Appendix - V

COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

Scheme of Examination & Syllabus

For III to VIII Semesters

B.TECH ELECTRICAL & ELECTRONICS ENGINEERING

(2015 Admission onwards)

SEMESTER III

Course Code	*Subject*	L Hrs/Wk	T Hrs/ Wk	P/D Hrs / Wk	*Credits*	*Marks*		*Total*
						CA	*ESE*	
AS15- 1301*	Linear Algebra & Transform Techniques	3	1	0	3	40	60	100
EE15-1302	Fluid Machinery & Heat Engines	3	1	0	3	40	60	100
EE15-1303	Circuits And Networks	3	1	0	3	40	60	100
EE15-1304	Electrical Measurements & Measuring Instruments	3	1	0	3	40	60	100
EE15-1305	Electronic Devices and Circuits	3	1	0	3	40	60	100
EE15-1306	Electrical Machines I	3	1	0	3	40	60	100
EE15-13L1	Electronic Circuits Lab	0	0	3	2	25	25	50
EE15-13L2	Electrical Measurements Lab	0	0	3	2	25	25	50
TOTAL		**18**	**6**	**6**	**22**			

* Common for CE/CS/EC/EE/IT/ME/SE
CA – Continuous Assessment, ESE – End Semester Examination

SEMESTER IV

Course Code	*Subject*	L Hrs/Wk	T Hrs/ Wk	P/D Hrs/ Wk	*Credit*	*Marks*		*Total*
						CA	ESE	
AS15-1401*	Complex Variables and Partial Differential Equations	3	1	0	3	40	60	100
EE15-1402	Circuits, Signals & Systems	3	1	0	3	40	60	100
EE15-1403	Electrical Machines II	3	1	0	3	40	60	100
EE15-1404	Electrical Engineering Materials	3	1	0	3	40	60	100
EE15-1405	Digital Electronics	3	1	0	3	40	60	100
EE15-1406	Power Electronics	3	1	0	3	40	60	100
EE15-14L1	Digital Electronics Lab	0	0	3	2	25	25	50
EE15-14L2	Electrical Machines Lab I	0	0	3	2	25	25	50
TOTAL		**18**	**6**	**6**	**22**			

* Common for CE/CS/EC/EE/IT/ME/SE
CA – Continuous Assessment, ESE – End Semester Examination

SEMESTER V

Course Code	*Subject*	L Hrs/ Wk	T Hrs/ Wk	P/D Hrs/ Wk	*Credit*	*Marks*		*Total*
						CA	ESE	
AS15- 1501*	Numerical and Statistical Methods	3	1	0	3	40	60	100
EE15-1502	Linear Integrated Circuits	3	1	0	3	40	60	100
EE15-1503	Field Theory	3	1	0	3	40	60	100
EE15-1504	Microprocessor & Microcontroller Based Systems	3	1	0	3	40	60	100
EE15-1505	Electrical Drawing	3	1	0	3	40	60	100
EE15-1506	Power Systems I	3	1	0	3	40	60	100
EE15-15L1	Electrical Machines Lab II	0	0	3	2	25	25	50
EE15-15L2	Microprocessor & Microcontroller Lab	0	0	3	2	25	25	50
TOTAL		**18**	**6**	**6**	**22**			

* Common for CE/CS/EC/EE/IT/ME/SE
CA – Continuous Assessment, ESE – End Semester Examination

SEMESTER VI

Course Code	*Subject*	L Hrs/ Wk	T Hrs/ Wk	P/D Hrs/ Wk	*Credit*	*Marks*		*Total*
						CA	ESE	
EE15-1601	Electronic Communication	3	1	0	3	40	60	100
EE15-1602	Digital Signal Processing	3	1	0	3	40	60	100
EE15-1603	Power Systems II	3	1	0	3	40	60	100
EE15-1604	Electric Drives	3	1	0	3	40	60	100
EE15-1605	Control System I	3	1	0	3	40	60	100
EE15-1606	Elective I	3	1	0	3	40	60	100
EE15-16L1	Linear Integrated Circuits Lab	0	0	3	2	25	25	50
EE15-16L2	Mini Project	0	0	3	2	25	25	50
TOTAL		**18**	**6**	**6**	**22**			

EE15-1606 ELECTIVE-I

E1: Advanced Microprocessors
E2: Optimization Techniques & Algorithm
E3: Image Processing
E4: Advanced Power Electronics
E5: Modern Communication Engg.

SEMESTER VII

Course Code	*Subject*	L Hrs/ Wk	T Hrs/ Wk	P/D Hrs/ Wk	*Credit*	*Marks*		*Total*
						CA	ESE	
GE15-1701	Principles of Management	3	1	0	3	40	60	100
EE15-1702	Electrical System Design	3	1	0	3	40	60	100
EE15-1703	New and Renewable Sources of Energy	3	1	0	3	40	60	100
EE15-1704	Control System II	3	1	0	3	40	60	100
EE15-1705	Elective II	3	1	0	3	40	60	100
EE15-17L1	Power Electronics Lab	0	0	3	2	25	25	50
EE15-17L2	Advanced Electrical Engg. Lab	0	0	3	2	25	25	50
GE15-17L3	Entrepreneurship and Development	0	0	2	1	50	-	50
EE15-17L4	Project Phase I and Industrial Internship **	0	0	2	2	50	-	50
TOTAL		**15**	**5**	**10**	**22**			

EE15-1705 ELECTIVE-II

E1: Wireless Communications
E2: Digital Control System
E3: Soft Computing
E4: Energy Auditing & Analysis
E5: Electrical Machine Design

** Industrial internship of a minimum duration of 2 weeks during May-June vacation before the commencement of 7th Semester classes is desirable.

SEMESTER VIII

Course Code	*Subject*	L Hrs/ Wk	T Hrs/ Wk	P/D Hrs/ Wk	*Credit*	*Marks*		*Total*
						CA	ESE	
EE15-1801	Electronic Instrumentation	3	1	0	3	40	60	100
EE15-1802	Utilization of Electrical Power	3	1	0	3	40	60	100
EE15-1803	Power Systems III	3	1	0	3	40	60	100
EE15-1804	Elective III	3	1	0	3	40	60	100
EE15-18L1	Seminar	0	0	3	2	50	-	50
EE15-18L2	Project Phase II	0	0	11	6	200	-	200
EE15-18L3	Comprehensive Viva-voce	0	0	0	2	-	50	50
TOTAL		**12**	**4**	**14**	**22**			

EE15-1804 ELECTIVE-III

E1: Mechatronics
E2:Dynamics of Electrical Machines
E3: Power Quality
E4: HVDC & FACTS
E5: Smart Grid

LIST OF OPTIONAL SUBJECTS

Sl. No:	Subject	L	T	P	No: of Hours/Semester	CA Marks
1	Personality Enrichment	1	2		30	50
2	General Aptitude	1	2		30	50
3	Foreign Language	1	2		30	50
4	Advanced Computer Programming	1		2	30	50
5	Healthy Living	1		2	30	50
6	Theatre Arts	1		2	30	50
7	Imaging Devices	1		2	30	50
8	Disaster Management	1		2	30	50

One or more optional subjects may be offered in any semester outside regular teaching hours and the students may opt to study them if they wish. The course may be conducted by using experts from inside or outside the University on Self Supporting manner. The Fee may be fixed based on the expenses in a non-profit manner with the students of the department given a subsidised rate of fee and those from outside may also be allowed at a higher fee. The regular students may be issued the mark list with the optional subject included in current semester and the outsiders may be issued a certificate separately.

AS 15- 1301 LINEAR ALGEBRA & TRANSFORM TECHNIQUES
(Common for all branches)

Course Objectives:
To acquire fundamental knowledge in linear algebra and transform techniques and apply in engineering disciplines.

Course Outcomes:
On completion of this course the student will be able to

1. Solve linear system of equations and to determine Eigen values and vectors of a matrix.
2. Understand the concept of vector space and sub space.
3. Determine Fourier series expansion of functions and transform.
4. Solve linear differential equation and integral equation using Laplace transform.

Module I.
Linear Algebra 1:Rank of a matrix, solution of linear system of equations- existence, uniqueness, general form-Eigen values and Eigen vectors- properties of Eigen values - Diagonalization of a matrix - Cayley Hamilton theorem (without proof) Verification-Finding inverse and power of a matrix using it-Quadratic form-orthogonal reduction of quadratic form to Canonical form.

Module II
Linear Algebra 2: Vector space-subspace-Linear dependence and independence-Spanning of a subspace- Basis and Dimension. Inner product- Inner product spaces - Orthogonal and Orthonormal basis –Gram- Schmidt Orthogonalization process. Linear Transformation.

Module III
Fourier Analysis: Periodic function, Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansion, Harmonic analysis, Complex Fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform.

Module IV
Laplace Transforms: Gamma functions and Beta function-Definition and properties, Laplace transforms. Inverse Laplace Transform, Shifting theorem, Transform of Derivative and Integrals, Solution of differential equation and integral equation using Laplace transform, Convolution, Unit step function, Second Shifting theorem, Laplace transform of periodic function.

References:
1. Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.
3. Hsiung,C.Y and Mao, G. Y. (1999). *Linear algebra*. World Scientific, New Jersey.
4. Hoffman, K. and Kunze, R. (1971). *Linear algebra*. Prentice Hall of India, New Delhi.
5. Venkataraman,M.K. (1999). *Linear algebra*. The National Publishing Co, Chennai.

Type of Questions for End Semester Examination
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

EE15-1302 FLUID MACHINERY & HEAT ENGINES

Course Objectives:

To understand the working principle and performance of pumps, turbines and engines

Course Outcomes:

1. To understand the basic principles of fluid statics and dynamics
2. To get insight into the working principle of turbines.
3. To understand the working principle of pumps.
4. To learn about the performance of internal combustion engines.

Module I

Fluids and their properties: Fluids, shear stress in a moving fluid, viscosity, Newtonian and non-Newtonian fluids, viscosity. Fluid statics - pressure, variation of pressure in a static fluid, absolute and gauge pressure, measurement of gauge pressure.

Kinematics of fluid flow: Eulerian and Langragain approaches, classification of fluid flows, Path line, stream line, streak line, velocity and accelerations in steady and unsteady flows, Ideal fluids, equations of continuity in the differential form, rotational and irrotational flow, Stream function, Velocity potential, one dimensional flow along a stream line, Bernoulli's equation and its limitations, venturi meter, orifice meter, notches, Laminar flow in circular pipes, Darcy- Weisbach equation, friction factor, minor losses in pipes.

Module II

Dynamic action of fluid: Momentum equation applied to a control volume, impact of jets, flow of an incompressible fluid over fixed and moving vanes, work done and efficiency.

Hydraulic turbines: velocity triangles, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine, constructional features and performance characteristics, non-dimensional parameters for comparative study of turbine performance, theory of draft tubes, speed regulation of turbines, selection of type and speed of turbines.

Module III

Pumping machinery: general features of positive displacement and rotodynamic pumps, centrifugal pumps, classification, principle of working, velocity diagrams, losses in pumps, circulatory flow, multistage pumps, priming, cavitation and its significance.

Reciprocating pumps: Discharge through a reciprocating pump, Work done, Acceleration head, Effect of friction, Indicator diagram, Effect of acceleration and friction in suction and delivery pipes, Air vessels, efficiencies, pump characteristics.

Module IV

I C Engines: Spark Ignition and Compression Ignition engines, mean effective pressure, characteristic curves, Brake power, Indicated power, efficiencies, performance test, Morse test, Retardation test, Heat balance test, Governing of I C Engines.

Gas turbines: Classifications, Ideal gas turbine cycle, work output, efficiency, Effect of Compressor and Turbine efficiency, Optimum pressure ratio for maximum specific work output, Open cycle analysis, simple cycle with regeneration, inter cooling, reheating, Performance of gas turbines.

References:

1. Frank M. White, Fluid Mechanics, Tata Mc Graw Hill, 7th Ed., (2008).
2. Massey, Fluid Mechanics, English Language Book Society, (2006)
3. Kumar, K. L., Engineering fluid mechanics, Eurasia publishing house, 6th Ed., (1995).
4. Stepanoff, A. J., Centrifugal and axial flow pumps, John Wiley & Sons, (1958).
5. Shepherd, D. G., Principles of turbo machinery, Mac Millan publishing Co. Inc., (1957)
6. Som S. K., and Biswas G., Fluid Mechanics and Fluid Machines, Tata Mc Graw Hill, 2nd Ed., (2004).
7. Govinda Rao, N. S., Fluid flow mechanics, Tata Mc Graw Hill, (1983).
8. Agarwal, Fluid Mechanics & Machinery, Tata Mc Graw Hill, (2001).
9. Bansal, R. K., Fluid Mechanics & Hydraulic Machines, Laxmi Publications, (2005).
10. Rajput, R. K., Thermal Engineering, Laxmi Publications, (2010).
11. Ganesan, V., Fundamentals of I.C. engines, Tata Mc Graw Hill, (2000).
12. Ganesan, V., Gas Turbines, Tata Mc Graw Hill, (2003).

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1303 CIRCUITS AND NETWORKS

Course Objectives:

To impart knowledge of various fundamental techniques used for steady state and transient analysis of electrical networks .

Course Outcomes:

On successful completion of this course, the student will be able to

1. Understand various DC network theorems.
2. Analyze (transient and steady state) complex electric circuits (D.C and poly phase A.C) by applying basic circuit theorems.
3. Model two-port networks using network parameters.

Module I

Review of network theorem – steady state AC analysis-mesh and node analysis, mesh and node analysis by inspection, superposition theorem, reciprocity theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem.

Module II

Network topology – definition of graph,tree, incidence matrix, tie-set matrix, cut-set matrix, application of graph theoretic methods to formulation of network equation, current variable and voltage variable methods.

Coupled circuit – self and mutual inductance analysis of coupled coils, dot rule, conductively coupled equivalent circuits, coupling coefficient, linear transformer and ideal transformer.

Module III

Polyphase systems – balanced and unbalanced loads – unbalanced three wire and four wire star connected load, displacement neutral method, power measurement using wattmeter.

Circuit transients – direct current transients - RL, RC, RLC transients, alternating current transients – application of Laplace transform for transients analysis.

Module IV

Two port networks - characterization in terms of impedance, admittance, hybrid and transmission parameters – inter relationship among parameter sets – reciprocal and symmetrical two port networks – inter connection of two port network – I and II equivalent of a two port network – image impedance – characteristic impedance and propagation constant of a symmetrical two port network.

Text Books:

1. Van Valkenburg M.E: Network Analysis, Prentice Hall India, 1989
2. A Sudhakar, Shyammohan S Pally, "Circuits and Networks Analysis and synthesis", Tata McGraw Hill.
3. Joseph. A.Edminister, "Theory & problems of electric circuit", Schaum's outline series, Tata McGraw Hill.

References:

1. D. Roy Choudhury, "*Networks and Systems*", New Age International
2. C.P.Kuriakose ,"*Circuit Theory Continuous and Discrete-Time Systems*, Elements of Network Synthesis",PHI.
3. K. S. Suresh Kumar, *Electric Circuits and Networks*, 1st Ed, Pearson Education, 2009

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1304 ELECTRICAL MEASUREMENTS& MEASURING INSTRUMENTS

Course objectives:

To understand the working of instruments used for the measurement of different electrical and magnetic quantities.

Course outcomes:

On successful completion of this course, the student will be able to

1. Know the principle of measurements and different measuring instruments.
2. Understand the principle and operation of various wattmeter, energy meters, CT and PT
3. Familiarize the working of various potentiometers, instruments for measurement of R,L and C
4. Understand the different measurement techniques in illumination

Module I

General Principles of Measurements, Units-emu, esu & relationships, dimensions of electrical quantities, MKSA system –Concepts of absolute and working standards, Calibration of Meters, Qualities of Measurements - accuracy - precision - sensitivity - resolution -loading effects, Errors in Measurement and its Analysis- combination of component errors.

CRO - Theory and working –measurements using CRO - Types of CRO - Dual Beam CRO- Dual Trace Oscilloscope - Time base generator circuit.

Direct Deflecting Instruments. Principle, construction, operation, torque equation ,calibration and application of D'Arsonval Galvanometer. Moving Coil - Moving Iron, Dynamo Meter, Induction, Thermal, Electrostatic and Rectifier Type meters - Shunts and Multipliers- Various Types of Galvanometers. (principle, construction, operation, torque equation)

Concepts of digital measurement, multi function meters.

Module II

Measuremet of Power and energy : Concepts, connections , impedance features and errors due to connections in Wattmeters - Measurement of three phase power (active and reactive) – Two wattmeter method- Single and Three Phase Energy Meters (Induction Type) – Calibration- phantom loading.- Trivector Meter - Advanced techniques in power & energy measurement

Current transformer and potential transformer: Construction, theory operation, phasor diagram, characteristics – error elimination and its application.

Frequency Meters - Power Factor meters

Module III

DC Potentiometer – Crompton Potentiometer- Vernier Potentiometer- **A.C. Potentiometers** – Applications of AC Potentiometers.

Measurement of Resistance: Wheatstone bridge –problems with measurement of low & high resistance- Kelvin Double Bridge - Carey Foster Slide Wire Bridge - Bridge Current Limitations - Insulation Resistance, Earth Resistance, Earth Tester - Localization of Cable Fault by Murray and Varley Loop Test

Measurement of Inductance & Capacitance: AC bridges –Maxwell's bridge, Anderson bridge, Hay's bridge, Schering bridge, Wein bridge.

Module IV

Magnetic Measurements - Measurement of flux and permeability - Measurement using Hall effect sensors.

Illumination - Definition of solid angle, Candella, Luminous flux, Luminous intensity, illumination, luminance - Laws of illumination - Inverse square law and Lamberts Cosine Law - Measurement of Candle power - Photometric bench, Bunsen and Lummer Brodhun Photometer heads - Measurement of illumination Macbeth illuminometer - Distribution of Candle Power - Polar curve - Determination of mean spherical candle power by Rosseau's construction - Integrating spheres

Text/Reference Books:

1: Golding E.W *Electrical Measurements & Measuring Instruments*, 5e, Reem Publications,2009.
2: Cooper W.D, *Modern Electronics Instrumentation*, Prentice Hall of India, 1996.
3: Stout M.B, *Basic Electrical Measurements*, Prentice Hall, 1986.
4: Oliver, Cage, *Electronic Measurements & Instrumentation,* McGraw Hill, 1979.
5: Sawhney A. K., *Electrical and Electronic Measurements and Instrumentation*, Dhanpath Rai & Co.,2007

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b)---(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1305 ELECTRONIC DEVICES AND CIRCUITS

Course Objectives:

To understand basic knowledge on designing and setting up of electronic circuits like amplifiers, oscillators and wave shaping networks for customized applications.

Course Outcomes:

On successful completion of this course, the student will be

1. Understand the working of various electronic circuits using discrete components
2. Understand the operation and design of small signal amplifiers and power amplifiers
3. Familiarise the operation and design of sinusoidal and non sinusoidal oscillators
4. Design wave shaping circuits for specialised applications

Module I

Special semiconductor devices: Principles and operation of photodiodes, PIN diodes, phototransistors, LED, UJT, FET. MOSFET- Enhancement and depletion type NMOS, PMOS AND CMOS - basic principles and characteristics.
Dual power supplies - zener diodes and zener voltage regulator.
Pulse Circuits:-Different types Pulse circuits - pulse characteristics - Pulse shaping using RC circuits - Differentiating and integrating circuits –applications. Clipping and clamping circuits using diodes.

Module II

Small Signal amplifiers: Bipolar junction transistor – configurations, characteristics - current amplification factors - relations between alpha & beta – comparison.
BJT amplifiers: Biasing techniques of BJT- stabilization of operating point - h-parameters - CE RC coupled amplifier - concept of load lines- frequency response of RC coupled amplifier - frequency response of R C coupled amplifier - lower cut-off frequency - upper cut-off frequency - 3 db bandwidth.
FET Amplifiers: Principle of operation, characteristics, Common source amplifier- design, frequency response-applications

Module III

Power amplifier - classification - class A, B, AB and C power amplifiers-tuned amplifier- pushpull and complementary symmetry power amplifier –Harmonic distortion.
Feed-back amplifiers: concept of Negative and positive feedback – Bark Hausen criteria -low frequency sinusoidal oscillators
High frequency oscillators – types- LC, Crystal oscillators –circuit diagram-description-applications

Module IV

Transistor as a switch– simple sweep circuits-bootstrap sweep, Miller sweep
Multivibrators- astable, monostable and bistable circuits using BJTs-applications. UJT Relaxation oscillator, Schmit trigger.

References:

1. Boylestead, Neshelsky: *,"Electronic Devices & Circuit Theory",* PHI2003
2. Millman, Halkias, "*Electronic Devices & Circuits*", TMH, New Delhi.1996
3. Taub,Schilling, *Pulse, Digital and Switching ciruits,* TMH, New Delhi
4. Bapat Y N, "*Electronic Devices & Circuits*", Tata McGraw Hill, New Delhi.1995
5. Allan Mottorshed, " *Electronic Devices & Circuits",* PHI, New Delhi.
6. Schilling ,Belove "*Electronic Circuits, Discrete & Integrated",* TMH, New Delhi 1989
7. Theodore F.Bogart: "*Electronic Devices & Circuits"* Universal Book Stall, New Delhi 1992

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1306 -ELECTRICAL MACHINES I

Course Objectives:
To analyze the performance of DC machines and transformers

Course Outcomes:
On successful completion of this course, the student will be **able**

1. To understand the construction and principle of operation of DC machines,
2. To understand the effect of armature reaction and the process of commutation.
3. To understand the operation ,starters and speed control of DC motor ,
4. To understand the working principle of single phase and Three phase transformers, Equivalent circuit , regulation and parallel operation.

Module I
DC generators: Principle of DC generators, constructional details, field, armature and commutator or magnetic circuits, field flux distribution. Armature windings – pole pitch, coil span, winding pitch and commutator pitch. Simplex lap and wave windings, parallel paths, equalizer ring connections, dummy coils – methods of setting brushes in d.c machines. Methods of excitation – separately excited, shunt, series and compound machines. Induced e.m.f – e.m.f. equations. Armature m.m.f. – Magnitude and direction, armature reaction – air gap flux distribution under load conditions, effect of saturation, demagnetizing and cross-magnetizing armature m.m.f. – variation with brush position – compensating winding connections.

Module II
Commutator: Time of commutation, e.m.f. In the coil undergoing commutation, reactance e.m.f. – effect of brush shift, interpoles – polarity and winding connections. Type of d.c. generators – characteristics – open circuit characteristics, condition for self-excitation, critical resistance, critical speed. Load characteristics, effect of compounding. Parallel operation – parallel operation of shunt series and compound generations, equalizer connections.

Module III
DC Motors: Principles of operation, back e.m.f, production of torque, torque equation, developed and shaft torque, performance characteristics of shunt, series and compound motors, applications of various types of DC motors. Starting – need of the starter, face plate starters – three point and four point starters, calculation of resistance elements for shunt meter starter, Speed control – field control, armature control – Ward Leonard speed control. Testing of d.c. machines – losses and efficiency, separation of losses – Swinburne's test, Hopkinson's test, Fields Test, retardation test.

Module IV
Transformers: Single-phase transformer - constructional details – core, winding, insulation and brushing. Principles of operation, turns ratio, emf equation. Operation on load - magnetizing and core loss components – phasor diagram – equivalent circuit. Regulation – losses and efficiency.
Testing of transformers: OC test, SC test, Sumpner's back to back test, separation of losses, three phase connections – star and delta connections using single phase transformers. Three phase transformers – oscillating, neutral, tertiary winding, Scott connection –open delta connection – six phase connections. Parallel operation, load sharing, distribution transformers – all day efficiency, autotransformers - single phase.

References:

1) Clayton A.E.,Hancock N.N.- *Performance and Design of DC machines*,ELBS/CBS Publishers, Delhi, 1990
2) Theraja B.L.- *A text book of Electrical Technology Vol II*, S. Chand & Co.,New Delhi, 1992
3) Bhimbra P.S.- *Electrical Machinery*, Khanna Publishers, NewDelhi, 1992
4) M.G. Say- *Performance and Design of AC machines*, ELBS & Pitman, Third Edition, 1980**.**

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-13L1 ELECTRONIC CIRCUITS LAB

Course Objectives:
To understand the basics of designing setting up of amplifiers and oscillators.

Course Outcomes:
On successful completion of this course, the student will be able to
1. Familiarize various electronic devices and measuring instruments
2.To design and setup and analyse amplifier, oscillator and Multivibrator circuits.
3. Measurement of various parameters of semiconductor devices

List of Experiments:

1. Study of Multimeter, Signal generators, CRO etc. and measurement of electrical quantities
2. Testing of Passive and Active components - Resistors, Capacitors, inductors, Transformers, diodes, Transistors, etc.
3. Characteristics of Active devices
    1. Transistor characteristics CE Configuration
    2. Transistor characteristics CB Configuration
    3. UJT Characteristics
    4. FET Characteristics
4. Pulse circuits
    1. Clipping
    2. Clamping
    3. Integrator
    4. Differentiator
5. Amplifying Circuits
    1. RC Coupled Amplifier
    2. FET Amplifier
6. Oscillators
    1. RC Phase shift Oscillator,
    2. UJT Relaxation Oscillator
7. Sweep Generator
8. Multivibrators
    1. Astable Multivibrator
    2. Monostable Multivibrator

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners . A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

EE15-13L2 ELECTRICAL MEASUREMENTS LAB

Course objectives:

Students will gain knowledge in measurement of different electrical quantities, calibration of different electrical instruments and verify different circuit theorems

Course outcome:

After successful completion of the course students will be able to

1. Understand different types of measuring instruments
2. Verify different laws and theorems in electric circuits.
3. Measure power and energy in single phase and three phase circuits.
4. Calibrate various types of instruments using potentiometers.
5. Understand the resistance classification and measurements.
6. Understand the different types of instruments transformers.

List of Experiments

1. Study of PMMC & MI voltmeters and ammeters, dynamometer type wattmeter, clip on ammeter, standard symbols on the dials of the meters
2. Determination of the voltage-current characteristics of linear and nonlinear resistance.
3. Verification of Kirchoff's laws, Thevenin's theorem, superposition theorem etc.
4. RLC series parallel circuit – Measurement of current in various branches and verification by calculation – drawing Phasor diagram.
5. Single-phase power measurement using wattmeter
6. Measurement of power in three-phase circuits using
    a) Single wattmeter
    b) Two wattmeters
    c) Three phase wattmeter
7. Measurement of resistance using Wheatston's bridge
8. Measurement of resistance using Kelvin's double bridge
9. Measurement of insulation resistance using megger.
10. Measurement of self and mutual inductance of coupled coils
11. Calibration of ammeter using slide wire potentiometer
12. Calibration of Voltmeter using slide wire potentiometer
13. Measurement of internal resistance of battery using vernier potentiometer
14. Measurement of resistance of earth electrode using earth megger.
15. Calibration of single phase energy meter by direct and phantom loading
16. Calibration of single-phase energy meter at 0.5 & 0.866 p.f. without using phase shifting transformer.
17. Calibration of 3-phase energy meter.
18. Extension of instrument range using CT and PT.

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners. A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

AS15- 1401 COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS
(Common to all branches)

Course Objectives:

To understand and use complex variables, function integrals, partial differential equation in engineering discipline.

Course Outcomes:

On completion of this course the student will be able to:
1. Transform a region to another region using conformal mapping
2. Evaluate real integrals using residue theorem
3. Form and solve partial differential equation
4. Determine solution of partial differential equation for vibrating string and heat conduction

Module I
Analytic function- Cauchy-Riemann equation (Cartesian and polar)-Harmonic function- construction of analytic function given real or imaginary parts- Conformal mapping of standard elementary function and bilinear transformation.

Module II
Cauchy's integral theorem, Cauchy's integral formula and for derivatives-Taylor's and Laurent's expansion (without proof) - Singularities-Residues-Cauchy's Residues theorem- Contour integration involving unit circle.

Module III
Formation of partial differential equation eliminating arbitrary constants and function—Solution of first order equation- four standard types- Lagrange's equation—Linear homogeneous partial differential equation with constant coefficient.

Module IV
One dimensional wave equation, Alembert's solution and one dimensional heat flow equation—solution by the method of separation of variables- application of Fourier series solution. Solution of Laplace's equation over a rectangular region by the method of separation of variables.

References:

1. Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.

Type of Questions for End Semester Examination
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

EE15-1402 CIRCUITS, SIGNALS & SYSTEMS

Course Objectives:

To impart the knowledge of waveform analysis and obtain frequency spectrum of continuous time signals, design and analyze passive filters and synthesis R-L and R-C networks

Course Outcomes:

After successful completion of the course students will be able to

1. Understand basic signals – Impulse, step, ramp, exponential and sinusoidal signals, operations of signals and properties of continuous time systems.
2. Understand one sided and two sided frequency spectrum of periodic signals using Fourier method of waveform analysis
3. Study classification of filters and fundamental techniques used in passive filter design.
4. Understand network functions, restrictions on pole and zero locations for driving–point functions, synthesis of L-C and R-C circuits using Foster and Cauer Forms.

Module I

Continuous time signals and systems – Basic signals – Impulse, step, ramp, exponential and sinusoidal signals, Basic operations on signals. Continuous time systems – Properties – Linearity, stability, causality, memory, inevitability, time invariance. Analysis of LTI system – Impulse response – Convolution, differential equation representation.

Module II

Fourier method of waveform analysis – frequency spectrum of periodic signals, trigonometric Fourier series, exponential Fourier series.

Fourier transform and inverse Fourier transform – properties of Fourier transforms, continuous amplitude and phase spectra.

Module III

Passive filters- Filter fundementals, Classification of Filters- Low pass, High pass, Band Pass & Band reject Filters, image parameters, characteristic impedance, design of filter networks - T and π sections of constant K low pass filter, constant K high pass filter, m-derived low pass filter, m-derived high pass filter, composite filters.

Module IV

Review of Network Functions - Network functions for one port and two port networks – Poles and Zeros of network functions – Restrictions on pole and zero locations for driving–point functions – Restrictions on pole and zero locations for transfer functions – Concept of stability

Elements of Realizability - Hurwitz polynomials – properties - Brune's positive real functions – Properties of positive real functions - Necessary and sufficient conditions for positive real functions – Sturm's test for positive real functions – Synthesis of L-C and R-C circuits using Foster and Cauer Forms.

Text Books:

1. Openheim , Wilsky, *Signals &Systems* , Pearson Education
2. Ramesh Babu,P ,*Signals and Systems*, SciTech Publications
3. Sudhakar, A ,Shyammohan Pillai, S.,*Circuits and Networks Analysis and synthesis*, Tata McGraw Hill.

References:

1. NagoorKani, A ,*Signals and Systems*, Tata McGraw-Hill.
2. Suresh Kumar.,K..S,2009, *Electric Circuits and Networks*, 1st Ed, Pearson Education
3. Roy Choudhury,D, *Networks and Systems*, New Age International.
4. David Cheng , K. , 1977, *Analysis of Linear System*s, Addison Wesley
5. Lathi, B.P, *Signal Processing and Linear Systems*, Oxford University Press.

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a),(b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b)---(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1403- ELECTRICAL MACHINES II

Course Objectives:

To analyze the performance of synchronous machine and induction machines.

Course outcomes:

After successful completion of the course students will be able

1. To understand the construction and principle of operation of synchronous machines and to evaluate the voltage regulation
2. To analyze the parellel operation of alternators and the performance of synchronous motors
3. To understand the performance of three phase induction motor and starting of three phase induction motors.
4. To understand the performance of Induction generator , Synchronous induction motor and Single phase induction motor

Module I

Alternators- constructional features of high speed cylindrical rotor and low speed salient pole machines, synchronous speed. AC windings - different types (detailed drawing not required) emf equation- distribution factor- coil span factor- – harmonics in induced emf - remedial measures - revolving magnetic field.

Theory of cylindrical rotor machines- armature reaction- synchronous impedance- voltage regulation-determination of regulation by mmf, emf and Potier methods- Principles of operation of automatic voltage regulators - determination of Xd, Xq by slip test.

Module II

Parallel operation of alternators - performance of two machines in parallel-synchronising power - effect of speed regulation on load sharing -methods of synchronizing- synchroscope -synchronous machines on infinite bus bars-

Power angle diagrams -power flow equation for cylindrical and salient pole machines-reluctance power-maximum power transfer-stability limit-control of active and reactive power in synchronous machines on infinite bus bars.

Synchronous motor-torque and power relationship-phasor diagram starting of synchronous motors-losses and efficiency calculations-V curves-synchronous condenser-load angle

Symmetrical short circuits (only qualitative analysis) - steady state, transient and subtransient reactance - time constants- Hunting in synchronous machines- natural frequency of oscillations - damper windings.

Module III

Three phase induction motor - constructional details - slip ring and squirrel cage types- Theory of the induction machine with constant mutual flux - slip phasor diagram - mechanical power and developed torque - Torque slip curves - variation and starting torque with rotor resistance- pull out torque - losses and efficiency - approximate and exact equivalent circuits - circle diagram - No load and blocked rotor tests - performance calculations from the equivalent circuit.

Starting - starting squirrel cage motors- direct on-line starting auto transformer and star - delta starter - starting current and torque - starting of slip ring motors - design of rotor rheostat.

Module IV

Effects of harmonics - Harmonic induction and harmonic synchronous torques - cogging, crawling and noise production - methods of elimination - special rotor construction - Deep bar, equivalent circuits and torque curves of double cage motors.

Methods of speed control - pole changing methods - rotor rheostatic control, principle of speed regulation and improvement of power factor by rotor injected emf.

Induction generator Theory - phasor diagram - circle diagram - equivalent circuit - applications.

Synchronous induction motor- construction - rotor winding connections - circle diagram - pulling into step.

Single phase induction motor - revolving field theory equivalent circuit - torque slip curve- starting methods - split phase, capacitor start, capacitor run motors shaded pole motor - repulsion start and repulsion induction motor.

Text Book:

1. Nagrath , I.J. , Kothari, D.P. *Theory of AC machines,* Tata McGraw Hill
2. Bimbra , P.S,*Electrical Machinery,* Khanna Publications

References:

1) Say, M.G, *Performance and design of AC Machines,* ELBS, Pitman
2) Langsdorf , A.S, *Theory of AC machines,* Tata McGraw Hill
3) Gupta B.R , Vandana Singhal *,1990, Fundamentals of Electrical Machines,* New Age International

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1404 ELECTRICAL ENGINEERING MATERIALS

Course Objectives:

To get exposed to different classes of electrical engineering materials and to learn about their properties and behavior.

Course Outcomes:

After successful completion of the course students will be able

1. To understand the theory of electrical conduction in conductors and semiconductors and to learn about the basic properties of magnetic materials.
2. To learn about dielectric polarization and its characteristics.
3. To get basic understanding about material used for solar power.
4. To learn about techniques for material studies.

Module I

Conducting materials: Review of metallic conduction on the basis of free electron theory- Fermi-Dirac distribution – variation of conductivity with temperature and composition, Materials for electric resistances- general electric properties: brushes of electrical machines, lamp filaments, fuses and solder.

Semiconductors: Compound semiconductors – basic ideas of amorphous and organic semiconductor – preparation of semiconductor materials – zone-refining technique – fabrication of p-n-p junction.

Magnetic materials: Classification of magnetic materials – origin of permanent magnetic dipoles – ferromagnetism - hysterisis curve – hard and soft magnetic materials – magnetic material used in electrical machines, instruments and relays.

Module II

Dielectrics: dielectric polarization under static fields – electronic, ionic and dipolar polarizations – behavior of dielectrics in alternating fields – mechanism of breakdown in gases, liquids and solids - factors influencing dielectric strength – capacitor materials Insulating materials – complex dielectric constant – dipolar relaxation dielectric loss insulator materials used – inorganic materials (mica, glass, porcelain, asbestos) – organic materials (paper, rubber, cotton silk, fibre, wood, plastics, bakelite)- resins and varnishes – liquid insulators (transformer oil) – gaseous insulators (air, SF6, and hydrogen) – ageing of insulators.

Module III

Solar energy and Materials: Solar radiation, spectrum, UV, VIS, IR Solar constant, optical response of materials, optical band gap. Photo thermal conversion – use of coatings for enhanced solar thermal energy collection – Solar selective coatings – Cold mirror coatings – Heat mirror coatings – Anti reflection coatings. Photovoltaic conversion – Solar cells – cell efficiency, characteristics, equivalent circuit–Silicon , Cadmium sulphide and Gallium arsenide. Planner PN Junction. I-V curve of dark and illuminated junction. Solar cell parameters.

Module IV

Modern techniques for Material Studies: optical microscopy – electron microscopy – photoelectron spectroscopy – atomic absorption spectroscopy – magnetic resonance – nuclear magnetic resonance – electron spin resonance – ferromagnetic resonance.

Textbooks:

1. Indulkar , C.S. Thirivengadam , S *An Introduction to Electrical Engineering Materials, S Chand Co, 1998.*
2. A.J Dekker *Electrical Engineering Materials, Prentice Hall of India*.
3. Arumugam , M *Materials Science, Anuradha Publishers, 1990.*

References:

1. Yu Koristky *, 1970,Electrical Engineering Materials, MIR*
2. Meinal A.B , Meinal M.P- *Applied Solar Energy An Introduction,* Addition Wesley Publications.
3. Kapoor P.L Electrical *Engineering Materials,* Khanna Publications.
4. Tiwari, G. N. , *Solar Energy,* Narosa Publication
5. Agnihotri O.P , Gupta B. K*., Solar Selective Surfaces,* John Wiley

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1405 DIGITAL ELECTRONICS

Course Objectives:

To design digital electronic circuits for different practical applications

Course Outcomes:

After successful completion of the course students will be able to

1. Provide an overview of different types of number systems and codes.
2. Discuss the fundamental postulates of Boolean algebra, its basic theorems & properties.
3. Designing of various types of registers and counters using latches and flip-flops.
4. Able to understand different types of memories and logic families like TTL, CMOS, ECL and its characteristics.

Module I

Number System and binary codes: Binary, Octal and Hexadecimal number systems – binary arithmetic, binary codes, excess-3 code, Gray code error detection and correction – Boolean algebra – minimisation of Boolean functions using Karnaugh map and Quine-Mclusky methods – formation of switching functions from word statements, realisation using NAND, NOR & XOR gates.

Module II

Combinational circuits – multiplexer, demultiplexer, decoder, encoder.

Arithmetic circuits: Half adder, full adder, subtractor, serial and parallel addition – carry look ahead adder – binary multiplication – multivibrators – monostable, astable and bistable multivibrators using discrete gates.

Module III

Sequential circuits: flip-flops – RS, JK, T & D flip-flops, shift registers – counters – design -asynchronous and synchronous counters, up-down counters, Modulo counter, ring counter, Johnson counter – sequence generators – analysis of sequential circuits – state table and diagrams

Memories – ROM, RAM, EPROM, EEPROM Programmable logic array, devices – basic ideas – PLD architecture – PAL and PLA – programmable examples with software tools.

Module IV

Logic families: Standard logic levels - Current and voltage parameters - fan in and fan out - Propagation delay, noise consideration. Basic idea of DCTL, RTL and DTL families. TTL family NAND gate working principle, need for totem pole configuration, TTL inverter characteristics, Open collector gate and tri- state logic gate. CMOS: characteristics of basic CMOS inverter - interfacing of CMOS to TTL and interfacing of TTL to CMOS, Merits and demerits of TTL family and CMOS family. ECL family OR-NOR gate working principle.

References:

1. Taub , Schilling, *Digital Integrated Electronics*

2. Anand Kumar, 2010, *Fundamentals of Digital Circuits*, , 2nd edition, PHI learning

3. Thomas Floyd, L., 2011, *Digital Fundamentals*, 10th edition Pearson

4. Jain , R.P ,2009*,Modern Digital Electronics*, 4th edition, Tata Mc Graw Hill

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1406 POWER ELECTRONICS

Course Objectives :

To design different power electronic converters for various applications including renewable energy.

Course Outcomes :

After successful completion of the course students will be able

1. To study and design different types of DC-DC converters ,.
2. To study switching characteristics various power semiconductor devices.
3. To study various triggering and commutation circuits of SCR
4. To design various inverter circuit topologies based on application and knowledge of PWM technique.
5. To study and analyze the working of different types of rectifier circuits using SCR.

Module I

Power Semiconductor Devices

Basic Structure, Static and dynamic characteristics of Power diodes, Power Transistors, IGBT, MOSFET

Thyristors – DIAC, TRIAC (principle of operation), Silicon Controlled Rectifier, -Structure- Characteristics- methods of turning on - gate triggering circuit R and RC, concept of linear firing angle control-cosine wave crossing control - methods of turning off - commutation schemes- device specifications and ratings -Thyristor protection – Series and parallel operation of SCR.

Module II

AC-DC converters

Phase controlled rectifiers using SCR

Performance measures of rectifiers: ripple factor, TUF, rectification efficiency, Distortion factor, Displacement factor, over all PF, THD.

Single Phase – Half wave rectifier with R, RL and RLE loads – Full wave half controlled and fully controlled converters with continuous and discontinuous currents –Detailed analysis Output voltage and waveforms - Input side harmonics and power factor - Effect of source inductance.

Three Phase - Half wave rectifier with R and RL loads - Full wave half controlled and fully controlled converters with continuous and discontinuous currents - Output voltage and waveforms. Effect of rectifiers on neutral current in 3 phase four wire systems

Module III

DC-AC converters

Inverters – Voltage Source Inverters - Single phase inverters – series, parallel and bridge inverters. Single Phase Pulse Width Modulated (PWM) inverters – Basic circuit and operation of single pulse, multiple pulse, unipolar & bipolar sinusoidal PWM. Single phase current source inverter. Three phase bridge inverters - 120 and 180 conduction mode.

AC Voltage controllers - single phase ac regulator with R and RL loads - sequence control of ac regulators **Cycloconverters** - basic principle of operation.

Module IV

DC-DC converters

Choppers - principle of operation - step-up and step-down choppers -Four quadrant operation of a chopper with motor load - voltage and current commutated chopper **Switching regulators** - Buck regulators - Boost regulators - Buck-boost regulators - Switched mode power supply -principle of operation and analysis.

UPS: functional block diagrams and features of on line, off line & line interactive UPS

Text/Reference Books:

1. Ned Mohan , *1995*,*Power Electronics.,* 2nd edition, John Wiley and Sons
2. Rashid *, 2004, Power Electronics, Circuits Devices and Applications*, 3rd edition, Pearson Education
3. Dubey, G.K. *, 1993,Thyristorised Power Controllers*, Wiley Eastern Ltd
4. Sen, . P.C, *Power Electronics*, Tata Mc Graw Hill
5. Singh, Khanchandani , *Power Electronics*, *2nd ed.*, Tata Mc Graw Hill

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-14L1 DIGITAL ELECTRONICS LAB

Course Objectives:

To design and setup digital electronics circuits for different practical applications.

Course Outcomes:

After successful completion of the course students will be able

1. To design and setup sequential and combinational circuits.
2. To design and setup synchronous/asynchronous counters and shift registers using D and J –K flipflops.
3. To design and setup astable and monostable multi- vibrators using TTL gates

List of experiments:

1. Half adder and full adder using NAND gates.
2. Code converters - Binary to Gray and gray to Binary using mode control
3. Binary addition and subtraction (a) 1's complement (b) 2's complement (using 7483)
4. BCD adder using 7483.
5. Study of MUX, DeMUX &Decoder Circuits and ICs
6. Set up R-S & JK flip flops using NAND Gates
7. Asynchronous and Synchronous UP / DOWN counter using JK Flip flops
8. Design and realization of sequence generators.
9. Study of shift registers and Implementation of Johnson and Ring counter using it.
10. Study of IC counters 7490, 7492, 7493 and 74192 or the CMOS equivalent.
11. Astable and monostable multi- vibrators using TTL gates.
12. Transfer characteristics and specifications of TTL gates

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners . A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

E15-14L2 ELECTRICAL MACHINES LAB I

Course Objectives:
To analyze the performance characteristics of DC machines and transformers.

Course Outcomes:
After successful completion of the course students will be able
1. Select range of apparatus based on the ratings of DC Machines and Transformers.
2. Determine equivalent circuit parameters of transformers
3. Evaluate the efficiency of the machine by analyzing test results

List of experiments
Plotting of the open circuit characteristics of the given d.c. shunt generator at rated speed. Pre-determination of o.c.c. at other speeds and critical resistances of various speeds. Finding the voltage built-up with a given field circuit resistance and the critical speed for a given field circuit resistance.
Load test on the given DC shunt generator and plotting external characteristics – Deduce the internal characteristics and armature reaction curve.
Brake test on DC shunt and series motor and plot the following characteristics:

Output Vs Efficiency
Output Vs Line current
Output Vs Speed
Speed Vs Torque
Line current Vs Torque

a) Study of 3 point and 4 point starters for DC shunt motor
b) Swinburne's test on DC shunt machine and pre-determination of armature current and percentage efficiency when the machine operates as a motor and as a generator delivering ¼, ½, ¾, full and 5/4th rated output.

Hopkinson's Test on a pair of DC Machines and pre-determining of the efficiency of the machine working as motor and as a generator under various conditions of load on the generator.
Separation of losses in a d.c. machine by conducting a retardation test and determination of the moment of inertia of the rotating system.
Separation of losses in d.c. shunt machine by conducting no load test at different excitations and plotting the variations of these losses at various speeds.

Transformers

a) Polarity test on single phase transformers.
b) Connect three single phase transformers to form a 3 phase transformer with YY and DYI connection. Perform the load test, under balanced upf conditions – Plot the efficiency Vs output and % regulation Vs output characteristics.

O.C and S.C test on the single phase transformer and Pre-determination of the following:
Efficiency at various loads and power factors.
Regulation at various loads and lagging and leading power factors.
Equivalent circuits referred to H.V and L.V sides.
Calculation of performance using equivalent circuit and given load connection to the equivalent circuit.
Upf load at which efficiency is maximum.
Separation of losses of single phase transformer into hysteresis and eddy current loss components at normal voltage and frequency.
Sumpner's test on a pair of identical single phase transformers and pre-determination of the efficiency and regulations at various loads and power factor.
Scott connection of the single phase transformers and the performance under various load conditions at Upf and plotting the efficiency curves with
Main transformer secondary alone loaded.
Teaser transformer secondary alone loaded.
Balanced loading.
Unbalanced loading.
Student shall present his/her fair record, notebook duly certified by the Head of the Department, to the examiners at the time of University practical examination.

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners . A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

AS15 - 1501 NUMERICAL AND STATISTICAL METHODS
(Common to all branches)

Course Objectives:
To understand the concept of probability, statistics and numerical methods which arise in engineering application.

Course Outcomes:
On completion of this course the student will be able to:

1. Solve algebraic and transcendental equations by numerical methods
2. Perform numerical differentiation and integration
3. Find the mean and variance of a probability distribution including the binomial distribution.
4. Use statistical tests in testing hypotheses on data

Module1
Numerical solution of algebraic and transcendental equation by - Regula-Falsi method, Newton Raphson's method. Gauss Seidal iteration method to solve a system of equations and convergence (without proof) Newton's forward and backward interpolation formula. Lagrange interpolation, Newton's divided difference and central differences.

Module2
Numerical differentiation at the tabulated points with forward, backward and central diffrences. Numerical integration with trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Taylor series method. Euler method, Modified Euler method, Runge–Kutta method of second and fourth order for solving 1st order ordinary differential equation.

Module3
Random variable (discrete and continuous) Expectation-mean and variance of probability distribution. Binomial, Poisson and Normal distribution and Fitting of this Distribution to the given data. Curve fitting-fitting of straight line, parabola, exponential.

Module4
Population and Sample-Sampling Distribution (of mean and variance) Testing of Hypothesis-level of significance, Z-test statistic, Chi square test for variance, for goodness of fit and F-test.

References:
Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.
Kandaswamy, P. Thilagavathy, K. and Gunavathy, K. (2007) *Numerical methods*. S Chand &Co, New delhi.
Richard A. Johnson. Irvin Miller and John E. Freund. (2010). *Probability and statistics for engineers*. (eighth edition). Pearson, New Delhi.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

EE1502 LINEAR INTEGRATED CIRCUITS

Course Objectives:
To understand and familiarize various ICs and their applications.

Expected Outcomes:
After successful completion of the course students will be able

1. Get basic knowledge of OP-APMS
2. To develop practical skills required to work with opamps & more complex linear integrated circuits.
3. Know the underlying principles of different op amps circuits, various ICs like 723 regulator etc..
4. Acquire the capability to build a number of applications based on ICs like 555 timer, 566 VCO, 565 PLL etc.

Module I
Integrated Circuits- Introduction to operational amplifiers – basic differential amplifier – dual input balanced output and unbalanced output – Internal block schematic of op amp - Biasing used in IC – Constant current source - current mirror Circuits – Op – amp parameters – ideal op amp – transfer curve – equivalent circuit –internal circuit analysis of a typical op – amp- frequency response frequency compensation. Slew rate and its effect, typical data sheet 741.

Module II
Input bias current – off set – drift – compensating networks CMRR,SVRR, finite gain bandwidth and its effect in Op-amp circuits performance Open loop configurations Op amp in closed loop configuration : Different feed back configurations – voltage follower – V/I converters, I/V converters and its applications – Differential amplifiers with one op amp and 3 op amps. Instrumentation amplifier IC-AD620- and its application.

Module III
Op amp applications – Summer – Sub tractor –Log amplifier –Antilog amplifier _ Integrator and differentiator Comparators : zero crossing – using voltage references – regenerative (Schmitt trigger) comparators : window detector application – Op-amp as comparators – precision comparator 311 - Astable and monostable multivibrators – Triangular and tooth wave generators – RC phase shift and Wien bridge oscillators – Sample and hold circuit –LF198- peak detector circuit. Precision rectifiers. Voltage regulators – 723 (block diagram, typical low voltage regulator circuit). 78XX, 79XX, 371.

Module IV
Specialized ICs and applications: 555 timers – Functional block diagram – A stable multi vibrator , mono stable , multi vibrator and its applications – Voltage to Frequency converter – Automobile tachometer : 566 VCO chip 565 PLL: - PLL applications . ADC and DAC – performance specification – weighted, R – 2R ; successive approximation , flash, integrating ,Filters: Transfer functions – LPF,HPF,BPF,BRF Approximation methods Butter worth – Chebyshev – Active Filters – I order filters, Quality factor Design – Universal Active Filters – All Pass filters.Introduction to Switched Capacitive Filters.

References:
1. Coughlin R.F., *Op amps and Linear Integrated circuits* :– Pearson Education /PHI
2. Sargio Franko, *Design with operational Amplifiers Analog Ics*:– 2nd Edition McGraw Hill
3. Roy Chaudary D., Shail B Jain Linear Integrated Circuits :
4. Botkar K.R, *Integrated circuits* :
5. Gray John, *Analog Integrated Circuits* : Wiely 2nd edition
6. Godse and Bakshi , *Analog Integrated Circuits*:

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1503 FIELD THEORY

Course Objectives:

To impart a basic knowledge in electrostatics, magneto statics, electromagnetic waves, its propagation, reflection and applications.

Course Outcomes:

After successful completion of the course students will be able to

1. Calculate the force, electric field intensity and capacitance of different charge distributions using the basic concepts of Coulombs law and Gauss' law.
2. Calculate the inductance of co-axial cables and overhead transmission lines making use of the boundary conditions for different media.
3. Write the wave equation for Electromagnetic waves and calculate different parameters of wave propagation.
4. Identify the nature of polarization of Electromagnetic wave.
5. Apply the basic knowledge of electromagnetic waves in real life situations such as wave propagation in transmission lines.

Module I

Overview of vector analysis – Co-ordinate systems – rectangular, cylindrical, spherical - transformations. Divergence theorem, Stokes theorem, Div, Grad, Curl.

Static Electric field: Coulomb's law, superposition, electric flux, electric field, electric scalar potential, dipole, method of images – Gauss law for electric flux, boundary conditions – capacitance of isolated sphere, concentric sphere, co-axial cylinder/cable two wire transmission line- energy stored in electric field / capacitor, energy density. Laplace equation, Poisson's equation, Uniqueness theorem.

Module II

Static magnetic field of steady electric currents – magnetic flux, Biot -Savart law, Ampere's law, Gauss law for magnetic flux –boundary conditions, magnetic vector potential, inductance of a coaxial cable, two wire transmission line, solenoid, toroid. Electromagnetic induction – Faraday's law, self & mutual inductance. Continuity equation – displacement current – Maxwell's equations integral & differential form.

Module III

Uniform plane waves –general solution –TEM waves – relation between electric and magnetic fields, phase and group velocity – plane waves in lossy medium, skin depth, propagation constants and intrinsic impedance – Harmonically varying field, Poyntings theorem-interpretation, application. Wave polarization – linear, elliptic and circular polarization, wave guides – rectangular - modes of propagation- cylindrical wave guides.

Module IV

Reflection of plane waves at boundaries – normal and oblique incidence – refraction – transmission – Snell's law – critical angle – Brewster angle – total internal reflection.

Transmission lines: - Uniform transmission line – VI solution- characteristic impedance – VSWR – impedance matching – quarter wave and half wave length transformer – stub matching – single and double – Smith chart – impedance matching using Smith Chart.

References:

1. Sadiku, M. N. O (2002), *Elements of Electromagnetics*, Addison Wesley
2. Premlet, B (2002), *Electromagnetic theory with applications*, Phasor Books
3. Hayt, W. H. (2001) - *Engineering Electromagnetics*, Mc Graw Hill
4. Nannapaneni Narayana Rao - *Elements of Engineering Electromagnetics* Prentice –Hall
5. Cheng D.K (2002) - *Electromagnetic Fields & Wave*, Addison Wesley .

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1504 MICROPROCESSOR AND MICROCONTROLLER BASED SYSTEMS

Course Objectives:-
To understand the architecture and programming of microprocessors and micro controllers

Course Outcome:
After successful completion of the course students will be able to
1. Get a clear understanding of the architecture of 8085 microprocessor.
2. Do programming and interfacing of 8085 microprocessor.
3.Do programming of 8051 and operation with different input output devices.
4. Do interfacing of 8051 with I/O devices for practical applications.

Module I
Basics of 8085 Microprocessor
Architecture- pin description-Features-Interrupt system-Stack and subroutine Memory Interfacing-Decoding techniques-Absolute and Partial decoding-System Design-Mapping techniques I/O mapped I/O-Memory mapped I/O-Serial Communication-Synchronous and Asynchronous communication, USART-DMA features

Module II
Programming with 8085
Basic instruction set-Addressing modes-Timing diagram-Assembly language programs- Delay routines
Peripheral Interfacing
8255-Programmable Peripheral Interface –Interfacing of Matrix Keyboard (4*4) and seven segment LED display.
8253-Programmable Interval Timer –Modes of operation-Functional Block diagram-Interfacing with 8085
8279-Programmable Keyboard & Display Controller –Functional block diagram –Interfacing with 8085

Module III
8051-Architecture -Internal Memory organization-Counters Timers-Serial data input and output –Addressing modes-Simple Programs with -External memory interfacing.

Module IV
Interfacing of 8051 with I/O devices- ADC0808, DAC0800, 16*2 alphanumeric LCD.
Introduction to Embedded systems – Characteristics -Application areas-examples (block diagram)-Real time systems-Application Specific Processors.

Reference:

1. Gaonker R.S. - Microprocessor Architecture, Programming and applications
2. Ghosh and Sridhar, 0000 to 8085 Microprocessors for Engineers and Scientists, Prentice-Hall India, 2nd edition
3. Kenneth Ayala, The 8051 Microcontroller ,West Publishing Company.
4 .Muhammed Ali Mazidi :The 8051 Microcontrollers & Embedded Systems, Pearson Education
5. A.Nagoor Kani,:Microprocessors,architecture and programming,RBA Publications
6. Douglas V Hall : Microprocessors and Interfacing, , Tata Mc Gram Hill
7. R. S. Kaler: A Textbook of Microprocessors and Microcontrollers
8. V Udayashankara M S Mallikarjunaswamy 8051 Microconroller : Hardware, Software and Applications

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1505 ELECTRICAL DRAWING

Course Objectives:
To acquire a clear understanding of different DC & AC windings of Machines, generating stations and sub stations

Course Outcomes:
After successful completion of the course students will be able

1. Design armature windings of dc machines
2. Identify the different parts of AC machines
3. Design different types of windings of ac machines
4. Draw a single line layout for substations and generating stations and also to understand double circuit and single circuit transmission towers

Module I
D.C Armature windings- Simplex lap and wave windings.
Sectional front and side elevation of the armature with commutator.
Sectional front and side elevation of the yoke and pole assembly with field winding.
Sectional front and side elevation of an assembled dc machine.

Module II
Transformers
Sectional plan and elevation of core type and shell type single-phase transformer.
Sectional plan and elevation of a three-phase transformer.
Induction Motors
Sectional front and side elevation of slip ring and squirrel cage induction motor.
Alternators
Sectional front and side elevation of salient pole and turbo alternators.

Module III
Three-phase AC windings
Single layer windings- Mush windings and concentric windings.
Double layer lap windings- Full pitched, short pitched and fractional slot windings.
Double layer lap windings.

Module IV
Single line layout of substations.
Single line layout of generating stations.
Single circuit and double circuit transmission towers.

Reference:

1. *Narang K.L . A text book of Electrical Engineering Drawing. Tech India Publication.*
2. *S.K Battacharya . Electrical Engineering Drawing.*
3. *A.K Sawhney . Electrical Machine Design, Dhanapath Rai, New Delhi.*

Type for questions for University Exams
Two questions of 15 marks each from all the four modules. Answer one question from each module. (4x15 = 60 marks)

EE15-1506 POWER SYSTEMS I

Course objectives:
To acquire a clear understanding about different power generation, transmission and distribution systems.

Course outcomes:
After successful completion of the course students will be able

1. Familiarize the different power generation schemes and also different types of tariffs.
2. Learn the different components of power transmission systems.
3. Design power distribution systems.
4. Calculate power flow in transmission lines.

Module I
Conventional sources of electrical energy- thermal, hydroelectric, diesel and nuclear power plants-introduction to renewable energy sources- power plant economics –operating coasts- load factor- demand factor- diversity factor- plant factor. Types of tariffs, power factor improvement.

Module II
Overhead transmission systems- arrangement of conductors- sag and tension- transmission line supports and their location, economic span- choice of transmission voltage- line insulators- string efficiency- impulse ratio- arcing horns and rings- failure of insulation- corona- underground cables- different types- capacitance of single core and three core cables- grading of cables.

Module III
Distribution systems- classification and arrangement of distribution systems- distribution substation layout and arrangement- economic loading of distribution transformers- design of feeders. Kelvin's Law- considerations in primary and secondary distribution system design- current distribution and voltage drop in single-phase and three-phase four-wire distribution systems- voltage drop calculation and design of distributors in ring system- improvement of existing distribution systems- LT capacitor installation- size and connection- Rising mains- Equipment earthling- Electric energy management. Power quality.

Module IV
Performance of transmission lines- calculation of transmission line inductance and capacitance- GMD and GMR- bundled conductors- transposition- short, medium & long transmission lines-equivalent circuit representation-ABCD constants- effect of capacitance- nominal T and π methods of calculations- power flow through a transmission line. Methods of voltage control.

Reference:
1. Soni, Gupta, Bhatnagar - A course in Electric Power, Dhanapat Rai & Sons New Delhi, 1996.
2. A.T Star, - Generation, Transmission & Utilization of Electric Power, Sir. Issac Pitman and Sons, 1961.
3. Turan, Goren - Electric Power Transmission System Engineering, John Wiley,1988.
4. S.L Uppal - Electric Power, Khanna Publishers, 1992.
5. A.S Pabla - Electric Power Distribution System, Tata McGraw Hill, 1992.
6. M N Bandyopadhyay, "Electrical Power Systems- Theory and Practice", Prentice Hall of India, 2006.
7. Weedy B M, Cory B J, "Electric Power Systems", John Wiley Publication, 4 ed., 1998.

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-15L1 ELECTRICAL MACHINES LAB II

Course Objectives:-
To Understand the performance characteristics of induction motors and synchronous machines

Course outcomes:
On completion of this course the student will be able to**:**

1. Determine the performance of three phase induction motor and single phase induction motor by load test
2. Determine the voltage regulation by direct loading and indirect loading of 3-phase alternator
3. Analyse the performance of 3-phase, single phase induction motor and 3-phase alternator
4. Perform synchronizing of alternator to mains

.

Synchronous Machines
Regulation of alternator by direct loading
Regulation of alternator by emf and mmf methods.
Regulation of alternator by potier method
Slip test and regulation of salient pole alternator using two - reaction theory
Synchronizing of alternator to mains by dark lamp & bright lamp method and control of reactive power.

Induction machines
Variation of starting torque with rotor resistance in slip ring induction motor.
Direct load test on induction motor.
Pre determination of Characteristic and equivalent circuit of induction motor from no load and blocked rotor test.
Synchronous induction motor V- curves, pre determination of field current.
Pre determination of characteristic of pole changing motor
Test on Induction generator. Determination of rotor hysterisis.

Special experiments
V/f control of induction motor.
Characteristic of single-phase induction motor.
Complete torque slip characteristic of induction motor.
Characteristic of double cage induction motor.
Slip power recovery schemes:
Cascade operation of induction motor. Determination of slip and load shared by each motor and overall efficiency of the test.
Methods using converter/inverter operations
From the above list, maximum number of experiments may be conducted subject to facility available.

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners. A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

EE15-15L2 MICROPROCESSOR & MICROCONTROLLER LAB

Course Objectives:
To acquire knowledge in programming and interfacing of microprocessors and microcontrollers
Course outcomes:

On completion of this course the student will be able to**:**

1. Program microprocessor /microcontroller to perform various operations.
2. Interface input output devices to perform specific operations.
3. Design and setup microcontroller/microprocessor based system for various applications

Part A

1) Study of a typical microprocessor trainer kit and its operation

a) Programming examples using 8085 instruction set. To understand the use of various instructions and addressing modes.
b) Interfacing and programming of 8255 (eg: traffic light control)
c) Interfacing and programming of 8253/8254 (Stop watch , Real Time Clock etc.)
d) Interfacing and programming of 8279.

Part B

8051 Microcontroller

a) Basic arithmetic operations
b) Interfacing with ADC0808 and DAC0800
c) Interfacing with Stepper motor
d) Interfacing with Multidigit LED Display
e) Interfacing with 16*2 LCD Display
f) Programming of different types of EPROM 2716, 2732, etc.

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners. A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

EE15-1601 ELECTRONIC COMMUNICATION

Course Objectives:
On successful completion of this course, the student will be able to interpret various modulation techniques and understand the transmitter and receiver components of analog and digital communication systems.

Course Outcomes:
On completion of this course the student will be able

1. To understand the fundamentals of radiation and propagation of electromagnetic waves
2. To understand the basics of analog communication systems.
3. To understands fundamentals of sampling techniques and multiplexing
4. To understand the essentials of wireless communication and fibre optic communication system

Module 1
Radiation and Propagation of Waves: - (analysis not required) - Electromagnetic Radiation- Waves in free space- polarization - reception- effects of Environment- Propagation of waves:- Ground waves- Sky-wave propagation - space waves- antennas- Basic consideration - wire radiator in space - common terms and definitions- Effects of ground on Antennas- Directional High frequency Antennas - UHF Micro wave antennas - Wide band and special purpose antennas.

Module II
Amplitude modulation – principles – visual concepts, modulation factor and percentage of modulation, mathematical relationship, component phasors, frequency spectrum, band selection. Amplitude modulators – ISB modulators – VSB modulation. AM transmitters – low level, high level – SSB systems – comparisons,
SSB generation –SSB transmitters -filter method, phase shift method, third method. AM receivers – TRF receivers, Super heterodyne receiver, Double Super heterodyne receiver – SSB receiver
Angle Modulation- principles, waveforms, frequency deviation, frequency analysis, bandwidth requirement, phasor representation–pre-emphasis, de-emphasis. FM modulators – direct, indirect, Phase modulators – direct. FM transmitters – direct FM, indirect FM; FM receivers-block diagram– demodulators
Comparison of AM, FM & PM

Module III
Sampling Process: Sampling theorem, Interpolation Formula, Quadrature sampling of band pass signals, Reconstruction of a message process from its samples, signal distortion in sampling, practical aspects. PAM, PPM, PWM, Multiplexing-TDM, FDM. Frequency domain analysis
Waveform Coding Techniques: PCM, Quantization Noise & Signal to noise ratio, effect of sampling on quantization noise, uniform and nonuniform quantization companding- A Law and μ Law characteristics DPCM, Delta Modulation.

Module 1V
Multiple access techniques for Wireless Commuications – FDMA,TDMA and CDMA – Wireless systems and standards – AMPS – Global System for Mobile(GSM) – CDMA – General Packet Radio Service – DECT System .
Fiber optic communication: light wave communication systems- Fiber optic cable - optical transmitter and receiver.
Satellite Communication – Orbit of communication satellite – Satellite Constellation – Orbital parameters – Orbital perturbations – Geostationary orbits – Low Earth and Medium Orbits – Look Angles – Frequency selection RF Links – Propagation characteristics – Modulation methods- coding – multiple access

References:

1. Electronic Communication Systems : Kennedy & Davis - Fourth Edition-TMH
2. Communication Electronics : Frenzel, McGraw Hill, International Editions.
3. Simon Haykin, *Communication Systems*, Wiley India, 4/e, 2010
4. George Kennedy, *Electronic communication systems*, McGraw Hill ,4th ed.
5. *Wayne Tomasi, Electronic Communications Systems (Fundamentals through Advanced), Pearson Education 5th Ed.*
6. *Taub & Schilling, Principles of Communication Systems, Tata McGraw Hill, 1991*

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
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Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1602 DIGITAL SIGNAL PROCESSING

Course Objectives:
To impart the knowledge of fundamentals of Digital signal processing, Discrete Fourier Transforms and FFT algorithms, the knowledge of DSP Architecture and its features.

Course Outcomes:
On completion of this course the student will be able to**:**

1) Understand the concept of discrete time signals and properties of systems in Z- domain
2) Understand DTFT, DFT and FFT
3) Design and realize both FIR and IIR digital filters. analyze stability, frequency response and phase relations
4) Understand general DSP architecture and applications of DSP

Module 1
Discrete time signals and systems – Sampling theorem, Nyquist rate-aliasing, impulse, step,exponential and sinusoidal signals. Discrete time systems: Properties- Linearity, stability, causality, memory, invertibility, time invariants. Representation of systems- Impulse response – Difference equation representation. Z Transform: Properties, analysis of LTI system using Z transform, inverse Z transform, system function.

Module 2
Frequency domain representation of discrete time signals. Discrete Time Fourier Transform (DTFT) properties, Discrete Fourier Transform (DFT) properties& Fast Fourier Transform (radix 2 FFT) Decimation in Time &Decimation in Frequency algorithms, overlap save and overlap add methods.

Module 3
FIR digital Filters: Frequency Response of DT LTI system - Transfer function. Generalized Difference equation representation. Concept of windowing(Rectangular, Bartlett, Hamming, Hanning). Non Recursive realization structures-direct (Tapped delay line structure) –cascade realization- Liner phase realization.
IIR Digital Filters: - Transfer function. Difference equation representation. Analog filter approximations – Butterworth &Chebychev; Transformation techniques – Impulse invariant and Bilinear; Recursive Realizations Direct form I, Direct form II –Cascade Realization-Parallel realization – Comparison of IIR & FIR filters in terms of computational complexity, memory requirement, hardware complexity, stability.

Module 4
Finite word length effects in digital filters- fixed point arithmetic -Floating point arithmetic - Truncation-Rounding - Quantization error in analog to digital conversion-Limit cycles. General DSP architecture- features – Comparison with general purpose microprocessor–Simplified Block diagram level treatment of TMS320C54X fixed point processor-Applications of DSP: Two sample method of phasor estimation, DFT of complex exponential/sinusoidal signals & its use in amplitude estimation, relation between DFT & fourier series coefficients of a signal & its use in spectral estimation.

Text Books:
1. Oppenheim & Ronald W Schafer: "Digital Signal Processing", Prentice Hall India
2. P. Ramesh Babu, “Digital Signal Processing”, SciTech Publications
3. John G Proakis& Dimitris G Manolakis : "Digital Signal Processing", PHI, New Delhi

References:
1. Cristi, Modern Digital Signal Processing, Nelson Engineering.
2. Ashok Ambardar, Analog and Digital Signal Processing, Brooks/Cole Publishing Company.
3. Steven W. Smith, “The Scientist and Engineer's Guide to Digital Signal Processing”
4. Sanjit K. Mithra," Digital Signal Processing", Tata Mc- Graw Hill

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
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Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1603 POWER SYSTEMS II

Course objective:

To impart good knowledge of different methods of load flow studies, various faults & stability in power system

Course outcome:

On completion of this course the student will be able to**:**

1. Find reactance diagram from single line diagram of any power system network.
2. Gain good knowledge of different methods of load flow studies, understand load dispatching problems with and without losses, load frequency control of single and multi-area systems and their transfer function model.
3. Determine the fault currents for symmetrical and unbalanced faults
4. Understand different types of stability in power system and their analysis.

Module I

Representation of power system – one line diagrams – impedance and reactance diagrams – per unit and percent quantities – primitive and interconnected networks and their performance equations – y-bus and z- bus matrices and their formulation – effect of off nominal transformer on y-bus – load flow studies – problem formulation – classification of buses – gauss-seidal method – Newton Raphson method and fast decoupled load flow method – line loss computation – voltage dependency consideration in load modelling.

Module II

Economic load dispatch – system constraints – economic dispatch of thermal plants neglecting line losses – optimum load dispatch including transmission line losses – optimal load flow solution – speed governing mechanism – speed governing of turbo generator – load sharing and governor characteristics – transfer function model – load frequency – control of single and multi area systems – static analysis – automatic voltage regulation.

Module III

Short circuit studies – faults on power systems – three phase to ground faults – SLGF – DLGF – LLF faults – sequence impedance and sequence network – symmetrical component methods of analysis of symmetrical and unsymmetrical faults at the terminals of an unloaded generator – fault analysis using z-bus phase shift in star – delta transformer banks – faults through impedance – short circuit capacity of a bus and circuit breaker rating.

Module IV

Power system stability studies – steady stage dynamic and transient stability – electrical stiffness – swing equation – inertia constant – equal area criterion applied to the case of a sudden change in mechanical power input – multi machine stability analysis using forward euler method – basic assumptions and algorithms – factors affecting stability – voltage stability problem – causes and mitigation methods – introduction to HVDC and flexible ac transmission (FACTS) systems.

References:

1. Stevenson W.D *Elements of Power System Analysis* (Tata McGraw Hill).
2. I.J Nagrath & D.P Kothari *Modern Power System Analysis*, (Tata McGraw Hill).
3. S.L.Uppal - *Electrical Powe*r (Khanna Publication).
4. S.S Rao - *Switch gear & Protection* (Khanna Publication)
5. Soni, Guptha, Bhatnagar - *A course in Electric Power* (Dhanapat Rai & Sons).
6. John J. Grainger & W.D. Stevenson: Power System Analysis – Mc Graw Hill International 1994.
7. C.L. Wadhwa: Electrical Power Systems – New Age International Pub. Co.Third Edition, 2001.
8. Hadi Scadat: Power System Analysis – Tata Mc Graw Hill Pub. Co. 2002

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1604 ELECTRIC DRIVES

Course Objectives:

To impart knowledge about speed control techniques for various DC/AC drives for different specific applications.

Course Outcomes:

On completion of this course the student will be able to**:**

1) gain knowledge in open loop and closed loop control of drives
2) understand various speed control methods of different DC drives using power electronics
3) understand various speed control methods of different AC drives using power electronics
4) understand various Special Electric Machines.

Module I

Concept of Electric Drives –parts of electrical Drives – Dynamics of electric drive – torque equation –Four quadrant operation of electric drives– Loads with rotational and translational motion – Steady state stability- components of load torques – nature and classification of load torques –load equalization – control of electrical drives – closed loop speed control – current limit control – closed loop torque control –Phase Locked Loop control- Energy conservation of electrical drives

Module II

Dc motor drives – basic equations – constant torque and constant power control – single phase semi converter and single phase fully controlled converter drives - continuous and discontinuous operation - Three phase-semi converter and fully controlled converter drives. Dual converters– Four quadrant operation of drive using dual converter- Chopper fed dc drives- closed loop control scheme for control below and above base speed

Module III

Three phase induction motor drives - AC Voltage controlled drives - stator voltage control, stator frequency control.- variable frequency control -V /f control - Rotor chopper speed control - Space Vector Modulation - Slip Power recovery schemes- rotor frequency control -VSI fed induction motor drive- CSI controlled induction motor drives

Module IV

Synchronous motor drives –Cylindrical rotor motors - Salient pole motors - Reluctance motors - Permanent Magnet ac motor drives-sinusoidal PMAC-Brushless DC (Trapezoidal PMAC) motor drives – Switched reluctance motors-closed loop control of synchronous motors - Stepper motor control. Traction: Important features of traction drives-Conventional DC and AC traction drives – DC & AC traction using PWM VSI SCIM drives

Text/Reference Books:

1. Dubey G. K., Fundamentals of Electric Drives
2. M. H. Rashid, Power Electronics Circuits, Devices and Applications, Prentice Hall of India
3. Sen P. C., Thyristor DC Drives, Tata McGraw Hill
4. B. K. Bose, Modern Power Electronics and AC Drives, Pearson Education
5. R. Krishnan, Electric Motor Drives- Modelling, Analysis and control, Pearson education
6. M. D. Singh & K. B. Khanchandani, Power Electronics, McGraw Hill

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15- 1605 CONTROL SYSTEMS I

Course Objectives:

To impart knowledge about modelling of Electrical system, Mechanical systems and their analogy, response to standard inputs, various control system components, steady state error, concept of stability, time domain and frequency domain analysis of physical systems.

Course Outcomes:

On completion of this course the student will be able to**:**

1. model and represent electrical, mechanical, thermal and hydraulic systems .
2. represent physical systems by their current and voltage electrical analogous circuit, to understand characterstics and applications of servo motors, Synchros, DC and AC servomotor, Stepper motor and Tacho generator.
3. understand the response to standard test inputs analyze the systems in time domain and study the effects of additional pole and additional zero, static error constants and system type number.
4. do frequency domain analysis using various techniques viz. Bode, Polar and Nyquist plots and stability using Routh's Hurwitz criterion.

Module I

Systems Concepts and Modeling: Classification of systems, static dynamic, linear, non-linear, time varying, time invariant, distributed, lumped etc. Superposition principle, Modeling of electrical systems, dynamic equations using Kirchhoff's laws. Transfer functions - armature controlled and field controlled DC motor- block diagrams and signal flow graphs.

Module II

Modeling of non-electrical systems: Translational and rotational systems, force voltage and force-current analogy, thermal and hydraulic systems. Dynamic equations and transfer functions-comparison of different systems.
Control system components: Synchros, DC and AC servomotor, Stepper motor, Tacho generator.

Module III

Time domain analysis for linear systems: Response to standard inputs, impulse response-step ramp and acceleration inputs-time domain performance measures of second order system-under damped and over damped systems, effect of pole locations in s-plane, effects of additional pole and additional zero, static error constants and system type number.

Module IV

Frequency domain analysis, sinusoidal frequency response. Polar plots and logarithmic plots – Bode plots – Nyquist plots – absolute stability and relative stability from Bode and Nyquist plots. Routh's Hurwitz criterion.

Text Books:

1. K Ogata. - "*Modern Control Engineering*", Low Price Edition.
2. M.Gopal,"C*ontrol Systems Principles and Design*", Tata Mc Graw Hill.

References:

1. *A.Nagoor kani, "Control Systems", RBA Publication*
2. *S Palani "Control Systems Engineering", Tata Mc Graw Hill.*
3. *Joseph J. Distefano, III.Allen R. Stubberud, Ivan J. Wililams, "Schaum's Outline oJ Feedback and Control Systems", Tata McGraw Hill.*

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1606- E1 - ADVANCED MICROPROCESSORS

Course Objectives:
To impart knowledge about microprocessor/microcontroller based systems for advanced applications.

Course Outcomes:
On completion of this course the student will be able to**:**

1. study architecture of 8086 and 8088 processors
2. write assembly language program of 8086, Interfacing of 8255, DMA controller (8257) - programmable interrupt controller (8259)
3. understand 80386 and its details
4. study architecture of PIC microcontroller and write assembly language programs.

Module I
Intel 8086 Architecture_ Memory address space and data organization_ Segment registers and memory segmentation_ I/O address space- Addressing modes Comparison of 8086 and 8088. Basic 8086/8088 configuration, Minimum mode- Maximum mode

Module II
8086 assembly language programming _Addressing modes _instruction set _data transfer, arithmetic bit manipulation & string instructions_simple sequential & looping programs -Interfacing of 8255, – DMA controller (8257) – programmable interrupt controller (8259) .

Module III
Introduction to 80386 – memory management unit – descriptors, selectors, description tables and TSS – real and protected mode – memory paging – special features of the Pentium processor – branch prediction logic – super scalar architecture.

Module IV
PIC controllers: Introduction to microchip PIC family of microcontrollers and development tools. CPU architecture and instruction set, Harvard Architecture and Pipelining. Program memory considerations, Register file structure and addressing modes, CPU Registers, Instruction set.

References:
1. Microprocessors and interfacing Douglas V Hall, Tata Mcgraw Hill

2. Gaonkar Ramesh, Fundamentals of Microcontrollers and applications in embedded systems, Penram International publishing

3. Design with PIC Microcontrollers John B Peatman, Pearson Education Asia LPE

4. THe 8086/8088 Family John Uffenbeck, Pearson Media, LPE

5. Brey B.B. - The Intel Microprocessors – Architecture, Programming & Interfacing, Prentice Hall.

6. Liu Y.C & Gibsen G.A - Microcomputer System - The 8086/8088 family. Prentice Hall of India.

7. Ray A.K, & Bhurchandi K.W - Advanced Microprocessors and Peripherals, Tata McGraw Hill.

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1606 E2 - OPTIMIZATION TECHNIQUES & ALGORITHM

Course objectives:
To impart knowledge to apply optimization techniques & algorithms to solve engineering problems

Course Outcomes:
On completion of this course the student will be able to**:**

1. formulate and solve linear Programming Problems
2. determine the optimum solution to constrained and unconstrained problems
3. unconstrained n dimensional optimization techniques
4. constrained optimization Technique and apply dynamic programming principle to Linear programming problems

Module I
Linear programming: Formulation-Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems.

Module II
Unconstrained one dimensional optimization techniques: Necessary and sufficient conditions -Unrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation and direct root methods.

Module III
Unconstrained n dimensional optimization techniques**:** Direct search methods -Random search -pattern search and Rosen brooch's hill claiming method- Descent methods-Steepest descent, conjugate gradient, quasi -Newton method.

Module IV
Constrained optimization Techniques**:** Necessary and sufficient conditions -Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method.
Dynamic programming- principle of optimality- recursive equation approach-application to shortest route, cargo-loading, allocation and production schedule problems.

References :
1. Rao,S.S.,'Optimization : Theory and Application' Wiley Eastern Press, 2nd edition 1984
2. Taha,H.A., Operations Research -An Introduction,Prentice Hall of India,2003
3. Fox, R.L., 'Optimization methods for Engineering Design', Addition Welsey, 1971
4. A. Ravindran , K. M. Ragsdell , G. V. Reklaitis, Engineering Optimization Methods And , Wiley, 2008
5. Godfrey C. Onwubolu , B. V. Babu , New optimization techniques in engineering , Springer, 2004

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1606 E3 IMAGE PROCESSING

Course Objectives:
To impart the knowledge of representation of 2D images in digital format and image visual enhancement, restoration of degraded images and compression of images.

Course Outcomes:
On completion of this course the student will be able to**:**

1. Concept of fundamentals of image processing.
2. Enhance the visual quality of images using spatial and frequency domain filtering techniques.
3. Understand the principles of image restoration.
4. Able to understand algorithm commonly used to compress images like Lossless predictive coding, JPEG etc

Module I

Digital image fundamentals: representation - elements of visual perception - simple image formation model - Image sampling and quantization - basic relationships between pixels – imaging geometry.
Review of matrix theory results: Row and column ordering - Toeplitz, Circulant and Block matrices. Review of Image transforms: 2D-DFT, FFT, Walsh, Hadamard, Haar, DCT and Wavelet transforms.

Module II
Image enhancement: Spatial domain methods: point processing - intensity transformations, histogram processing, image subtraction, image averaging; Spatial filtering- smoothing filters, sharpening filters. Frequency domain methods: low pass filtering, high pass filtering, homomorphic filtering. Generation of spatial masks from frequency domain specifications.
Image segmentation: Detection of discontinuities - point, line and edge and combined detection , Edge linking and boundary description - local and global processing using Hough transform – Thresholding - Region oriented segmentation - basic formulation, region growing by pixel aggregation, region splitting and merging - Use of motion in segmentation. Fundamentals of Representation and Description.

Module III
Image restoration: Degradation model - Diagonalization of circulant and Block circulant matrices - Algebraic approaches - Inverse filtering - Wiener filter - Constrained Least squares restoration - Interactive restoration - Geometric transformations.
Fundamentals of Colour image processing: colour models - RGB, CMY, YIQ, HIS - Pseudo color image processing - intensity slicing, gray level to color transformation.

Module IV
Image compression: fundamentals- redundancy: coding, inter pixel, psycho visual, fidelity criteria, Models, Elements of information theory, Error free compression- variable length, bit plane, lossless predictive, Lossy compression- lossy predictive, transform coding. Fundamentals of JPEG, MPEG & Fractal image compression techniques.

References:

1. Gonzalez and Woods, *Digital Image Processing*, *Pearson Education/ Prentice-Hall India Ltd., 2nd ed.*
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson Education/ PHI Ltd, 2003.
3. Mark Nelson, Jean-Loup Gailly, The Data compression Book, BPB Publications, 2nd ed.
4. Pratt William K., Digital Image Processing, John Wiley & sons, 2nd ed.
5. Chanda & Majumdar, Digital Image Processing and Analysis, Prentice-Hall India Ltd, 2003.
6. M. Sonka, V. Hlavac, R. Boyle, Image Processing, Analysis and Machine Vision, Thomson Learning, 2006

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1606 E4 Advanced Power Electronics

Course Objectives :

To acquire knowledge on Multi Level Inverters/ Converters for various applications

Expected Outcomes:

On completion of this course the student will be able

1. To understand different types of Multi Level Inverter Topologies
2. To develop knowledge on Automatic Power Factor Control methods
3. To develop knowledge on Derived Converters
4. To develop knowledge on Zero Voltage and Zero Current Switching.

Module 1

Multi-Level Inverters - Diode Clamped Type and Flying Capacitor Type and suitable modulation strategies -Space Vector Modulation - Minimum ripple current PWM method. Multi-level inverters of Cascade Type.

Current Regulated Inverter -Current Regulated PWM Voltage Source Inverters . Methods of Current Control , Hysteresis Control . Variable Band Hysteresis Control ,Fixed Switching Frequency Current Control Methods.

Module 2

Switched Mode Rectifier - Operation of Single bilateral Bridges in Rectifier Mode . Control Principles . Control of the DC Side Voltage . Voltage Control Loop . The inner Current Control Loop. Single phase boost type APFC.

Module 3

Buck, Boost, Buck-Boost SMPS Topologies . Basic Operation- Waveforms - modes of operation – Output voltage ripple Push-Pull and Forward Converter Topologies - Basic Operation . Waveforms - Voltage Mode Control. Half and Full Bridge Converters . Basic Operation and Waveforms- Flyback Converter . discontinuous mode operation . waveforms . Control - Continuous Mode Operation . Waveforms

Module 4

Introduction to Resonant Converters . Classification of Resonant Converters . Basic Resonant Circuit Concepts . Load Resonant Converter . Resonant Switch Converter . Zero Voltage Switching Clamped Voltage Topologies . Resonant DC Link Inverters with Zero Voltage Switching . High Frequency Link Integral Half Cycle Converter.

References

1. Ned Mohan et.al "Power electronics : converters, applications, and design" John Wiley and Sons, 2006

2. Rashid "Power Electronics" Prentice Hall India 2007.

3. G.K.Dubey et.al "Thyristorised Power Controllers" Wiley Eastern Ltd., 2005, 06.

4. Dewan & Straughen "Power Semiconductor Circuits" John Wiley & Sons., 1975.

5. G.K. Dubey & C.R. Kasaravada "Power Electronics & Drives" Tata McGraw Hill., 1993.

6. IETE Press Book Power Electronics Tata McGraw Hill, 2003

7. B. K Bose "Modern Power Electronics and AC Drives" Pearson Education (Asia)., 2007

8. Abraham I Pressman "Switching Power Supply Design" McGraw Hill Publishing Company., 2001.

9. Daniel M Mitchell "DC-DC Switching Regulator Analysis" McGraw Hill Publishing Company.-1988

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1606 E5 MODERN COMMUNICATION ENGINEERING

Course objectives:
To get an overview about different communication systems

Course outcomes:
On completion of this course the student will be able to**:**

1. Understanding about microwave communication.
2. Basic knowledge about satellite communication systems.
3. Knowledge about multiple access techniques, mobile communication and fibre optic communication systems.
4. Understanding about basic concepts of radiation and propagation techniques

Module 1
Microwave Communication : Basic principles of microwave links- Microwave Relay Systems – Choice of frequency – line of sight and over the horizon systems – modulation methods – block schematics of terminal transmitters and receivers – microwave repeaters – microwave repeaters – microwave repeaters – microwave antennas – propagation mechanisms – propagation characteristics – path loss models – shadowing models – small scale fading and multipath fading – basic principles of design of microwave link

Module II
Satellite Communication – Orbit of communication satellite – Satellite Constellation – Orbital parameters – Orbital perturbations – Geostationary orbits – Low Earth and Medium Orbits – Look Angles – Frequency selection RF Links – Propagation characteristics – Modulation methods- coding – multiple access – space craft – antennas – transponders – intersatellite link – link power budget – earth station interference – Satellite systems – Geostationary systems – Distress and Safety systems – Navigation systems – direct sound broadcast systems – Direct Television broadcast systems

Module III
Wireless communication systems: Cellular concepts – Cell Splitting and Frequency Reuse - Propagation Mechanisms – Modulation techniques for wireless communication – Analog, Digital and Spread Spectrum modulation – Equalisation, Diversity and Channel coding Diversity Techniques – Multiple access techniques for Wireless Commuications – FDMA,TDMA and CDMA – Wireless systems and standards – AMPS – Global System for Mobile(GSM) – CDMA – General Packet Radio Service – DECT System .
Fiber optic communication: light wave communication systems- Fiber optic cable - optical transmitter and receiver.

Module 1V
Radiation and Propagation of Waves: - (analysis not required) - Electro magnetic Radiation- Waves in free space- polarization - reception- effects of Environment- Propagation of waves:- Ground waves- Sky-wave propagation - space waves- antennas- Basic consideration - wire radiator in space - common terms and definitions- Effects of ground on Antennas- Directional High frequency Antennas - UHF Micro wave antennas - Wide band and special purpose antennas.

References:
1) Dennis Roddy, John Coolen, 1999 ,*Electronic Communications* , Prentice Hall, India.
2) Kennedy & Davis , *Electronic Communication Systems Fourth Edition-TMH*
3) Frenzel *Communication Electronics* :, *McGraw Hill, International Editions*.
4) Frenzel MGH *Communication Electronics* :

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-16L1- LINEAR INTEGRATED CIRCUITS LAB

Course Objectives:
To understand designing and setting up of different filters, amplifiers and comparators using Op-amp

Expected Outcomes:
After successful completion of this course the student will be able

1. To design and setup different waveform generation and oscillator circuits using Op-amp
2. Able to design Op-amp based circuit for real time applications
3. To understand simulation in various software tools like PSpice/LTspice.

Experiments:

1. Study of Op-amps
2. OP-amp Inverter-scale changer-summer-integrator-differentiator-comparator and instrumentation amplifier
3. Design and setup of Low pass-High-pass and Band pass filters using Op-amps
4. Voltage regulation 723
5. PLL 565 - Lock range and capture range
6. Circuits using Op-amps for waveform generation
7. 555 Timer based Astable, Monostable Multivibrators and PWM circuits
8. Wien bridge oscillator
9. Triangular and square waveform generation
10. Precision rectifiers
11. Schmitt Trigger using Op-amps
12. Inverting and Non –Inverting amplifier based on 741-frequency response
13. Precision comparator and window detector using IC311
14. VCO 566
15. Simulation of some above experiments using PSpice/LTspice.

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners . A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

EE15-16L2 MINI PROJECT

Course Objectives:
To enable the student apply the theoretical knowledge gained to specificindustrial / research problems.

Course Outcomes:
On completion of this course the student will be able to
1. Work independently on a specific problem relevant to research or industry.
2. Develop team work skills to work in group

Each batch comprising of 3 to5 students shall design, develop and realize an electronic product. Basic elements of product design must be considered. Fully software/simulation projects are not allowed. Each student shall submit a project report at the end of the semester. The project report should contain the design and engineering documentation including the Bill of Materials and test results. Product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations and aesthetics / ergonomic aspects taken care of in the project shall be given due weight.

Guidelines for evaluation:

Attendance and Regularity	5
Work knowledge and Involvement	15
End-Semester presentation & Oral examination	10
Level of completion and demonstration of functionality/specifications	10
Project Report	10
Total	*50*

***Note**: External projects and R&D projects need not be encouraged at this level. Points (i) & (ii) to be evaluated by the project guide & co-ordinator and the rest by the final evaluation team comprising of 3 teachers including the project guide*

GE15-1701 PRINCIPLES OF MANAGEMENT

Course Objectives:
To identify and analyse problems by applying the principles of management

Course Outcomes:
On completion of the course, the student will be able:
1. To inculcate the ability of formulating, analyzing, and solving management problems through the application of scientific management.
2. To introduce the importance of Productivity and Project Management.
3. To get exposed to personnel, marketing and financial management.
4. To understand the principles of economics and IPR aspects.

Module I
Basic concept of Management: Introduction, definitions of managements, characteristics of management, levels of management, management skills, Scientific management - Contributions of Gilbreth and Gantt.
Functions of Management: Planning, forecasting, organizing, staffing, directing, motivating, controlling, co-coordinating, communicating, decision making.
Organization: Introduction, definition of organization, system approach applied to organization, necessity of organization, elements of organization, process of organization, principles of organization, formal and informal organization, organization structure, types of organization structure.
Forms of Business Organization: Concept of ownership organization, types of ownership, Individual ownership, partnership, joint stock company, private and limited company, co-operative organizations, state ownership, public corporation.

Module II
Productivity and Production: Measurement of productivity, productivity index productivity improvement procedure, Organization by product function.
Inventory control: Classification, Functions, inventory models, inventory costs, EOQ, Materials Requirement Planning – Objectives, Functions and methods.
Project Management: Functions, Characteristics and feasibility studies.

Module III
Personnel Management: Introduction, definition, objectives, characteristics, functions, principles and organization of personnel management, Recruitment and training methods.
Markets and Marketing: Introduction, the market, marketing information, market segmentation, consumer and industrial markets, pricing, sales, physical distribution, consumer behaviour and advertisement.
Financial Management: the basic concepts of financial accounts, inflation, profitability, budgets and controls, cost accounting, valuation of stock, allocation of overheads, standard costing, marginal costing, Break even point.

Module IV
Economics: Principles of economics, problem of scarcity, demand, supply, utility, time value of money, inflation and deflation, determination of price, Consumer Optimization, Consumer Response, Consumer Demand Curve.
IPR Aspects: General introduction to IPR, eligibility for patent, patent information and prior art search, procedure for filing patent application, rights of patent owner and duration, ownership of patent and commercialization, assignment, licensing and technology transfer, designs and Utility models.

References:

1. Fraidoon Mazda, Engineering Management, Addison-Wesley, (1997).
2. Koontz and O'Donnell, Essentials of Management, Mc Graw Hill, (1978).
3. Kotler P., Marketing Management, Prentice Hall, (2011).
4. Prasanna Chandra, Finance Management, Tata Mc Graw Hill, (2008).
5. Monks, J. G., Operations Management, Mc Graw Hill, (1982).
6. Cornish W. R., & Llewellyn, Intellectual Property, Sweet & Maxwell, 6th Ed., (2007).
7. WIPO, Intellectual Property Hand book, WIPO Publication, (2004).
8. David Hunt, Long Nguyen and Matthew Rodgers, Patent Searching: Tool and Techniques, John Wiley and Sons, (2007).
9. Neil F. Sullivan, Transfer of Technology, Cambridge University Press, (1995).
10. Lipsey, R., & Chrystal, K. A., Economics, Oxford University Press, 13 Ed. (2013).
11. Case E. Karl & Ray C. Fair, Principles of Economics, Pearson Education, 8th Ed. (2009).
12. Mankiw, N. G., Principles of Economics, Thomson South-Western, 3rd Ed. (2005).

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1702 ELECTRICAL SYSTEM DESIGN

Course objectives:

Students will gain the basic knowledge of design, estimation and costing of different electrical installations

Course outcomes:

After successful completion of the course students will be able to

1. Understand the basic principle of design, estimation and costing of different electrical installations.
2. Prepare the design, estimation and costing of electrical installations of domestic, commercial, industrial establishments indoor and outdoor substations
3. Acquire the knowledge and skill required to prepare the design and estimate of illumination schemes for different applications.
4. Understand the various types of lamps and can select the appropriate one based on the requirement

Module I

Role of national electrical code in the design of electrical installation – electrical symbols and diagrams – design considerations of electrical installations – electric supply systems – protection and protective devices for electric installation against overload – short circuit and earth fault – electric services in building – service connections – service mains – reception and distribution of main supply – sub- circuits – neutral and earth wire – earth bus – guideline for installation of fittings – design, selection, layout, drawing and location of distribution boards and panel boards – control and switch gears – criteria for selection of HT and LT underground cables.

Module II

Design of illumination schemes – various types of light sources – different types of lighting arrangement – energy efficiency in lamps and illumination – design considerations of good lighting schemes – design of lighting schemes for various purposes – lighting calculations – design of flood lighting and street lighting – electrical aspects and considerations for lifts, escalator services and standby generators, hospitals, hotels, recreational and assembly buildings and cinema theatre – design and safety aspects of electrical installations for residential buildings.

Module III

Electrical installations of high rise buildings – design – schematic diagram – layout – estimation and testing of rising main – main supply board and distribution boards for high rise buildings – lighting protection – electrical system design – estimation and costing of commercial buildings – design considerations of electrical installations in Industries – design, estimating and costing of electrical installations for small industries.

Module IV

Selection of EHV and HV power and distribution transformers and switchgears – case studies – design – layout – schematic diagram –estimation– (a) 16MVA – 110/11KV outdoor substation having one or two incoming and 8 or less outgoing – (b) 11KV/415V outdoor substations up to 630KVA – (c) 11KV/415V indoor substation up to 630KVA – (d) bus bar trunking above 630KVA – design of earthing system – plate and pipe earthing

References:

1. Raina, Battacharya, *Electrical System Design, Estimation & costing,* Wiley Eastern
2. Gupta J.B, *Electrical Installating, Estimating & Costing*, Kataria & Sons
3. ISI, *National Electric Code, Bureau of Indian Standard Publications*
4. Cinema Regulation (Rules) & Act
5. IEEE Standards, IEEE
6. Relevant Indian Standard Specifiactions, IS Publication.

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1703 NEW AND RENEWABLE SOURCES OF ENERGY

Course Objectives:
Students will have a good knowledge of renewable energy sources and their applications

Course outcomes:
After successful completion of the course student will be able to
1. Understand the fundamentals of solar energy and its radiation, collection, storage and application.
2. Familiarize photovoltaic cells and different Instruments for measurement of solar radiation
3. Understand fundamentals of the wind energy, Biomass energy, geothermal energy and
Ocean energy as alternative energy sources.
4.Acquire knowledge in biomass conversion and types of fuel cells

Module I
Renewable and non-renewable sources of energy – brief review of conventional sources of energy – energy production and world energy consumption – green house effect and global warming. Solar energy option. Thermal conversion – design fabrication and performance of flat plate collectors – description of solar thermal devices (stills water heater, furnaces cookers and refrigerators) – Solar thermal power generation systems – thermal storage.

Module II
Photovoltaic conversion – conceptual description of photo voltaic effect – electrical characteristic of silicon PV cells and modules – solar cell material and prospects – Instruments for measurement of solar radiation – Empirical equations for predicting availability of solar radiation.

Module III
Wind energy – wind turbines – Horizontal axis and vertical axis with turbines – Power and energy from wind turbines – wind characteristics. Energy from oceans: wave energy – Physical principles – wave characteristics and wave power – wave energy technology. – fixed devices – floating devices

Module IV
Bioms – classification – biomass – conversion process – application – ocean thermal energy conversion systems – Tidal & wave power application – fuel cells – types – losses in fuel cell - application – MHD generators – application of MHD generation - micro and mini hybrid power.

References:
1. John W, Twidell , Antony D. Wier – *Renewable energy sources* –ELBS Publication
2. Renewable Energy - *Power for sustainable Future* – Edited by Godfrey Boyle – Oxford University Press in association with the Open University, 1996.
3. Meinel A B ,Meinel MP *Applied solar Energy* -, Addison Wesley Publications.
4. SL Sah, *Renewable and Novel energy sources MI Publications*, New Delhi, 1995.
5. George Sutton *Direct Energy Conversion* – McGraw hill Publications.

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15- 1704 CONTROL SYSTEMS II

Course Objectives:
To impart knowledge about modeling in state space and stability analysis .

Course Outcomes:
After successful completion of the course student will be able to
1. Represent a system and check its stability in state space.
2. Design various controllers and compensators using Bode plot and Root locus.
3. Design compensating networks and cascade compensation using Bode plots.
4. Analyze non-linear systems using phase plane and describing function.

Module I
State space models for linear systems: Concepts, state space, linear systems in state space, state diagram, state models from transfer functions, phase variable and canonical forms, state transition matrix, solution of state equations, controllability and observability, control system design by pole placement, state observers
Linear discrete time systems: pulse transfer function, state space representation of discrete time systems, stability using Jury's test.

Module II
Basic control actions and Root locus technique: Modes of control- Proportional(P) , Integral(I), Derivative(D) and combinations of P, I and D. and its effects on system performance. PID controller tuning in process control.
Basic theory and properties of root locus, rules for construction of root locus, complete root locus diagram , effects of addition of poles and zeros.

Module III
Design of control systems: Cascade and feedback compensations, design principles, compensating networks- lead, lag, lag lead, design by gain adjustment, cascade compensation using Bode plots.

Module IV
Nonlinear systems analysis. Non-linear systems behavior, nonlinearities in control systems, describing function of common nonlinearities, stability analysis by describing function, Phase plane and phase trajectories, Lyapunov stability.

Text Books:
1. K Ogata. - *Modern Control Engineering,* Prentice Hall .
2. M.Gopal, *Control Systems Principlas and Design*, Tata Mc Graw Hill.
3.M Gopal, *Digital Control and State Variable Methods*, Tata Mc Graw Hill.

References:
1. A.Nagoor kani "*Advanced Control Theory*", RBA Publication
2.S Palani "*Control Systems Engineering*", Tata Mc Graw Hill.
3.Benjamin C. Kuo : "*Automatic Control Systems"*, John Wiley & Sons

Type for questions for University Exams
PART A
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EE15-1705 E1 - WIRELESS COMMUNICATION

Course Objectives:
To understand the fundamentals of wireless communication

Course outcomes:
After successful completion of the course students will be able to
1. Understand the fundamentals of digital wireless communication.
2. Know the fundamentals of various spectrum modulation techniques used
3. Understand the Characteristics of speech signals, quantization techniques
4. Know the different cellular network technologies in application and methods to improve coverage and capability in cellular systems.

Module I
Evolution of mobile radio communication fundamentals. Large scale path loss: propagation models, reflection, diffraction, scattering, practical link budget design using path loss model. Small scale fading & multipath propagation and measurements, impulse response model and parameters of multipath channels, types of fading, theory of multi-path shape factor for fading wireless channels.

Module II
Spread spectrum modulation techniques: Pseudo-noise sequence, direct sequence spread spectrum (DS-SS), frequency hopped spread spectrum(FHSS), performance of DS-SS, performance of FH-SS, modulation performance in fading and multipath channels, fundamentals of equalisation, equaliser in communication receiver, survey of equalisation techniques, linear equaliser, linear equaliser, non-linear equalisation, diversity,
techniques RAKE, receiver.

Module III
Characteristics of speech signals, quantisation techniques, vocoders, linear predictive coders, time division multiple access, space division multiple access, and frequency division multiple access.

Module IV
Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems. Introduction to wireless networks, 2G, 3G, 4G wireless systems, wireless standards.

Reference:
1. T.S. Rappaport, "*Wireless Communication-Principles and practice*", Pearson
2. Willium C. Y. Lee, "*Mobile communication Design and fundamentals"*
3. D. R. Kamilo Fehar, "*Wireless digital communication"*
4. Haykin S ,Moher M., *"Modern wireless communication",* Pearson, 2005.
5. R. Pandya, " *Mobile and personal communication system*", PHI.

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
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EE15-1705 E2 -DIGITAL CONTROL SYSTEMS

Course objectives:
To analyze and design digital control system

Course Outcomes:
After completing the course students will have be able
1. To have a good knowledge on digital controllers.
2. To analyze Time responses of discrete data systems.
3. To design PID controllers by using bilinear transformation-
2. To understand state variable model of discrete data systems

Module 1
Basic digital control system- Examples - mathematical model-ZOH and FOH- choice of sampling rate principles of discretisation-Mapping between s-domain and z-domain-Pulse transfer function- Different configurations for the design- Modified z-transform- Multi-rate discrete data systems.

Module 2
Time responses of discrete data systems- Correlation between time response and root locations in the z-plane- Steady state performance- Disturbance Rejection- Robustness and Sensitivity -Jury's stability test – Routh stability criterion on the r-plane -Root locus- Polar plots-Nyquist stability criterion- Bode plot- Bilinear transformation method .

Module 3
Cascade compensators using Root Locus- Design of PID controllers by using bilinear transformation- Digital controller design using bilinear transformation- Dead-beat response design- Deadbeat controller without and with prescribed manipulated variable-Choice of sample time for deadbeat controller-Realization of digital controllers- Computer based simulation.

Module 4
State variable model of discrete data systems with S/H devices- State transition equations- state diagrams- Transfer function- Transformation to Jordan canonical form and phase variable form- Computation of state transition matrix using Cayley-Hamilton theorem and z-transform method- Response between sampling instants- Controllability, Observability, stabilizability and reachability- Loss of controllability and observability due to sampling- Pole placement design using state feedback for SISO systems- Computer based simulation.

References:
1. M.Gopal,*Digital control and State Variable methods*, Tata McGraw –Hill , 1997
2. B.C.Kuo, *Digital Control Systems*, 2nd Ed., Oxford University Press,1992.
3. Constantine H. Houpis ,Gary B. Lamont, *Digital control systems Theory, hardware software,* Mc-Graw Hill Book Company, 1985.
4. R.Isermann, *Digital control systems, Volume 1, Fundamentals , Deterministic control,(*2nd revised edition),Springer Verlag, 1989.
5. R.G.Jacquot, *Modern digital control systems,* (second edition),Marcel Dekker, Inc., 1995.
6. Philips, Nagle, *Digital control system analysis and design,* Prentice Hall, 1984.
7. G.F.Franklin, J.David Powell , M.Workman,*Digital Control of Dynamic Systems,* 3rd Ed.,,Addison Wesley, 2000.

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Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
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EE15-1705 E3-SOFT COMPUTING

Course Objectives:
Gain a fair knowledge on different soft computing techniques & their applications.

Course outcomes:
After successful completion of the course students will be

1. To give an introduction to Neural Networks
2. To understand fundamental concepts of ANN, Fuzzy Logic and Genetic Algorithm.
3. To gain a fair knowledge of application of soft computing techniques for real-world problems

Module I
Introduction to Neural Network**:** Concept, biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervise) and activation function, Models of ANN-Feed forward network and feed back network, Learning Rules- Hebbian, Delta, Perceptron Learning and Windrow-Hoff, winner take all.

Module II
Supervised Learning**:** Perceptron learning,- Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN. Application of Neural network in forecasting, data compression and image compression.
Unsupervised learning**:** Kohonen SOM (Theory, Architecture, Flow Chart, Training Algorithm) Counter Propagation (Theory , Full Counter Propagation NET and Forward only counter propagation net), ART (Theory, ART1, ART2). Application of Neural networks in pattern and face recognition, intrusion detection, robotic vision.

Module III
Fuzzy Set: Basic Definition and Terminology, Set-theoretic Operations, Member Function, Formulation and Parameterization, Fuzzy rules and fuzzy Reasoning, Extension Principal and Fuzzy Relations, Fuzzy if-then Rules, Fuzzy Inference Systems. Hybrid system including neuro fuzzy hybrid, neuro genetic hybrid and fuzzy genetic hybrid, fuzzy logic controlled GA. Application of Fuzzy logic in solving engineering problems.

Module IV
Genetic Algorithm: Introduction to GA, Simple Genetic Algorithm, terminology and operators of GA (individual, gene, fitness, population, data structure, encoding, selection, crossover, mutation, convergence criteria). Reasons for working of GA and Schema theorem, GA optimization problems including JSPP (Job shop scheduling problem), TSP (Travelling salesman problem), Network design routing, timetabling problem. GA implementation using MATLAB.

References:-
1. S.N. Shivnandam, "*Principle of soft computing",* Wiley.
2. S. Rajshekaran ,G.A.V. Pai, "*Neural Network , Fuzzy logic And Genetic Algorithm*", PHI.
3. Jack M. Zurada, "*Introduction to Artificial Neural Network System"* JAico Publication.
4. Simon Haykins, "*Neural Network- A Comprehensive Foudation"*
5. Timothy J.Ross, "*Fuzzy logic with Engineering Applications*", McGraw-Hills 1.

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
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EE15-1705 E4 - ENERGY AUDITING & ANALYSIS

Course Objectives:
To gain fundamental knowledge of energy auditing & analysis

Course outcomes:
After successful completion of the course student will be able
1. To gain fundamental knowledge of different types of Electricity tariff
2. To analyze efficient starting ,control and loading of motor.
3. To analyze Peak Demand controls and Transformer Loading/Efficiency
4. To understand about Energy conservation measures, types of electric loads like refrigerators etc.

Module I
System approach and End use approach to efficient use of Electricity: Electricity tariff types; Energy auditing: Types and objectives-audit instruments- ECO assessment and Economic methods-specific energy analysis-Minimum energy paths-consumption models-Case study.

Module II
Electric motor: Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis- Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors.
Variable speed drives: Pumps and Fans-Efficient Control strategies- Optimal selection and sizing -Optimal operation and Storage; Case study

Module III
Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, case study.
Reactive Power management**:** Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-Placement-Maintenance, case study.
Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study.
Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast-Power quality issues-Luminaries, case study.

Module IV
Cogeneration: Types and Schemes-Optimal operation of cogeneration plants-case study;
Electric loads of Air conditioning & Refrigeration-Energy conservation measures- Cool storage. Types-Optimal operation-case study; Electric water heating-Gysers-Solar Water Heaters- Power Consumption in Compressors, Energy conservation measures; Electrolytic Process; Computer Controls- software-EMS .

References:
1. Y P Abbi , Shashank Jain *Handbook on Energy Audit and Environment Management*, TERI, 2006
2. William J. Younger , Terry Niehus, Albert Thumann *Handbook of Energy Audits*, , 2009
3. Howard E. Jordan, *.Energy-Efficient Electric Motors and Their Applications*., Plenum Pub Corp; 2nd edition (1994)
4. Albert Thumann , *.Handbook of Energy Audits.,* Fairmont Pr; 5th edition (1998)
5. Albert Thumann, P.W, -.*Plant Engineers and Managers Guide to Energy Conservation*. - Seventh Edition-TWI Press Inc, Terre Haute, 2007
6. *IEEE Recommended Practices for Energy Management in Industrial and Commercial Facilities*
7. Donald R. Wulfinghoff, *Energy Efficiency Manual: for everyone who uses energy, pays for utilities, designs and builds, is interested in energy conservation and the environment*, Energy Institute Press (March 2000)

Type for questions for University Exams
PART A
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PART B (4 x 10 = 40 marks)
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EE15-1705 E5 ELECTRICAL MACHINE DESIGN

Course objectives:
To understand designing of electrical machines according to given specifications

Course outcomes:
After successful completion of the course student will be able to
1. Gain a deep knowledge of different design aspects of D.C machines.
2. Acquire knowledge in designing of transformer windings, cooling tanks and tubes etc
3. Gain a deep knowledge of different design aspects of Alternators
4. Design a induction machines according to the given specifications.

Module I
D C Machines:- Output equation – main dimensions choice of specific electro magnetic loadings – choice of speed and number of poles. Design of armature conductors, slots and windings – design of airgap,field system, commutator, interpoles, compensating winding and brushes – Carter's co-efficient – real and apparent flux density. Design examples.

Module II
Transformers; - Single phase and Three phase transformers – output equation - main dimensions – specific electric and magnetic loadings – design of core, LV winding, HV winding – cooling of transformers – design of cooling tank and tubes. Temperature rise time curve – short time and continuous rating.

Module III
Alternators:- Salient pole and turbo alternators – output equation – main dimensions – choice of specific electric and magnetic loadings – choice of speed and number of poles – design of armature conductors, slots and winding – design of air-gap, field system and damper winding – prediction of open circuit characteristics and regulation of the alternator based on design data – design examples.

Module IV
Induction machines:- Output equation – main dimensions – choice of specific electric and magnetic loadings – design of stator and rotor windings, stator and rotor slots and air-gap of slip ring and squirrel cage motors – calculation of rotor bar and end ring currents in cage rotor – calculation of equivalent circuit parameters and prediction of magnetising current based on design data – design examples.

References:
1. Clayton , Hancock - *Performance and Design of DC Machines*, ELBS.
2. Sawhney - *Electrical Machine Design*, Dhanapath Rai.
3. Say M.G - *Performance and Design of AC Machines*, Pitman, ELBS.

Type for questions for University Exams
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
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Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-17L1-POWER ELECTRONICS LAB

Course Objectives:
Basic skill in methods of design and analysis across a broad range of Power Semiconductor devices.

Course Outcomes:
After successful completion of the course student will be able
1. Gain knowledge on firing techniques and experimental procedures in Power Electronics
2. Design power electronics circuits to meet the desired specification
3. Gain knowledge in designing various power electronics converters using Matlab Platform
4. To understand controlling motor drive using power electronics.

1. Study of V-I characteristics of SCR
2. Study of V-I characteristics of Triac
3. Study of V-I characteristics Diac
4. SCR firing Circuits.
5. AC voltage Controller
6. Design and set up a Single Phase half wave rectifier and study its performance for R and RL loads
7.Design and setup a single-phase full-converter and study its performance for R and RL loads.
8.Design and setup a single-phase semi-converter and study its performance for R and RL loads.
9.Design and set up a Single Phase square wave inverter and harmonic analysis of PWM waveforms using the Powergui/FFT tool.
10.Three-phase six-pulse thyristor converter and harmonic analysis using the Powergui/FFT tool.
11.GTO buck Converter and AC-DC-AC PWM Converter
Chopper-Fed DC Motor Drive (Continuous)

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners . A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

EE15-17L2 ADVANCED ELECTRICAL ENGG. LAB

Course Objectives:
To familiarize, use sophisticated software packages for designing and analysis of various engineering problems and to evaluate performance of various transducers, motors etc.

Course Outcomes:

1. After successful completion of the course student will be able
2. Perform industry based main project
3. Learn and adapt the various process in an industry
4. Find solutions to problems in industry/research with latest software tools.
5. Acquire practical knowledge about process control and automation.

List of Experiments

- MATLAB – I – experiments using MATLAB toolbox.
- Determination of transfer function of DC motor (a) armature control (b) field control.
- Study and experiments on (a) DC servo motor (b) AC servomotor.
- Experiments on synchros (a) characteristics (b) data transmission (c) error detection (d) differential synchro.
- Design and experimental determination of frequency response of lag, lead and lag-lead networks.
- Static and dynamic performance evaluation of transducer (a) resistance thermometer (b) vibration pick up (c) Temperature Sensor
- Study and performance evaluation of transducers (a) strain gauge (b) inductive pick up (c) capacitive pick up (d) LVDT.
- Study and experiments on pneumatic control system.
- Simulation of Tank level control in LabView.
- Harmonic Analysis Simulation using Lab View
- Measurement and recording of a physical quantity (temperature/pressre etc.) using Lab view with suitable Data Acquisition System
- Power flow analysis of the system with the given single line diagram, using the given power flow analysis package.
- Fault analysis of the system with given single line diagram, using the given fault analysis package.
- Determination of relay characteristics.

Note: 50% Mark is earmarked for continuous evaluation and 50% mark for end semester examination, to be assessed by two examiners . A candidate has to obtain a minimum of 50% marks for continuous assessment and end semester examination put together with a minimum of 45% marks in the end semester examination for a pass in laboratory courses.

EE15- 17L3 ENTREPRENEURSHIP AND DEVELOPMENT

Course Objective:

Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

Course Outcomes:

Upon completion of this course the student will be able to

1. Develop awareness about the importance of entrepreneurship opportunities available in the society
2. Get acquainted with the challenges faced by the entrepreneur

Exercises:

1. To study the types of entrepreneurs and the factors affecting entrepreneurial growth.
2. To make an assessment of the major motives influencing an entrepreneur
3. To make an overview of the various stress management techniques
4. How to identify and select a good business opportunity?
5. Preparation of a techno economic feasibility report for a given project
6. Preparation of a preliminary project report for a given project
7. To identify the various sources of finance and management of working capital
8. Carry out the costing and break even analysis of a proposed project
9. Preparation of a PERT / CPM chart for the various activities involved in a project
10. To make a study of the various causes and consequences of sickness in small business and identify corrective measures.

References:

1. Roy Rajeev, Entrepreneurship, Second edition, Oxford Latest Edition, 2011.
2. E. Gordon , K. Natarajan, Entrepreneurship Development, Fourth edition, Himalaya, 2007.
3. Coulter, Entrepreneurship in Action, Second edition, PHI, 2008.
4. P. C. Jain, Handbook for New Entrepreneur, Oxford University Press, 2003.
5. S. S. Khanka, Entrepreneurial Development, Fifth edition, S. Chand and Co, 2013.

Note: There will only be continuous evaluation for this course. The evaluation will be based on the performance of the student in the exercises given above. A minimum of 50% marks is required for a pass.

EE15-17L4 PROJECT PHASE I & INDUSTRIAL INTERNSHIP

Course Objectives:

To enable the student apply the theoretical knowledge gained to specific industrial / research problems.

Course Outcomes:

On completion of this course the student will be able to

3. Work independently on a specific problem relevant to research or industry.

2. Develop team work skills to work in group

Each batch comprising of 3 to 5 students shall identify a project related to the curriculum of study. At the end of the semester, each student shall submit a project synopsis comprising of the following.

- Application and feasibility of the project
- Complete and detailed design specifications.
- Block level design documentation
- Detailed design documentation including circuit diagrams and algorithms / circuits
- Bill of materials in standard format and cost model, if applicable
- Project implementation action plan using standard presentation tools

Guidelines for evaluation:

Attendance and Regularity	5
Theoretical knowledge and Involvement in study or project	15
End-Semester presentation & Oral examination	10
Level of completion of design as per specifications	10
Project Phase 1 Report	10
Total	*50*

Note: *Points (i)-(iii) to be evaluated by the respective project guides and project coordinator based on continuous evaluation. (iv)-(v) to be evaluated by the final evaluation team comprising of 3 internal examiners including the project guide.*

EE15-1801 ELECTRONIC INSTRUMENTATION

Course Objectives:
Student will able to use and select sensors /Transducer for various industrial processes.

Course outcomes:
On successful completion of this course student will be able to

1. Distinguish the characteristics of various transducers
2. Use various modulation techniques for signals.
3. Select suitable transducers/sensors for specific applications.

4. Gain knowledge in PLC Programming.

Module I

Transducers – definitions – classifications – resistance transducers- strains gauge – types –construction – temperature effect - circuitry, semi conductor strain gauge – load cell.
Resistance thermo meter – types – circuits – errors. Thermistor – advantage of thermistor.
Inductive transducers – LVDT – applications – LVDT load cell – LVDT pressure transducer – resolver – capacitive transducer – principle of operation – applications – capacitor microphone.
Piezoelectric transducer – materials – equivalent circuit – d, g, coefficients – thermocouple – principle – applications – magnetostrictive transducers – materials, applications, Hall effect transducer – application – elastic transducers (brief study) – Bourdon tubes – diaphragms – Bellows –Optical transducers – digital transducers – shaft encoder.

Module II

Signal conditioning – instrumentation amplifiers – differential amplifiers – filters – law and high pass, band pass and band rejection filters –transducer bridges – null type and deflection bridges – AC bridges using push pull transducers – general telemetry systems – sampling process – principles of time division and frequency division multiplexing, different types of modulation techniques as applied to telemetry (general idea)

Module III

Instrumentations systems – basic measuring systems – analog and digital data acquisition systems – generalized input-output configuration of measuring systems – dynamic characteristics.
Digital instruments – operating principles of DVM using successive approximation – V/F conversion and integrating principles – counter digital method for frequency, phase, time and period measurements – digital RLC meters – Q-meter – vector impedance meter – electronic multimeter- display systems and recorders

Module IV

Programmable logic controller- Ladder diagram-relay sequencers, motor control starter circuits, Timer on/off delay
Block diagram of PLC system, programming of PLC-Ladder Programming of simple systems-Elevators, Conveyers etc.

References:

1. A.K Sawhney - *A course in electrical and electronic measurements and Instrumentation*, Dhanapath Rai & Co. 2001 eddition.
2. Ernest O.Doeblin - *Measurements systems application & design,* McGraw Hill International edition 1984.
3. Albert D. Helfric , William D. Cooper - *Modern Electronic Instrumentation & Measurements Techniques* (Prentice Hall)
4. Dr. S. Renganathan - *Transducers Engineering* (Allied Publishers Ltd. Delhi
5. K.B Kalaasen - *Electronic measurement and instrumentation*, Cambridge University press 1996.

Type for questions for University Exams

PART A

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PART B (4 x 10 = 40 marks)

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EE15-1802 UTILISATION OF ELECTRIC POWER

Course Objectives:

To understand the concept of illumination, electric heating, welding, traction, air conditioning & refrigeration

Course outcomes:

After completing the course students will be able
1. To gain fair knowledge of illumination & illumination requirements for different applications
2. To Understand principles of electric heating and welding

3. To understand the concept & technical aspects of electric traction
4. To acquire basic knowledge of air conditioning & refrigeration

Module I

Illumination: radiant energy-terms and definitions- laws of illumination- polar curves- photometry- MSCP-integrating sphere- luminous efficacy- electrical lamps- Color values of illuminates and color effects: colorimeter, artificial daylight, design of interior and exterior lighting systems- illumination levels for various purposes- light fittings- factory lighting- flood lighting-street lighting-energy conservation in lighting.

Module II

Electric heating: classification- heating element-losses in oven and efficiency- resistance furnace- radiant heating- induction heating- high frequency eddy current heating- dielectric heating- arc furnace- heating of buildings.

Electric welding:methods and equipments- electric supply for arc welding, Electrolysis and Electroplating applications.

Module III

Electric Traction: Features of an ideal traction system-systems of electric traction- mechanism of train movement- speed-time curve, Power and Power Measurement, traction supply system- transmission line to substation- feeding and distributing system on an ac traction- system of current collection-traction motors tractive effort and horse power- Speed control Schemes-Electric braking.

Module IV

Air conditioning and refrigeration: Control of temperature - protection of motors - simple heat load and motor calculations. Air-conditioning - function of complete air conditioning system - type of compressor motor. Cool storage - estimation of tonnage capacity and motor power..

References:

1. Taylor E Openshaw, "*Utilization of Electric Energy*", Orient Longman,1986.
2. J B Gupta, "*Utilization of electric power and electric traction*", S K Kataria & Sons, 2002.
3. Wadhwa. C.L., "*Generation, Distribution and utilization of electrical energy*", Wiley Eastern Limited,1993.
4. Soni, Gupta, Bhatnagar, *"A course in electric power",* Dhanapat Rai & sons, 2001.
5. S.L.Uppal, "*Electrical Power",* Khanna pulishers,1988.
6. Partab H., "*Art and Science of Utilisation of Electrical Energy",* Dhanpat Rai and Sons, New Delhi. Second edition
7. Tripathy S.C., "*Electric Energy Utilization And Conservation",* Tata McGraw Hill,1993 .
8.. William Edward Barrows, "*Light, Photometry and Illumination*", BiblioBazaar, LLC, 2009
9.R.K.Rajput,"*Utilisation of electric power*"Lakshmi Publications Private Ltd.
10.N.V. Suryanarayana: "*Utilisation of Electrical power including Electric drives and Electric Traction*", New Age Publishers, 1997.

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15 1803 POWER SYSTEMS III

Course objectives:

To understand different protecting devices & protection methods employed in power system

Course outcomes:

After successful completion of course students will be able
1.To understand about protecting devices in power systems
2. To acquire knowledge about protecting relays in power systems
3.To understand the different power tariff methods

4.To gain a fair knowledge of power system deregulation

Module I

Circuit breakers – principles of operation – different types and their operations – ABCB – oil CB – SFC – vacuum CB- circuit breaker ratings – cause of over voltages – surges and traveling waves – voltage waves on loss less line – reflection and attenuation – protection against lightning – earth wires – lightning diverters – surge absorbers- arcing ground – neutral earthing – basic concepts of insulation levels and their selection – BIL – coordination of insulation.

Module II

Protective relays – protective zones – requirement of protective relaying – different types of relays and their applications – generalized theory of relays – protection scheme for generator – transformers, lines and bus bars - static relays amplitude and phase comparators – block diagrams of static relays – protection scheme for generators – transformers, lines and bus bars – numerical relay protection.

Module III

Electricity tariff – rate structure elements – types of tariffs – declining block rates – demand energy rates – seasonal rates – time of day rates – interruptible rates – curtailable rates.

Interchange of power & Energy-Introduction -Economy interchange between interconnected utilities-Interutility economy energy evaluation-Interchange evaluation with unit commitment-Multiple utility interchange transactions.

Module IV

Power system deregulation- Market Overview in Electric Power Systems- Market structure & Operation- Key Market Entities-responsibilities & functions of ISO- Electricity Market Models- pool trading-concept of market clearing price-bilateral trading- -power market types-Energy, Ancillary Services, and Transmission Markets- Forward and Real-time Markets- spot market –need for a managed spot market-operation.

References:

1. Rao S.S - *Switch Gear protections*, Khanna.
2. Thomas , Browne Jr - *Circuit Interruption – Theory and Techniques.*
3. Soni, Gupta,Bhatnagar - *A Course in Electrical Power*, Dhanapat Rai.
4. Van.C Warrington A.R - *Protective Relays Vol.1 & 2,* Chappman & Hall.
5. Mason C.R - *Art and Science of Protective Relaying*, Wiley Eastern.
6. Ravindranath, Chander.M - Power System Protection and Switchgear, WileyEastern.
7.*IEEE Recommended Practice for Energy Management in Industries and Commercial Facilities*, IEEE Press USA
8. Allen J. Wood, Bruce F. Wollenberg *Power Generation, Operation, and Control –*
9. Mohammad Shahidehpour ,Hatim Yamin , Zuyi Li ,*Maket Operations in Electric Power Systems (IEEE)*
10. Daniel Kirschen,Goran Strbac *Fundamentals of power system economics*-
11 Loi Lei Lai- *Power System Restructuring and Deregulation: Trading, Performance and Information Technology*, John Wiley & Sons

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1804 E1 – MECHATRONICS

Course objectives:

*To understand the fundamentals of mechatronics, Numerical control machine tools and robotics***.**

Course outcomes:

After successful completion of the course student will

1.*To gain knowledge on the fundamentals of mechatronics*

2. To acquire knowledge on different actuator systems.

3.To know the basics of Numerical control of machine tools

4.To understand the basics of industrial robotics.

Module I

Introduction to Mechatronics - Elements of Mechatronic Systems. Mechatronics in manufacturing - Mechatronics in products - Scope of Mechatronics.

Mathematical modeling of Engineering Systems: System Building blocks for Mechanical, Electrical, Fluid and Thermal systems.

General Engineering System Modeling: Rotational - Translational, Electromechanical, Hydraulic_ Mechanical systems - System Transfer Function - Dynamic response of systems for standard test signals (Detailed mathematical analysis not required).

Module II

Actuation Systems: Pneumatic & Hydraulic Systems: Process Control Valves, Directional and Pressure Control valves, Linear and Rotary actuators.

Mechanical Actuation Systems: Translational and Rotational motions, Kinematic Chains, Cams, Gear Trains, Ratchet and Pawl, Belt and Chain drives, Bearings.

Electrical Actuation Systems: Mechanical and Solid State Relays, Solenoids, DC & AC motors, Servo & Stepper motors-feedback devices - encoders - pulse digitizers - resolvers - inductosyn – tachometers.

Module III

Fundamentals of numerical control - advantages of NC systems - classification of NC systems - point to point and contouring systems - NC and CNC - incremental and absolute systems - open loop and closed loop systems - features of NC machine tools - fundamentals of machining - design consideration of NC machine tools - methods of improving machine accuracy and productivity

Industrial robotics - basic concepts - robot anatomy - robotics and automation - specification of robots - resolution - repeatability and accuracy of manipulator - classification of robots.

Module IV

MEMS: Internal Structure, advantages, manufacturing, applications - Fibre Optic Devices in Mechatronics

Mechatronic System Controllers: ON/OFF, P, I, D, PI and PID Controllers, Digital controllers, Intelligent Controllers in Mechatronics.

Programmable Logic Controllers: Structure, I/O processing, Programming, applications – Selection Criteria.

References:

1. Bolton. N, Mechatronics- Electronic Control systems in Mechanical and Electrical Engineering, Pearson Education,4/e, 2008

2. M.D. Singh, J.G. Joshi, Mechatronics, Prentice Hall India, New Delhi, 2006

3. Dradly. D.A, Dawson.D, Burd N.C and Loader A.J, Mechatronics – Electronics in Products & Processes, Chapmen & Hail, 1993.

4. HMT Limited ,Mechatronics, Tata McGraw Hill,1998.

5. James Harter, Electromechanics- Principles concept and Devices, Prentice Hall, 1995.

6. Michel P. Groover, Industrial Robots-Technology, Programming and Applications, McGraw Hill,1986

7. Yoram Koren & Ben Yuri, Numerical Control of Machine Tools, Khanna Publishers,1984

8. A.Smaili,F.Mrad,Mechatronics-Integrated Technologis for Intelligent Machines,Oxford,2009

9. Appukuttan .K.K,Introduction To Mechatronics,Oxford University,Press,1/e, 2007

10. David G Alciatore,Micheal ,Introduction to Mechatronics and Measurement Systems,TMH,3/e,2007

11. Nitaigour P Premchand,Mechatronics-Principles,Concepts and Applications,TMH,11/e,201

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1804 E2 DYNAMICS OF ELECTRICAL MACHINES

Course Objectives:

To study about modeling & analysis of electrical machines

Course outcomes:

After successful completion of the course students will be able to

1.To understand the basic ideas of mathematical modeling and analysis of DC machines

2. To model and analyze induction

3. To model and analyze synchronous machines

4. To understand the dynamics of interconnected machines

Module I

Modeling and analysis of DC machines: Introduction to generalized machine theory- diagrammatic representation of generalized machine-formation of emf equations- expression s for power and torque-representation of D C machines.

Electro dynamical equations and their solution - a spring and plunger system - rotational motion system - mutually coupled coils - Lagrange's equation - application of Lagrange's equation to electromechanical systems - solution of electro dynamical equations by Euler's method and Runge-Kutta method - linearization of the dynamic equations and small signal stability - the primitive 4 winding commutator machine- the commutator primitive machine - the brush axis and its significance - self and mutually induced voltages in the stationary and commutator windings - speed emf induced in commutator winding - rotational inductance coefficients - sign of speed emf terms in the voltage equation - the complete voltage equation of primitive 4 winding commutator machine - the torque equation - DC Machines - analysis of simple DC machines using the primitive machine equations - analysis of cross-field DC machines using the primitive machine equations

Module II

Modeling and analysis of induction motors: Representation of Induction machine using Generalized machine theory - Formation of general equations - The three phase induction motor - equivalent two phase machine by m.m.f equivalence - equivalent two phase machine currents from three phase machine currents - power invariant phase transformation - voltage transformation - voltage and torque equations of the equivalent two phase machine - commutator transformation and its interpretation - transformed equations - different reference frames for induction motor analysis - choice of reference frame- nonlinearities in machine equations - equations under steady state - solution of large signal transients in an induction machine - linearised equations of induction machine in current variables and flux linkage variables - small signal stability - Eigen values - transfer function formulation - application of large signal and small signal equations

Module III

Modeling and analysis of synchronous machines: Modeling and analysis of synchronous machines - Synchronous machine representation using generalized machine theory - general equations - three phase to two phase transformation - voltage and torque equations in stator, rotor and air-gap field reference frames - commutator transformation and transformed equations - parks transformation - suitability of reference frame Vs kind of analysis to be carried out - steady state analysis - large signal transient analysis - linearization and eigen value analysis - general equations for small oscillations - small oscillation equations in state variable form - damping and synchronizing torques in small oscillation stability analysis - application of small oscillation models in power system dynamics

Module IV

Dynamic analysis of interconnected machines: Machine interconnection matrices - transformation of voltage and torque equations using interconnection matrix - large signal transient analysis using transformed equations - small signal model using transformed equations - the DC generator/DC motor system - the alternator/synchronous motor system - the Ward-Leonard system - hunting analysis of interconnected machines - selection of proper reference frames for individual machines in an interconnected system

References:

1. Dr. Bhimbra P. S., *Generalised Machine Theory*, Khanna Publishers.
2. Sengupta D. P. , Lynn J. B., *Electrical Machine Dynamics*, The Mac Millan Press Ltd.
3. Jones C. V., *The Unified Theory of Electrical Machines*, Butterworth
4. Woodson, Melcher, *Electromechanical dynamics,* John Wiley
5.. Kraus P. C., *Analysis of Electrical Machines,* McGraw Hill Book Company
6. Boldia I , Nasar S. A., *Electrical Machine Dynamics*, The Mac Millan Press Ltd.

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III

Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1804 E3 -POWER QUALITY

Course Objectives:

To understand different power quality issues

Course outcomes:

After successful completion of the course students will be able to

1. Understand the different power quality issues and indices
2. Evaluate the severity of voltage sag, voltage swell, harmonics, and transients in distribution networks
3. Find out the harmonic distortion in power system

4. Familiarize the different PQ monitoring instruments

Module I

Introduction: Definition of Power quality, Power Quality Voltage & Current Quality, Importance of Power Quality, Power quality Evaluation.

Terms and Definitions: General Classes of Power quality Problems, Transients, Long Duration Voltage Variations, Short Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage fluctuation, Power Quality Terms, CBEMA and ITI Curves.

Module II

Voltage Sags and Interruptions: Sources of Sags and Interruptions, Estimating voltage Sag Performance, Fundamental -Principles of Protection, Solution at the End User Level, Motor -Starting Sags.

Transient over Voltages: Sources of Transient Over voltages, Principles of Over voltage Protection, Devices for over voltage Protection, Utility Capacitor- Switching transients, Utility System Lightning Protection,
Managing Ferro resonance, Switching Transient Problems with Loads, Computer Tools for Transients Analysis

Module III

Fundamentals of Harmonics: Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads, Locating Harmonic Sources, Effects of Harmonic distortion, Inter harmonics, Harmonic distortion Evaluations, Principles for Controlling Harmonics, Harmonic Filter design: A Case Study, Standards of Harmonics.

Long Duration Voltage Variations: Principles of Regulating the Voltage, Devices for Voltage Regulation, Utility Voltage Regulator application, Capacitors for Voltage Regulation, End - Users Capacitors Application, and Regulating Utility Voltage with distributed Resources Flicker.

Module IV

Power Quality Monitoring: Monitoring considerations, Historical Perspective of Power quality Measuring Instruments, Power Quality Measurement Equipment, Assessment of Power Quality Measurement Data, Application of intelligent Systems, Power Quality Monitoring Standards, Monitoring considerations

References :

1. Heydt G.T., *Electric power quality,* McGraw-Hill Professional, 2007

2. Math H. Bollen, *Understanding Power Quality Problems*, IEEE Press, 2000

3. Arrillaga J., .*Power System Quality Assessment*., John wiley, 2000

4. Arrillaga J., Smith B.C., Watson N.R. Wood A. R ,.*Power system Harmonic Analysis*., Wiley, 1997

5. *IEEE and IEE Papers from Journals and Conference Records*

Type for questions for University Exams

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

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Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-1804 E4 HVDC & FACTS

Course objectives:

To acquire fair knowledge of HVDC & FACTS

Course outcomes:

After successful completion of course student will be able
1.To Able to acquire a good knowledge of HVDC transmission system.
3. To know the different types of DC links and control of HVDC converters and design parameters of converters.

3. To gain a fair knowledge on the concepts and technology of flexible AC transmission systems.
4.To gain a fair knowledge of static & shunt compensation in power system using FACTS controllers

Module I
HVDC Transmission-Need for power system interconnections, Evolution of AC and DC transmission systems, Comparison of HVDC and HVAC Transmission systems, Types of DC links, relative merits, Components of a HVDC system, Modern trends in DC Transmission systems

Module II
EHV DC Transmission: Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of dc link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of dc link.

Module III
FACTS concepts and general system considerations: Power flow in AC systems - Definition of FACTS - Power flow control -Constraints of maximum transmission line loading - Benefits of FACTS Transmission line compensation-Uncompensated line -shunt compensation - Series compensation -Phase angle control.

Static shunt compensators-SVC and STATCOM - Operation and control of TSC, TCR and STATCOM - Compensator control - Comparison between SVC and STATCOM.

Module IV
Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators - TCVR and TCPAR- Operation and Control -Applications.
Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPFC- Basic Principle of P and Q control-independent real and reactive power flow control- Applications - Introduction to interline power flow controller.

References:
1. Padiyar K. R., "*HVDC Power Transmission Systems: Technology and System Reactions*" New Age International.
2 Arrillaga J.," *High Voltage Direct current Transmission" IFFE Power Engineering Series 6*, Peter PeregrinusLtd,London.
3. Kimbark,E.W., `*Direct current transmission-Vol.1'*,Wiley Interscience, New York, 1971
4.Arrilaga,J., `*High Voltage Direct current transmission',Peter Pereginver Ltd.,* London,UK.,1983
5. Kundur P., "*Power System Stability and Control*", McGraw-Hill, 1993.
6..NarainG.Honorani, Laszlo Gyugyi "*Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems"*
7.. Padyar K.R. *"FACTS controllers in power transmission & distribution*" New age international publications
8..Sood V. K, "*HVDC and FACTS controllers- Applications of Static Converters in Power System*", Kluwer Academic Publishers, 2004
9.A.T.John, "*Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE*), 1999.
10.Mohan Mathur, R., Rajiv. K. Varma, "*Thyristor – Based FACTS Controllers for Electrical Transmission Systems*", IEEE press and John Wiley & Sons, Inc, 2002.

Type for questions for University Exams
PART A
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PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
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EE15-1804 E5 SMART GRID

Course objectives:
To gain good knowledge of smart grid and the technologies associated with it
Course outcomes:
After successful completion of course students will be able to
1.To Understand the features of smart grid
2.To Understand the role of automation in transmission and distribution in a smart grid

3.To gain a fair knowledge of Smart Grid technologies, different smart meters and advanced metering infrastructure.
4.To gain a fair knowledge of power quality management issues in Smart Grid

Module I

Evolution of Electric Grid-Concept-Definitions and Need for Smart Grid- Smart grid drivers-functions-opportunities-benefits- Difference between conventional & Smart Grid-Components and Architecture of Smart Grid Design –key challenges for smart grid.

Module II

Smart grid technologies: Smart energy resources-Smart substations-Substation Automation-Feeder Automation -Transmission systems: EMS, FACTS and HVDC-Wide area monitoring- Protection and control- Distribution systems: DMS, Volt/VAr control-Fault Detection-Isolation and service restoration-Outage management-High Efficiency Distribution Transformers-Phase Shifting Transformers-Plug in Hybrid Electric Vehicles in smart grid

Module III

Smart metering & advanced metering infrastructure: Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits-AMI protocols, standards and initiatives-Phasor Measurement Unit(PMU)- Intelligent Electronic Devices(IED) & their application for monitoring & protection.

ModuleIV

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

References:

1.Stuart Borlase "*Smart Grid :Infrastructure, Technology and Solutions*",CRC Press 2012.
2.Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihi ko Yokoyama, "*Smart Grid: Technology and Applications",* John Wiley & Sons
3. James Momoh, "*Smart Grid: Fundamentals of design and analysis*", John Wiley & sons 4. Fereidoon P. Sioshansi, "*Smart Grid: Integrating Renewable, Distributed & Efficient Energy*",Academic Press, 2012.
4.Clark W.Gellings,"*The smart grid: Enabling energy efficiency and demand response*", Fairmont Press Inc, 2009
5. Xi Fang, Satyajayant Misra, Guoliang Xue,De jun Yang"*Smart Grid The New and Improved Power Grid: A Survey" , IEEE Transacti*on on Smart Grids
6. Vehbi C. Güngör,DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella,Carlo Cecati ,and Gerhard P. Hancke, *Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics*, Vol. 7, No. 4, November 2011

Type for questions for University Exams

PART A

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PART B (4 x 10 = 40 marks)

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Question nos. VI ,VII with sub sections (a), (b) ---(10 marks each with options to answer either VI or VII) from Module III
Question nos.VIII , IX with sub sections (a), (b)--(10 marks each with options to answer either VIII or IX) from Module IV

EE15-18 L1 SEMINAR

Course Objectives:

To encourage and motivate the students to read and collect recent and relevant information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conferences, books, project reports, etc., prepare a report based on a central theme and present it before a peer audience.

Course Outcomes:
On completion of this course the student will be able to:

1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and reference identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. Develop skills like time management, leadership quality and rapport with an audience.

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Electronics & Communication Engineering. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks, technical reports and URLs. The references shall be incorporated in the report following IEEE standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 30 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

EE15-18L2 PROJECT PHASE II

Course Objectives:

To enable the student apply the theoretical knowledge gained to specific industrial / research problems.

Course Outcomes:
On completion of this course the student will be able to

1. Work independently on a specific problem relevant to research or industry.
2. Develop team work skills to work in group

Each batch of students shall develop the project designed during the VII semester. The implementation phase shall proceed as follows:

- For hardware projects, practical verification of the design, PCB design, fabrication, design analysis and testing shall be done.
- For software projects, a proper front end (GUI) if applicable, shall be designed. A detailed algorithm level implementation, test data selection, validation, analysis of outputs and necessary trial run shall be done.
- Integration of hardware and software, if applicable, shall be carried out.
- A detailed project report in the prescribed format shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report.
- The work shall be reviewed and evaluated periodically

The final evaluation of the project shall be done by a team of minimum 3 internal examiners including the project guide and shall include the following.

- Presentation of the work
- Oral examination
- Demonstration of the project against design specifications
- Quality and content of the project report

Guidelines for evaluation:

i.	Regularity and progress of work	40%
ii.	Work knowledge and Involvement	40%
iii.	End semester presentation and oral examination	40%
iv.	Level of completion and demonstration of functionality/specifications	40%
v.	Project Report – Presentation style and content	40%
	Total	200 marks

Note: *Points (i) and (ii) to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (iii)-(v) to be evaluated by the final evaluation team comprising of 3 internal examiners including the project guide.*

EE15-18L3 COMPREHENSIVE VIVA-VOCE

Course Objectives:

To test the student's learning and understanding of the theory and applications of the various concepts taught during the entire course of their programme and to prepare the students to face interviews in both the academic and industrial sectors.

Course Outcomes:

On completion of this course the student will be able to refresh all the subjects covered during the programme to

1. gain good knowledge of theory and practice
2. develop oral communication skills and positive attitude
3. face technical interviews with confidence

Each student is required to appear for a viva-voce examination at the end of the complete course work. The examination panel shall comprise of one internal examiner and one external examiner, both appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the course of study and practical/analysis skills in the field.