBUTED ENERGY RESOURCES	**09**
Combined heat and power (CHP) systems-Wind energy conversion systems (WECS)- Solar photovoltaic (PV) systems-Small-scale hydroelectric power generation-Other renewable energy sources-Storage devices-Inverter interfaces	
UNIT – III DG PLANNING AND PROTECTION	**09**
Generation capacity adequacy in conventional thermal generation systems-Impact of distributed generation-Impact of distributed generation on network design-Protection of distributed generation-Protection of the generation equipment from internal Faults-Protection of the faulted distribution network from fault currents supplied by the distributed generator-Impact of distributed generation on existing distribution system protection.	
UNIT - IV CONCEPT OF MICROGRID	**09**

Microgrid Definition-A typical Microgrid configuration- Functions of Micro source controller and central controller- Energy Management Module (EMM) and Protection Co-ordination Module (PCM)- Modes ofOperation- Grid connected and islanded modes- Modelling of Microgrid- Microturbine Model- PV Solar Cell Model- Wind Turbine Model-Role of Microgrid in power market competition.

UNIT - V IMPACTS OF MICROGRID	**09**

Technical and economical advantages of Microgrid-Challenges and disadvantages of Microgrid development-Management and operational issues of a Microgrid- Impact on heat utilization-Impact on process optimization-Impact on market-Impact on environment-Impact on distribution system-Impact on communication standards and protocols.

Microgrid economics-Main issues of Microgrid economics-Microgrids and traditional power system economics-Emerging economic issues in Microgrids-Economic issues between Microgrids and bulk power systems-Potential benefits of Microgrid economics.

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

REFERENCES

1. Nick Jenkins, Janaka Ekanayake , GoranStrbac ,"Distributed Generation", Institution of Engineering and Technology, London, UK,2010.
2. S. Chowdhury, S.P. Chowdhury and P. Crossley, "Microgrids and Active DistributionNetworks", The Institution of Engineering and Technology, London, United Kingdom, 2009.
3. Math H. Bollen , Fainan Hassan, "Integration of Distributed Generation in the Power System",John Wiley &Sons, New Jersey, 2011.
4. Magdi S. Mahmoud, Fouad M. AL-Sunni, "Control and Optimization of Distributed Generation Systems", Springer International Publishing, Switzerland, 2015.
5. Nadarajah Mithulananthan, Duong Quoc Hung, Kwang Y. Lee, "Intelligent Network Integration of Distributed Renewable Generation", Springer International Publishing, Switzerland, 2017.
6. Ali K., M.N. Marwali, Min Dai, "Integration of Green and Renewable Energy in Electric Power Systems", Wiley and sons, New Jersey, 2010.

Mapping of COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1	2	1	2	1
CO2	2	2	2	1	3	2
CO3	2	2	2	1	3	2
CO4	1	1	2	1	2	1
CO5	2	2	2	2	3	2
Total	8	8	10	6	13	8
Scaled	2	2	2	2	3	2

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

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

SPECIALIZATION COURSE SYLLABUSES

FUNDAMENTALS OF ELECTRIC VEHICLES

COURSE CODE	COURSE NAME	L	T	P	C
XEEEV1		3	0	0	3
C:P:A = 3:0:0		L	T	P	H
		3	0	0	3

Course Outcomes:		Domain	Level
CO1	To explain the fundamentals, basic principles, operation, performance of conventional vehicles	Cognitive	Understanding
CO2	To differentiate and compare the structure, components required, general layout of Electric Vehicle and Hybrid Electric Vehicle	Cognitive	Understanding
CO3	To understand the types of DC Motors used in Electric Vehicles	Cognitive	Understanding
CO4	To explain the four-quadrant operations and the working of various converters	Cognitive	Understanding
CO5	To understand the various Policies and Regulations in Indian and Global Electric Vehicles Scenario	Cognitive	Understanding

UNIT -I VEHICLE FUNDAMENTALS	06
Vehicle resistance, Types: Rolling Resistance, grading resistance, Aerodynamic drag, vehicle performance, Calculating The Acceleration Force, maximum speed, Finding The Total Tractive Effort, Torque Required On The Drive Wheel, Transmission: Differential, clutch &gear box, Braking performance.	
UNIT - II: ELECTRIC AND HYBRID VEHICLES	**12**
History, Components of Electric Vehicle, General Layout of EV, EV classification, Comparison with Internal combustion Engine: Technology, Advantages &Disadvantages of EV, Overview of Tesla car. History, Components of Hybrid Electric Vehicle , General Layout of Hybrid EV, Comparison with Electric Vehicles, Advantages &Disadvantages of Hybrid EV, Overview of Toyota Prius	
UNIT – III MOTORS	**09**
Principle and working of DC motor, Characteristics and Types of DC Motors - Overview (Speed torque characteristics) of Permanent Magnet motor, BLDC Motor and Induction motor. Comparison of all motors.	
UNIT - IV CONVERTERS	**09**
Introduction of DC-DC, AC-AC, AC-DC, DC-AC, four-quadrant operation, Driver circuits	
UNIT - V INDIAN AND GLOBAL SCENARIO	**09**
Technology Scenario, Market Scenario, Policies and Regulations, Payback and commercial model, P, Polices in India.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXTBOOKS / REFERENCES

1. John Lowry and James Larminie, Electric Vehicle Technology Explained, Second Edition, 2012.
2. MehrdadEhsani and Yimin Gao Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design Power Electronics and Applications Series, Second Edition,2009.
3. Iqbal Husain , Electric and Hybrid Vehicles: Design Fundamentals, Third Edition, 2021.
4. Seth Leitman and Bob Brant Build Your Own Electric Vehicle,Third Edition, 2013.
5. Wei Liu , Introduction to Hybrid Vehicle System Modeling and Control, Second Edition,2013.

COs versus POs Mapping

	PO 1	**PO2**	**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	2	1	0	1	1	0	0	1	0	1	1	2
CO2	3	1	2	1	0	1	1	0	0	1	0	1	1	2
CO3	3	2	2	1	0	1	1	0	0	1	1	2	1	2
CO4	3	2	2	1	1	1	1	0	0	1	1	1	1	3
CO5	0	0	0	1	0	1	1	1	0	1	1	1	1	3
Total	**12**	**6**	**8**	**5**	**1**	**5**	**5**	**1**	**0**	**5**	**3**	**6**	**5**	**12**
Scaled	**3**	**2**	**2**	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**2**	**2**	**1**	**3**

0–No Relation 1 –LowRelation 2 – Medium Relation 3 – HighRelation

XEEEV2 FUNDAMENTALS OF ELECTRIC VEHICLES LABORATORY

Objectives

Understanding the performance of various measuring instruments through practical demonstrations.

Course Outcomes:		**Domain**	**Level**
CO1	To demonstrate conversion of DC-to-DC voltage using converter	Psychomotor	Guided Response
CO2	To carry out Simulation for AC-to-AC conversion, AC to DC conversion and DC to AC conversion	Psychomotor	Guided Response
CO3	Perform speed control of DC motor and reversal of DC shunt motor	Psychomotor	Guided Response
CO4	Calculate and compare the brake power, torque and mechanical efficiency of IC Engine and Electrical Motor of same configuration	Psychomotor	Guided Response
CO5	Recall various elements of transmission systems and various types of braking systems	Psychomotor	Guided Response

Practical

Perform any 8 Experiments.

List of Practical:

1. Experiment for conversion of DC-to-DCvoltage using converter.
2. Simulation for AC-to-ACconversion.
3. Simulation for AC to DC conversion.
4. Simulation for DC to AC conversion.
5. Study of 3phase Induction motor.
6. Speed control of DC motor using IGBT.
7. To perform speed reversal of DC shunt motor.
8. Study of various elements of transmission systems (clutch, differentials, gearbox etc.)
9. Calculate and compare the brake power, torque and mechanical efficiency of IC Engine and Electrical Motor of same configuration.
10. Study of various types of braking systems.
11. Case study of Tesla Car.
12. Case study of Toyota Prius.

TOTAL **30 Hours**

COs versus POs Mapping

	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	0	0	0	0	0	0	0	1	0	1	1	2
CO2	3	2	0	0	0	0	0	0	0	1	0	1	1	2
CO3	3	2	0	0	0	0	0	0	0	1	1	2	1	2
CO4	3	2	0	0	1	0	0	0	0	1	1	1	1	2
CO5	3	2	0	0	1	0	0	0	0	1	1	1	1	2
Total	**15**	**6**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**	**3**	**6**	**5**	**10**
Scaled	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**2**	**2**	**1**	**2**

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

SEMESTER IV

ELECTRIC VEHICLES ARCHITECTURE

COURSE CODE	COURSE NAME	L	T	P	C
XEEEV3	ELECTRIC VEHICLES ARCHITECTURE	3	0	0	3
C:P: A = 3:0:0		L	T	P	H
		3	0	0	3

Course Outcomes:		Domain	Level
CO1	To explain the basic architecture of hybrid drive trains and analyze series drive train	Cognitive	Understanding
CO2	To understand the Power flow in HEVs	Cognitive	Understanding
CO3	To understand Torque Coupling and analyze Parallel hybrid electric power-train architecture	Cognitive	Understanding
CO4	To explain the roles of various components in hybrid electric power-train architecture	Cognitive	Understanding
CO5	To select the appropriate EV configuration with suitable power source	Cognitive	Understanding

UNIT -I BASIC ARCHITECTURE OF HYBRID DRIVE TRAINS AND ANALYSIS OF SERIES DRIVE TRAIN	**09**

Hybrid Electric Vehicles (HEV): The gasoline ICE and battery, Diesel ICE and battery, Battery and Fuel Cells, Battery and capacitor, Battery and flywheel, Battery and battery hybrids. Energy use in conventional vehicles, Energy saving potential of hybrid drive trains: Regenerative braking, More efficient operation of the ICE, including reduction of idle, Smaller ICE, Potential for higher weight, Electrical losses. Various HEV configurations and their operation modes: Series configuration, Parallel configuration, Series-parallel configuration, Complex configuration.

UNIT – II POWER FLOW IN HEVs	**12**

Power Flow Control: Optimal ICE operating point and operating line, Safe battery voltage.
Power Flow Control in Series Hybrid for various modes, Power Flow Control in Parallel Hybrid for various modes.
Power Flow Control in Series – Parallel Hybrid for various modes, The operating modes of EM dominated system, Power Flow Control Complex Hybrid Control for various modes.

UNIT – III TORQUE COUPLING AND ANALYSIS OF PARALLEL DRIVE TRAIN	**06**

Introduction to Parallel Hybrid Electric Drive Train, Torque Coupling, Speed Coupling, Post-Transmission Parallel Hybrid Drive Train with Torque Coupling, Pre-Transmission Parallel Hybrid Drive Train with Torque Coupling, Parallel Hybrid Drive Train with Speed Coupling: Hybrid traction, Engine alone traction, Motor alone traction, Regenerative braking, Battery charging from the ICE. Complex Hybrid Drive train.

UNIT - IV BASIC ARCHITECTURE OF ELECTRIC DRIVE TRAINS - I	**09**

Electric Vehicle (EV) Configuration: Electric propulsion – The electronic controller, Power converter, Electric Motor (EM), Mechanical transmission, Driving wheels. Energy source-The energy source (battery, fuel cell, ultra capacitor), Energy management unit, Energy refueling unit. Auxiliary system- Power steering unit, Temperature control unit, Auxiliary power supply. EV alternatives based on drivetrains: EV configuration with clutch, gearbox and differential-I, EV configuration without clutch and gearbox, EV configuration with clutch, gearbox and differential-II.

UNIT – V BASIC ARCHITECTURE OF ELECTRIC DRIVE TRAINS - II	**09**

EV configuration with two EM, EV configuration with in wheel motor and mechanical gear, EV configuration with in wheel motor and no mechanical gear. EV alternatives based on power source configuration: EV configuration with battery source, EV configuration with two battery sources, EV configuration with battery and fuel cell source, EV configuration with multiple energy sources, EV configuration with battery and capacitors sources, EV configuration with battery and flywheel sources, Single and Multi-motor drives, In wheel drives.

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

TEXTBOOKS / REFERENCES

1. M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005.
2. I. Husain, Electric and Hybrid Electric Vehicles, CRC Press, 2003, 2nd edition.
3. L. Guzzella and A. Sciarretta, Vehicle Propulsion Systems: Introduction to Modeling and Optimization, Springer, 2007 Fifth edition
4. G. Lechner and H. Naunheimer, Automotive Transmissions: Fundamentals, Selection, Design and Application, Springer, 1999, Third edition.
5. C.C. Chan and K.T. Chau Modern Electric VehicleTechnology, Oxford Science Publication Volume,2001.

COs versus POs Mapping

	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	1	0	0	0	0	0	1	0	1	1	2
CO2	3	1	1	0	0	0	0	0	0	1	0	1	1	2
CO3	3	1	1	0	0	0	0	0	0	1	1	2	1	2
CO4	3	1	1	0	1	0	0	0	0	1	1	1	1	3
CO5	3	1	1	0	1	0	0	0	0	1	1	1	1	3
Total	**15**	**5**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**	**3**	**6**	**5**	**12**
Scaled	**3**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**2**	**2**	**1**	**3**

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