SYLLABUS & CURRICULUM

of

B.Tech.

ELECTRICAL & ELECTRONICS
(3rd to 8th semesters)

UNIVERSITY OF CALICUT

(2014 admission)

SCHEME for Electrical and Electronics Engineering (EEE) Branch for 3rd to 8th Semesters

3rd Semester

Code	Subject	Hours/week			Marks			
		L	T	P/D	Inte-rnal	Sem-end		
EN14 301	Engineering Mathematics III	3	1	-	50	100	3	4
EN14 302	Computer Programming in C	3	-	1	50	100	3	4
EE14 303	Electric Circuit Theory	3	1	-	50	100	3	4
EE14 304	Electrical Measurements & Instrumentation Systems	3	1	-	50	100	3	4
EE14 305	Analog Electronics	3	1	-	50	100	3	4
EE14 306	Mechanical Engineering	3	1	-	50	100	3	4
EE14 307(P)	*Basic Electrical Engg Lab*	-	-	3	50	100	3	2
EE14 308(P)	*Electronics Lab*	-	-	3	50	100	3	2
	Total	**18**	**5**	**7**				**28**

Note: For EN 14 302 Computer Programming in C, the end semester examination will be held by the University as a theory paper.

4th Semester

Code	Subject	Hours/week			Marks			
		L	T	P/D	Inte-rnal	Sem-end		
EN14 401B	Engineering Mathematics IV	3	1	-	50	100	3	4
EN14 402	Environmental Science	3	1	-	50	100	3	4
EE14 403	Electrical Machines I	3	1	-	50	100	3	4
EE14 404	Signals and Systems	3	1	-	50	100	3	4
EE14 405	Digital Electronics	3	1	-	50	100	3	4
EE14 406	Electromagnetic Field Theory	3	1	-	50	100	3	4
EE14 407(P)	*Mechanical Engg. Lab*	-	-	3	50	100	3	2
EE14 408(P)	*Electrical Measurements & Instrumentation Lab*	-	-	3	50	100	3	2
	Total	**18**	**6**	**6**				**28**

5th Semester

Code	Subject	Hours/week			Marks			
		L	T	P/D	Inte-rnal	Sem-end		
EE14 501	Power Electronics	3	1	-	50	100	3	4
EE14 502	Electrical Power Generation, Transmission and Distribution	3	1	-	50	100	3	4
EE14 503	Electrical Machines II	3	1	-	50	100	3	4
EE14 504	Analog & Digital Communication	3	1	-	50	100	3	4
EE14 505	Digital System Design	3	1	-	50	100	3	4
EE14 506	Electrical Material Science	3	1	-	50	100	3	4
EE14 507(P)	*Electrical Machines Lab I*	-	-	3	50	100	3	2
EE14 508(P)	*Integrated Circuits Lab*	-	-	3	50	100	3	2
	Total	**18**	**6**	**6**				**28**

6th Semester

Code	Subject	Hours/week			Marks			
		L	T	P/D	Inte-rnal	Sem-end		
EE14 601	Engineering Economics and Principles of Management	3	1	-	50	100	3	4
EE14 602	Linear Control System	3	1	-	50	100	3	4
EE14 603	Electrical Machines III	3	1	-	50	100	3	4
EE14 604	Microprocessors and Microcontrollers	3	1	-	50	100	3	4
EE14 605	Digital Signal Processing	3	1	-	50	100	3	4
EE14 606	Numerical Analysis and Optimization Theory	3	1	-	50	100	3	4
EE14 607(P)	*Electrical Machines Lab II*	-	-	3	50	100	3	2
EE14 608(P)	*Mini Project*	-	-	3	50	100	3	2
	Total	**18**	**6**	**6**				**28**

7th Semester

Code	Subject	Hours/week			Marks			
		L	T	P/D	Inte-rnal	Sem-end		
EE14 701	Power System Analysis	3	1	-	50	100	3	4
EE14 702	Modern Control Theory	3	1	-	50	100	3	4
EE14 703	Electric Drives	3	1	-	50	100	3	4
EE14 704	Elective I	3	1	-	50	100	3	4
EE14 705	Elective II	3	1	-	50	100	3	4
EE14 706(P)	*Power Electronics Lab*	-	-	3	50	100	3	2
EE14 707(P)	*System Simulation & Control Lab*	-	-	3	50	100	3	2
EE14 708(P)	*Project*	-	-	4	100	-	-	4
	Total	**15**	**5**	**10**				**28**

Elective I	**Elective II**
EE14 704(A) Switched Mode Power Converters	EE14 705(A) Soft Computing Techniques (G)
EE14 704(B) Electrical Machine Design	EE14 705(B) High Voltage Engineering
EE14 704(C) Generalised Machine Theory	EE14 705(C) Electric Power Utilisation
EE14 704(D) Mechatronics (G)	EE14 705(D) Professional Ethics
EE14 704(E) VLSI Design	EE14 705(E) Management Information Systems
	EE14 705(F) Satellite Communication

8th Semester

Code	Subject	Hours/week			Marks			
		L	T	P/D	Inte-rnal	Sem-end		
EE14 801	Electrical System Design	3	1	-	50	100	3	4
EE14 802	FACTs Controllers & Custom Power Devices	3	1	-	50	100	3	4
EE14 803	Power System Protection	3	1	-	50	100	3	4
EE14 804	Elective III	3	1	-	50	100	3	4
EE14 805	Elective IV	3	1	-	50	100	3	4
EE14 806(P)	Seminar	-	-	3	100	-	-	2
EE14 807(P)	Project	-	-	7	50	100	-	4
EE14 808(P)	Viva Voce	-	-	-	-	100	-	4
	Total	**15**	**5**	**10**				**30**

Elective III	**Elective IV**
EE14 804 (A) Power System Operation & Control	EE14 805 (A) Special Electrical Machines
EE14 804 (B) Biomedical Engineering(G)	EE14 805 (B) Digital Control Systems
EE14 804 (C) Optimal Control Theory	EE14 805 (C) Organisational Behaviour(G)
EE14 804 (D) Digital Image Processing	EE14 805 (D) Instrumentation Systems
EE14 804 (E) Robotics & Automation	EE14 805 (E) Embedded Systems
	EE14 805 (F) Process Control & Instrumentation

EN14 301 ENGINEERING MATHEMATICS III
(Common for all branches)

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

This course provides a quick overview of the concepts and results in complex analysis that may be useful in engineering. Also it gives an introduction to linear algebra and Fourier transform which are wealths of ideas and results with wide area of application.

Module I: Functions of a Complex Variable (13 hours)
Functions of a Complex Variable – Limit – Continuity – Derivative of a Complex function – Analytic functions – Cauchy-Riemann Equations – Laplace equation – Harmonic Functions – Conformal Mapping – Examples: e^z, sinz, coshz, $(z+{}^1/_z)$– Mobius Transformation.

Module II: Functions of a Complex Variable (13 hours)
Definition of Line integral in the complex plane – Cauchy's integral theorem (Proof of existence of indefinite integral to be omitted) – Independence of path – Cauchy's integral formula – Derivatives of analytic functions (Proof not required) – Taylor series (No proof) – Laurent series (No proof) – Singularities - Zeros – Poles - Residues – Evaluation of residues – Cauchy's residue theorem – Evaluation of real definite integrals.

Module III: Linear Algebra (13 hours) – (Proofs not required**)**
Vector spaces – Definition, Examples – Subspaces – Linear Span – Linear Independence – Linear Dependence – Basis – Dimension– Orthogonal and Orthonormal Sets – Orthogonal Basis – Orthonormal Basis – Gram-Schmidt orthogonalisation process – Inner product spaces – Definition – Examples – Inequalities ; Schwartz, Triangle (No proof).

Module IV: Fourier Transforms (13 hours)
Fourier Integral theorem (Proof not required) – Fourier Sine and Cosine integral representations – Fourier transforms – transforms of some elementary functions – Elementary properties of Fourier transforms – Convolution theorem (No proof) – Fourier Sine and Cosine transforms – transforms of some elementary functions –Properties of Fourier Sine and Cosine transforms.

Text Books

Module I:
Erwin Kreysig, *Advanced Engineering Mathematics, 8e,* John Wiley and Sons, Inc.
Sections: 12.3, 12.4, 12.5, 12.6, 12.7, 12.9
Module II:
Erwin Kreysig, *Advanced Engineering Mathematics, 8e,* John Wiley and Sons, Inc.
Sections: 13.1, 13.2, 13.3, 13.4, 14.4, 15.1, 15.2, 15.3, 15.4
Module III:
Bernaed Kolman, David R Hill, *Introductory Linear Algebra, An Applied First Course,* Pearson Education.
Sections: 6.1, 6.2, 6.3, 6.4, 6.7, 6.8, Appendix.B.1
Module IV:
Wylie C.R and L.C. Barrett, *Advanced Engineering Mathematics*, McGraw Hill.
Sections: 9.1, 9.3, 9.5

Reference books

1. H S Kasana, *Complex Variables, Theory and Applications*, 2e, Prentice Hall of India.
2. John M Howie, *Complex Analysis*, Springer International Edition.
3. Anuradha Gupta, *Complex Analysis*, Ane Books India.
4. Shahnaz bathul, *Text book of Engineering Mathematics, Special functions and Complex Variables*, Prentice Hall of India.
5. Gerald Dennis, Mahan, *Applied Mathematics*, Springer International Edition.
6. David Towers, *Guide to Linear Algebra*, MacMillan Mathematical Guides.
7. Inder K Rana, *An Introduction to Linear Algebra*, Ane Books India.
8. Surjeet Singh, *Linear Algebra*, Vikas Publishing House.
9. Howard Anton, Chris Rorres, *Elementary Linear Algebra, Applications Version*, John Wiley and Sons.
10. Anthony Croft, Robert Davison, Martin Hargreaves, *Engineering Mathematics*, Pearson Education.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EN14 302: COMPUTER PROGRAMMING IN C

(Common for all branches)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour practical per week

Objectives

- *To impart the basic concepts of computer and information technology*
- *To develop skill in problem solving concepts through learning C programming in practical approach*

Module I (10 hours)

Introduction to Computers: CPU, Memory, input-output devices, secondary storage devices, Processor Concepts - Evolution and comparative study of processors. Machine language, assembly language, and high level language. Inside a PC, Latest trends and technologies of storage, memory, processor, printing etc. Concept of Program and data, System software - BIOS, Operating System-Definition-Functions-Windows, and Linux. Compilers and assemblers, Computer networks, LAN, WiFi.

Module II (14 hours)

Basic elements of C: Flow chart and algorithm – Development of algorithms for simple problems. Structure of C program – Operators and expressions – Procedure and order of evaluation – **Input and Output functions.** *while*, *do-while* and *for* statements, *if*, *if-else*, *switch*, *break*, *continue*, *goto*, and *labels*. Programming examples.

Module III (14 hours)

Functions and Program structures: Functions – declaring, defining, and accessing functions – parameter passing methods – **Recursion** – Storage classes – *extern*, *auto*, *register* and *static*. Library functions. Header files – C pre-processor. Example programs. **Arrays**: Defining and processing arrays – passing arrays to functions – two dimensional and multidimensional arrays – application of arrays. Example programs.

Module IV (14 hours)

Structures – declaration, definition and initialization of structures, unions, **Pointers**: Concepts, declaration, initialization of pointer variables simple examples **Concept of a file** – File operations File pointer.

Text Books

1. P. Norton, *Peter Norton's Introduction to Computers*, Tata McGraw Hill, New Delhi
2. E. Balaguruswamy, *Programming in ANSI C*, Tata McGraw Hill, New Delhi

Reference Books

1. K. N. King. *C Programming: A Modern Approach*, W. W. Norton & Company
2. S .Kochan , *Programming in C*, CBS publishers & distributors
3. P. Norton, *Peter Norton's Computing Fundamentals*, Tata McGraw Hill, New Delhi
4. M. Meyer, R. Baber, B. Pfaffenberger. *Computers in Your Future*, Pearson Education India
5. B.Gottfried, *Programming with C*, Tata McGraw Hill, New Delhi
6. B. W. Kernighan, and D. M. Ritchie, *The C Programming Language*, Prentice Hall of India

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Lab Practical Tests
20% - Assignments
20% - Main Record
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 303 ELECTRIC CIRCUIT THEORY

Teaching scheme **Credits: 4**
3 hours lecture and 1 hour tutorial per week

Objectives

- *Familiarization of various network topologies related to two- phase and three- phase systems*
- *Understanding the various methods for analysis of electrical networks*
- *Design of simple analog filter circuits*

Module I (14 hours)
DC excitation: Network elements- lumped parameters, active and passive elements – Dependent and independent sources- source transformation- mesh analysis- node analysis- super mesh and super node- Superposition theorem- Star-delta transformation- Thevenin's theorem- Norton's theorem- Maximum power transfer theorem
Steady state ac analysis: Complex form - polar form, phasor representation of series circuits (current reference) - parallel circuits (voltage reference) - series parallel- parallel series combinations, series resonance and parallel resonance –band width, quality factor.

Module II (14 hours)
Locus diagram- Current phasor locus of different combinations of circuits with fixed voltage and an element varying from zero to infinity. **Coupled circuits:** dot convention, mesh analysis, node analysis
Sinusoidal steady state in 3- phase circuits: 3 phase 3 wire and 3 phase 4 wire Y and Δ connected source and load. **Analysis of unbalanced three phase circuits:** Y-Y 4 wire circuit- neutral current- neutral impedance- Y-Y system with neutral isolated (3 wire)- neutral shift - Δ-Y - Δ-Δ systems- circulating currents in unbalanced Δ connected sources – 3 phase circuits with balanced sources and unbalanced loads.

Module III (12 hours)
Measurement of power and power factor: one wattmeter, two watt meter and three wattmeter methods
Symmetrical components: Zero sequence, positive sequence and negative sequence components- active power in sequence components. **Laplace Transform:** gate function – shifting theorem- initial and final value theorem- Laplace transform of periodical signals- sinusoidal- square- inverse Laplace transform
DC Transients: Initial conditions in network- steady state and transient responses of two element circuits consisting of RL,RC and LC circuits(both classic and Laplace Transform methods) for step input- transient and steady state responses of RLC circuits with step input(Laplace transform method only).

Module IV (12 hours)
AC transients: Transient and steady state responses of R,L,C circuits for sinusoidal inputs using Laplace transform approach. **Transformed circuits:** Analysis of transformed circuits- solution of transformed circuits including mutually coupled circuits. **Network functions:** Driving point immittance & transfer immittance functions- poles& zeros- pole- zero plots- time domain response from pole-zero plots.
Two port networks: Z, Y, h parameters- relationship between parameter sets- conditions for symmetry and reciprocity- interconnections of two port networks- open circuit and short circuit

impedances- input and output impedances- image parameters- attenuation and phase constants- characteristic impedance- T-π transformation

Text Books

1. Valkenberg, *Network Analysis*, Prentice-Hall of India
2. K.S. Suresh Kumar, *Electric Circuits & Networks*, Pearson Education
3. Edminister, *Electric Circuits – Schaum's Outline Series*, McGraw-Hill.
4. William H Hayt & Jack E Kemmerly, *Engineering Circuit Analysis*, TMH

Reference Books

1. Robert Boylestad, *Introductory Circuit Analysis*, Pearson Education
1. S.D. Rajankar, Kaduskar & Shedge, Network Synthesis & Filter Design, Wiley
2. B.C. Kuo, *Network Analysis & Synthesis*, Wiley-India
3. Richard C. Dorf & J.A. Svoboda, *Introduction to Electric Circuits*, Wiley-India
4. Huelsman L.P., *Basic Circuit Theory*, Prentice Hall of India
5. Roy Choudhury, *Networks & Systems*, New Age International publishers
6. Gopal G Bhise, *Engineering Network Analysis and Filter Design*, Umesh Publications
7. Nilsson & Riedel , *Electric Circuits*, Pearson Education
8. Lawrence Heulsman, Basic Circuit Theory, Prentice Hall of India

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 304 ELECTRICAL MEASUREMENTS & INSTRUMENTATION SYSTEMS

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objective

- *Understanding the basic working principle of electrical measuring instruments*
- *To design and calibrate an electrical measuring instruments*
- *Develop an instrumentation system for a particular application*

Module 1 (13 hours)

Indicating Instruments: Principle- Types of controls (spring and gravity controls) and Types of Damping (eddy current, air friction), Moving coil instruments - Permanent magnet, dynamometer type meters, Moving iron instruments – attraction and repulsion type, Dynamometer wattmeter – principles and torque equation – Classification of errors - errors in indicating instruments and compensation, Accuracy, precision, sensitivity, resolution, loading effect. Range extension of ammeter and voltmeter by using shunts, multipliers, Current transformers and Potential transformers – Phasor diagram – ratio and phase angle errors of CT's and PT's – use of instrument transformers with wattmeter

Module II (13 hours)

Watt meters: Working principle of wattmeter – Dynamometer and induction type wattmeter's, Errors & compensation in Wattmeter.

Energy Meters: Ampere hour meter (AH mercury motor meter), 1-φ and 3-φ energy meters (principles and torque equation) – errors and compensation, static wattmeter's and energy meters - principle and block diagram,

Special purpose measuring Instruments: Power factor meters (Dynamometer type –single and three phase), Vibrating reed frequency meter - TOD meter and Tri-vector meter.

Module III (14Hrs)

Measurement of resistance: Ohmmeter, Megger – measurement of insulation resistance by direct deflection method – Testing of earth electrode resistance, localization of cable fault by Murray and Varley loop tests

DC Bridges: Introduction, sources & detectors for DC bridge, general equation for bridge at balance. Wheatstone and Kelvin's double bridge – brief description only.

AC bridges: Introduction, sources & detectors for a.c bridge, general equation for bridge at balance. Maxwell's Inductance & Maxwell's Inductance – Capacitance Bridge, Anderson bridge, Measurements of capacitance using Schering Bridge.

Potentiometers: General principle, Modern forms of dc potentiometers, standardization, Vernier dial principle, AC potentiometers – coordinate and polar types, application of dc and ac potentiometers.

Module IV (12 hours)

Magnetic measurements: Measurement of flux, magnetizing force and permeability – Hibbert's magnetic standard – flux meter – Hall Effect gauss meter.

Transducers: Definition - different types of transducers (Types & Application only).

Display methods, recorders: Different types of display devices (CRT, LED, LCD, PDP and OLED), different types of recorders – galvanometric recorders – pen driving system (Basic concepts only).

Text Books

1. A.K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and sons
2. Joseph J Carr, *Elements of Electronic Instrumentation and Measurement*, Pearson Education
3. Arun K Ghosh, *Introduction to Measurements and Instrumentation*, PHI

Reference Books

1. William David Cooper, *Electronic Instrumentation and Measurement Techniques*, PHI
2. K.B. Klaassan, *Electronic Measurements and Instrumentation*, Cambridge University Press
3. GK. Banerjee, *Electrical and Electronic Measurements*, PHI
4. John Bentley, *Principles of Measurements Systems*, Pearson Education

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 305 ANALOG ELECTRONICS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To familiarize basic electronic elements and its characteristics*
- *To develop understanding about BJT and FET circuits*
- *To study linear and non linear applications of Op-Amp*

Module I (13 hours)
Diode: Diode as a circuit element - load line - piecewise linear model – single-phase half wave and full wave rectifier circuits - voltage regulation - ripple factor - rectifier efficiency - bridge rectifier - rectifier filters - diode clipping circuits - single level and two level clippers - clamping circuits – Zener diodes - Zener voltage regulators.
BJT: Operating point of a BJT – DC biasing - bias stability - thermal runaway - AC Concepts – role of capacitors in amplifiers – common emitter AC equivalent circuit - amplifier gain and impedance calculations- h parameter model of a BJT - common emitter and emitter follower analysis and comparison using hybrid equivalent circuit –cascaded amplifiers, frequency response of amplifiers (basic concepts only).

Module II (12 hours)
FET: Construction and characteristics of JFET and MOSFET, biasing a JFET and MOSFET, JFET and MOSFET small signal model - CS and CD amplifiers.
Feedback: - Concepts – negative and positive feedback – loop gain- advantages of negative feedback -feedback connection Types - practical feedback circuits
Power Amplifiers: Considerations in cascading transistor amplifiers- class B and class AB - power amplifiers using BJT

Module III (14 hours)
Operational amplifier - Ideal Op-Amp properties - properties of practical Op-Amps - Analysis of Op-Amp circuits using ideal Op-Amp model – open loop and closed loop configuration - concept of virtual short and its relation to negative feedback
Linear Op-Amp Circuits: Non-inverting amplifier -voltage follower - inverting amplifier - summing amplifier - subtracting circuits - voltage to current converter for floating and grounded loads - Op-Amp integrator - Op-Amp differentiator
Oscillators: Basics - stability and positive feedback- Barkhausen's criterion – phase shift oscillators- Wein bridge oscillators – crystal oscillators.

Module IV (13 hours)
Signal Generators: Square, triangle and ramp generator circuits using Op-Amps, voltage controlled oscillators
Comparator Circuits: Zero crossing detector- regenerative comparator circuits
Active filters – different types and their characteristics- frequency response of different types of filters- order and cut off frequency -Butterworth low pass filter – first order and second order filter design - Butterworth high pass filters - second order wide band and narrow band filters.
Timer IC 555: Functional diagram- astable and monostable modes
Phase locked loops: Principles – building blocks of PLL-Lock and capture ranges - capture process - frequency multiplication using PLL

Text Books

1. Allen Mottershead, *Electronic Devices and Circuits: An Introduction*, Prentice Hall of India.
2. V. Boylestad and Nashelsky, *Electronic Devices and Circuits*, Pearson Education
3. Ramakant A Gayakwad, *Op- Amps and Linear Integrated Circuits*, Prentice Hall of India

Reference Books

1. Schilling and Belove, *Electronic Circuits*, McGraw Hill
2. Theodore F. Bogart Jr., *Electronic Devices and Circuits*,
3. Coughlin and Driscoll, *Operational amplifiers and Linear Integrated Circuits*,
4. K. R. Botkar, *Integrated Circuits*, Khanna Publishers
5. Somanathan Nair, *Linear Integrated Circuits – Analsysis, Design & Application*, Wiley-India

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of BJT, MOSFET or Opamp systems using any technical computing software

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE 14 306 MECHANICAL ENGINEERING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basics of the application of dynamics, heat transfer, fluid mechanics, and hydraulic machines.*

(Steam table and Psychometric chart are permitted for the examination.)

Module 1 (13 Hrs.)
Fluid Mechanics
Fluid properties, Newton's Law of viscosity, Pressure, Measurement of Pressure, Pascal's law. Continuity equation, Euler's equation, Bernoulli's equation. Flow measuring instruments-Venturimeter, orifice meter, Pitot tubes (Simple numerical problems.)
Themodynamics
Definitions and basic concepts – systems, properties, state, process and cycle, Thermodynamic equilibrium , Zeroth law , Work and Heat , First law – internal energy and enthalpy, Heat engine Refrigerator and heat pump, Second law –entropy, Thermodynamic processes – isometric, isobaric, isothermal, poly tropic, adiabatic and isentropic, PV and TS diagrams. (Simple numerical problems.)

Module 2 (13 Hrs.)
Hydraulic machines
Turbines - Pelton Wheel – major parts, construction, working , Francis turbine - major parts, construction, working, Kaplan turbine - major parts, construction, working - Heads and efficiencies, specific speed, unit quantities, Characteristic Curves . (simple problems)
Pumps - Centrifugal Pump - major parts, construction, working, Heads and Efficiencies ,Specific Speed, Characteristic Curves, Cavitation, Maximum Suction Lift, Net Positive Suction Head (NPSH) Reciprocating pumps - major parts, construction, working, discharge, work done, power required and slip in a reciprocating pump. (simple problems)

Module 3 (13 Hrs.)
Applied thermodynamics
Properties of steam, saturation temperature, dryness fraction, degree of super heat, specific volume, enthalpy and entropy (Simple numerical problems.)
Vapour power cycle-Carnot cycle, Rankine cycle- thermal efficiency, work ratio and specific steam consumption, methods of improvement of thermal efficiency –regeneration and reheat. (Simple numerical problems.)
Gas power cycles- Carnot cycle, Otto cycle,Diesel cycle- thermal efficiency Brayton cycle thermal efficiency and work ratio, methods of improvement of thermal efficiency - regeneration, inter cooling and reheat. (Simple numerical problems.)
Refrigeration cycles-Reversed Carnot cycle, vapour compression refrigeration cycle, gas refrigeration cycle (Simple numerical problems.)

Module4 (13 Hrs.)
Heat Transfer
Modes of Heat Transfer, Conduction-Fourier Law of Conduction, Thermal Conductivity, Conduction Through Slab, composite wall, cylinder, Convection, Heat Transfer Coefficient, Natural and Forced Convection, Combined Conduction and Convection, concept of thermal resistance. Critical thickness of insulation. Fins and their application. Radiation, Concept of Black Body, Monochromatic and Total Emissive Power, Concept of Gray Body and Emissivity,

Kirchhoff's Law, Heat Exchangers, LMTD, Overall Heat Transfer Coefficient, parallel and counter flow heat exchangers (Simple numerical problems).

Reference Books

1 Dr.D.S.Kumar, *Fluid Mechanics and Fluid Power Engineering*, S.K.Kataria and Sons.
2 Dr.R.K.Bensal, *Fluid Mechanics and Hydraulic Machine*, Laxmi Publications (P) Ltd.
3 P.K.Nag, *Engineering Thermodynamics*, Tata McGraw Hill
4 Domkundwar & Kothandaraman, *Thermal Engineering*, Dhanpat Rai & Co. (P) Ltd.
5 D.S.Kumar, *Heat Transfer*, S. K.Kataria and Sons
6 P. K. Nag, *Heat Transfer*, Tata McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE 14 307(P) BASIC ELECTRICAL ENGINEERING LAB

Teaching Scheme **Credits**: 2
3 hours practical per week

Objectives

- *Implementation of basic electrical circuits and verification of basic theorems*

1. Study of PMMC/MI voltmeter/ammeter, dynamometer type wattmeter, clip on ammeter, analog/digital multimeters and static energy meters.
2. Determination of V-I characteristics of a) wire wound rheostat and b) incandescent lamps in series & parallel.
3. Measurement of linear resistance using voltmeter-ammeter method
4. Verification of Kirchoff's laws in DC circuit
5. Verification of Superposition theorem in DC circuit
6. Verification of Thevenin's theorem in DC circuit
7. Verification of Reciprocity theorem in DC circuit
8. Determination of impedance, admittance, power factor and real/reactive/apparent power drawn in RLC series/parallel circuits.
9. Single phase power measurement using a) dynamometer type wattmeter b) 3 ammeters method and c) 3 voltmeters method in an RL load.
10. 3-phase power measurement using one wattmeter and two wattmeters.
11. Power factor improvement in an RL circuit

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EE14 308(P) ELECTRONICS LABORATORY

Teaching Scheme **Credits**: 2

3 hours practical per week

Objectives

- *To familiarize the various instruments used in electronics lab*
- *To familiarize and conduct experiments on various analog electronic circuits*
- *To introduce the concept of electronic circuit simulation*

1. Study & Use of CRO: a) Measurement of current voltage, frequency and phase shift.
2. Rectifiers and filters with and without shunt capacitors- Characteristics full wave rectifier- Ripple factor, Rectification efficiency, and % regulation.
3. Second order LP and BP filters using single OPAMP
4. RC coupled amplifier using BJT in CE configuration- Measurement of gain, input and output impedance and frequency response
5. FET amplifier- Measurement of voltage gain, current gain, input and output impedance
6. Characteristics of clipping and clamping circuits using diodes.
7. Characteristics of voltage regulators- Design and testing of: a) simple zener voltage regulator b) zener regulator with emitter follower output
8. OPAMP circuits – Design and set up of inverter, scale changer, adder, non-inverting amplifier, integrator, differentiator, comparator.
9. Phase shift and Wein's Bridge oscillator with amplitude stabilization using OPAMPs.
10. Waveform generation – Square, triangular and sawtooth wave form generation using OPAMPs.
11. Introduction to circuit simulation-simulation of OPAMP and other analog IC circuits.

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EN14 401B: ENGINEERING MATHEMATICS IV

(Common for IC, EC, EE, AI, BM, CS, and IT)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To inculcate the students an adequate understanding of the basic concepts of probability theory.*
- *To make them develop an interest in the area which may find useful to pursue their studies*
- *To stimulate the students understanding of the z-transform*
- *To make the student get acquainted with the basics of PDE*

Module I: Probability Distributions (13 hours)

Random variables – Mean and Variance of probability distributions – Binomial Distribution – Poisson Distribution – Poisson approximation to Binomial distribution – Hyper Geometric Distribution – Geometric Distribution – Probability densities – Normal Distribution – Uniform Distribution – Gamma Distribution.

Module II: *Z* – Transforms (13 hours)

Some elementary concepts – Definition of ***Z***-transform – Convergence of ***Z***-transform – Examples of ***Z***-transform – Properties of ***Z***-transform – Inverse ***Z***-transform – Convolution Theorem

Module III: Series Solutions of Differential Equations (13 hours)

Power series method for solving ordinary differential equations – Frobenius method for solving ordinary differential equations – Bessel's equation – Bessel functions – Generating functions (No proof) – Relation between Bessel functions – Orthogonality property of Bessel functions (Proof not required).

Module IV: Partial Differential Equations (13 hours)

Introduction – Solutions of equations of the form $F(p,q) = 0$; $F(x,p,q) = 0$; $F(y,p,q) = 0$; $F(z,p,q) = 0$; $F_1(x,q) = F_2(y,q)$; Clairaut's form, $z = px + qv + F(p,q)$; Legrange's form, $Pp + Qq = R$ – Classification of Linear PDE's – Derivation of one dimensional wave equation and one dimensional heat equation – Solution of these equation by the method of separation of variables.

Text Books

Module I:

Richard A Johnson, CB Gupta, *Miller and Freund's Probability and statistics for Engineers, 7e*, Pearson Education - Sections: 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 5.1, 5.2, 5.5, 5.7

Module II:

Babu Ram, *Engineering Mathematics Vol. II, 2/e*, Pearson Education.
Sections: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7.

Module III:

Erwin Kreysig, *Advanced Engineering Mathematics, 8e,* John Wiley and Sons, Inc.
Sections: 4.1, 4.4, 4.5

Module IV:

N Bali, M Goyal, C Watkins, *Advanced Engineering Mathematics, A Computer Approach, 7e*, Infinity Science Press, Fire Wall Media.
Sections: 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9

Erwin Kreysig, *Advanced Engineering Mathematics, 8e,* John Wiley and Sons, Inc.
Sections: 11.2, 11.3, 9.8 Ex.3, 11.5

Reference books

1. H Parthasarathy, *Engineering Mathematics, A Project & Problem based approach,* Ane Books India.
2. B V Ramana, *Higher Engineering Mathematics,* McGrawHill.
3. J K Sharma, *Business Mathematics, Theory and Applications,* Ane Books India.
4. Wylie C.R and L.C. Barret, *Advanced Engineering Mathematics*, McGraw Hill.
5. V R Lakshmy Gorty, *Advanced Engineering Mathematics-Vol. I, II.*, Ane Books India.
6. Sastry S.S., *Advanced Engineering Mathematics-Vol. I and II*., Prentice Hall of India.
7. Michael D Greenberg, *Advanced Engineering Mathematics*, Pearson Education.
8. Lary C Andrews, Bhimsen K Shivamoggi, *Integral Transforms for Engineers*, Prentice Hall of India.
9. Babu Ram, *Engineering Mathematics Vol.I & II*, Pearson Education.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EN14 402 Environmental Science

(Common for all branches)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To understand the problems of pollution, deforestation, solid waste disposal, degradation of environment, loss of biodiversity and other environmental issues at local and global levels.*
- *To create awareness among the students to address these issues and conserve the environment in a better way.*

Module I (13 hours)

The multidisciplinary nature of environmental science - definition - scope and importance - need for public awareness-natural resources-renewable and non-renewable resources: natural resources and associated problems - forest resources: use and over-exploitation, deforestation, case studies. timber extraction, mining, dams and their effects on forests and tribal people - water resources: use and over utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems.- mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies.- food resources: world food problems, changes caused by agriculture over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - energy resources: growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources, land resources: land as a resource, land degradation, man-induced landslides, soil erosion and desertification.

Module II (13 hours)

Ecosystems - concept of an ecosystem-structure and function of an ecosystem - producers, consumers, decomposers - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - introduction, types, characteristics features, structure and function of the following ecosystems: forest ecosystem- grassland ecosystem - desert ecosystem - aquatic ecosystem (ponds, streams, lakes, rivers, oceans , estuaries)

Biodiversity and its consideration: introduction - definition: genetic, species and ecosystem diversity -bio-geographical classification of India - value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values - biodiversity at global, national, and local level - India as mega-diversity nation - hot spot of biodiversity - threats to biodiversity: habitat loss, poaching of wild life, man- wild life conflicts - endangered and endemic species of India - conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Module III (13 hours)

Environmental pollution: definition, causes, effects and control measures of: air pollution - water pollution - soil pollution - marine pollution - noise pollution - thermal pollution - nuclear hazards -Solid waste management: causes, effects and control measures of urban and industrial wastes; e-waste management-role of an individual in prevention of pollution - pollution case studies - disaster management: floods , earth quake, cyclone and landslides - environmental impact assessment

Module IV (13 hours)

Environment and sustainable development - Sustainable use of natural resources - conversion of renewable energy resources into other forms - case studies - problems related to energy and energy auditing - water conservation, rain water harvesting, watershed management - case studies - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust - waste land reclamation - consumerism and waste products - reduce, reuse and recycle concept of products - value education for environment conservation, global conservation movements and agreements, green economy, carbon foot print, carbon trading.

Text Books:

1. Daniels & Krishnaswamy, Environmental studies, Wiley India Pvt Ltd, 2009

2. Raman Sivakumar, Introduction to environmental science and engineering, 2nd edn, . Tata McGraw Hill, 2010

3. Anindita Basak, Environmental Studies, Pearson Education, 2009

4. Suresh K.D, Environmental Engineering and Management, Katson Books, 2007

5. Benny Joseph, Environmental studies, 2nd edn, McGraw Hill, 2009

References:

1. Raghavan Nambiar, K Text book of Environmental Studies, Scitech Publishers(India) Pvt. Ltd

2. S.P Misra, S.N Pandey, Essential Environmental studies, Ane books, Pvt Ltd, 2009

3. P N Palanisamy, P Manikandan, A Geetha, Manjula Rani, Environmental Science, Pearson Education, 2012

3. D.L. Manjunath, Environmental Studies, Pearson Education, 2011

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Attendance and Regularity in the class

Note: Field work can be visit to a local area to document environmental assets-river/forest/grass land/mountain or visit to local polluted site-urban/rural/industrial/agricultural etc. or study of common plants, insects, birds etc. or study of simple ecosystems-pond, river, hill slopes etc. or mini project work on renewable energy and other natural resources , management of wastes etc.

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 403 ELECTRICAL MACHINES I

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *Study the basic working principles of electrical machines*
- *Study the performance analysis of electrical machines*
- *Study the basic concepts of electrical machine design*

Module 1 (14hours) : Construction of DC Machine – Principle of operation - Types of Windings – Simplex lap and wave windings (developed winding diagram for assignment only.) - EMF equation-Armature reaction -Demagnetising and cross magnetizing ampere turns-Commutation-Reactance voltage-Interpoles-Compensating winding - DC Generators-Types-Separately excited and self excited-shunt , series and compound wound generators-Performance characteristics - applications - Parallel operation of DC generators

Module II (14 hours) : DC Motors-Principle of operation-Back emf-Torque and speed equations -Types- Performance characteristics applications - Starting-Need for starter- -design of starter resistance - Speed control- Theory of armature and field control methods-Solid state speed control methods-Series motor speed control - Losses and efficiency –Condition for maximum efficiency-Testing-Swinburne's test -Hopkinson's test- -Retardation test- Separation of losses.

Module III (14 hours) : Transformers-Types-Construction-Principle of operation-emf equation-phasor diagram-equivalent circuit- Per unit resistance and reactance of transformers-Voltage Regulation - losses-efficiency-SC & OC test- -Sumpner's test- Separation of losses - Parallel operation(with equal turns ratio) - Auto transformer-Comparison with two winding transformer – 3-phase transformer – Types of transformer connections Δ-Δ, Y -Y, Δ-Y, Y-Δ, V-V –Tap changing transformers-On load and Off load tap changing-Cooling of transformers

Module IV (10 hours) : Design fundamentals – DC machines –-specific loading- choice of specific electric and magnetic loadings - output equation- main dimensions-separation of D and L-choice of speed and number of poles--. Transformer design - specific loading –staking factor and window space factor-output equation & window dimensions- single phase and three phase core type transformers- -square and cruciform cross sections only.

Text Books

1. Clayton & Hancock, *Performance & Design of DC machines*, ELBS
2. P.S. Bhimbra, *Electrical Machinery*, Khanna Publishers
3. M.N.Bandyopadhyay, *Electrical Machinery*, Prentice Hall of India

Reference Books

1. Fitzgerald A.E and Kingsley, *Electrical Machinery*, Mc Graw Hill
2. Langsdorf A S, *Theory of A C Machinery*, Mc Graw Hill
3. Nagrath I J and Kothari D P, *Electric Machines*,Tata Mc Graw Hill
4. Stephen J Chapman, *Electric Machinery Fundamentals*, Mc Graw Hill.
5. Vincent Del Toro, *Electrical Machines and Power Systems*, Prentice Hall
6. Charles Hubert, *Electric Machines*, Pearson Education
7. K. Murukesh Kumar, *DC Machines and Transformers*, Vikas Publishing House

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
Note: One of the assignments shall be drawing of dc windings using Autocad

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 404 SIGNALS & SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *Understand the concepts of signals and systems*

Module 1 (14 hours)
Signals – classification – continuous-time/discrete-time, deterministic/non-deterministic, periodic/ aperiodic, even/odd, energy/power signals – elementary signals – exponential, sinusoidal, unit step, impulse, ramp – time-shifting, scaling, folding . Systems – classification – continuous-time/discrete-time, static/dynamic, linear/non-linear, time-invariant/variant, causal/non-causal, stable/unstable - Linear Time Invariant (LTI) systems – impulse response – convolution integral – convolution sum – condition for BIBO stability for CT and DT systems in terms of impulse response.

Module II (16 hours)
Representation of signals – Periodic signals – continuous-time fourier series (CTFS) – Trigonometric and exponential – symmetry conditions – amplitude & phase spectrum – properties of CTFS – Parserval's theorem for power signals – power spectral density.
Steady state solution of electric circuits with non-sinusoidal periodic inputs using Fourier series – effective values of voltages and currents – power due to non-sinusoidal voltages and currents. [Ref.Book. 3]
Non-periodic signals - continuous-time fourier transform (CTFT) – amplitude & phase spectra - gate function – sampling function – properties – convolution – Parseval's theorem for energy signals – energy-spectral density - Frequency response - Linear Constant-Coefficient Differential equations - review of Laplace transform – transfer function - relation between Laplace transform and Fourier transform - poles and zeros – pole-zero plots - basic concept of BIBO stability.

Module III (12 hours)
Periodic signals - Discrete-time Fourier series (DTFS) – properties of DTFS – aperiodic signals – discrete-time fourier transform (DTFT) – properties of DTFT - Parseval's theorem – energy spectral density – – frequency response - sampling – sampling theorem – impulse train - Nyquist rate - aliasing.

Module IV (10 hours)
Linear Constant-Coefficient Difference Equations (LCCDE) – Review of Z-transform – Region of Convergence (ROC) – importance of ROC - properties – inverse Z-transform by long division method & partial fraction expansion method – one-sided Z-transform – properties – initial value & final value theorem - solution of LCCDE with initial conditions –zero input response and zero state response - system function – impulse response - poles and zeros – basic concept of BIBO stability.

Text Books

1. Simon Haykin & Barry Van Veen, *Signals and Systems*, Wiley-India
2. Oppenheim A. V. & Schafer R. W., *Signals and Systems*, Pearson Education
3. Proakis J. G. & Manolakis D. G., *Digital Signal Processing, Principles, algorithms & applications*, Pearson Education.

Reference Books

1. Charles L. Phillips, John M. Parr & Eve A Riskin, *Signals, Systems and Transforms*, Pearson Education
2. D. Ganesh Rao & Satish Tunga, *Signals and Systems*, Sanguine Technical Publishers
3. Roy Choudhury, *Networks & Systems*, New Age International publishers
4. S.Palani , *Signals and Systems*, Ane Books Pvt. Ltd
5. V. Krishnaveni & R. Rajeswari, *Signals & Systems*, Wiley-India
6. Anand Kumar, *Signals & Systems*, Prentice-Hall of India
7. Guru, *Signals & Systems*, Prentice-Hall of India

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

Note : One of the assignments shall be determination of CTFS, amplitude spectrum, DTFT, Z-transform or other basic operations on signals & systems using softwares like MATLAB, Skylab etc.

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 405 DIGITAL ELECTRONICS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *Creation of awareness about the basic principles of digital electronics.*
- *Study of the logic design techniques.*
- *Understanding the concepts behind the hardware implementation of a digital computer.*

Module I (13 hours)
Logic gates and Boolean algebra

Ideal Logic Gates-Truth Tables of basic gates- Number Systems-Binary Numbers-Hexadecimal Numbers-Complements- Signed and unsigned numbers-one's complement and two's complement-Arithmetic operations of Binary and Hexadecimal Numbers-Binary codes - Boolean Functions-Canonical and Standard forms-Simplification of Boolean Functions by Karnaugh Map up to five variable map-NAND, NOR implementation.

Module II (13 hours)
Combinational circuits and Memories

Code Converters –- Adders-Subtractors- BCD Adder-Magnitude Comparator-Decoders and Encoders-Multiplexers and Demultiplexers
Implementation of Combinational Logic by using Multiplexers, ROM, PLA and PAL.
Memories - ROM, Static and Dynamic RAM, Read/Write Memory, EPROM, EEPROM, Memory Decoding.

Module III (13 hours)
Sequential Circuits

Comparison of sequential and combinational circuits-Latches, Flip Flops - RS , JK , T and D Flip Flops - Triggering of Flip Flops
Registers - Shift Registers –Different types-bidirectional shift register- Ring Counter - Johnson Counter.
Ripple Counters –Counters with truncated sequences.
Synchronous Counters – design of synchronous counters-state tables and state diagrams-state reduction and assignment-Flip Flop Excitation Tables

Module IV (13 hours)
Microprocessor 8085

Basic concepts of Microprocessor-Internal Architecture of 8085- register structure-Bus structure-Instruction set- Addressing modes-Simple programs-Timing diagram- Interrupts.
Programmable Peripheral interface (8255) – Mode 0,1,2 operations – Interfacing with 8085-programs – A/D and D/A interfacing.

Text Books

1. Thomas L Floyd, *Digital Fundementals* , Pearson Education
2. Ramesh S. Gaonkar, *Microprocessing Architecture- Programming and Application*, Wiley- Eastern.(Module IV)

Reference Books

1. A. Anand Kumar, *Digital Circuits*, PHI.
2. B. Ram, *Fundamentals of Microprocessors and Microcontrollers*, PHI
3. B. Somanathan Nair, *Digital Electronics and Logic Design*, PHI
4. John M. Yarbrough, *Digital Logic Application Design*, P W S Publishing Company
5. Maini, *Digital Electronics-Principles & Integrated Circuit*s, Wiley-India

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simple assembly language programs to be done in 8085 microprocessor kit.

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 406 ELECTROMAGNETIC FIELD THEORY

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *Understanding the basic principle of Electric and Magnetic Fields.*
- *Studying the governing relations between electric and magnetic fields.*
- *Studying the principle behind electromagnetic wave propagation.*

Module I (16 hours)

Introduction: Significance of electromagnetic models

Orthogonal Co-ordinate Systems: Cartesian coordinates-Cylindrical Coordinates-Spherical Coordinates-transformation between ordinate systems

Gradient of scalar field: Gradient operator in cylindrical and spherical coordinates

Divergence of a vector: Physical significance-Divergence Theorem

Curl of a vector field: Physical significance-Stoke's theorem

Static Electric fields: Fundamental postulates of electrostatic in free space-Coulomb's law-electric field due to discrete charges-continuous distribution of charge-Gauss Law and its applications-Electric potential due to discrete charges and charge distribution-Electric dipole-Conductors in static field-Dielectrics in static field-electric flux density and dielectric constant-Boundary conditions for electrostatic field-Capacitance-capacitances in multi-conductor system-electrostatic shielding-Electrostatic energy and forces.

Solutions of Electrostatic Problems: Poisson's and Laplace's Equations-Uniqueness of Electrostatic Solutions-Method of images-Boundary Value problems in Cartesian ordinates.

Module II (14 hours)

Steady Electric Current: Current density and ohms law- electromotive force and kirchoff's law-Equation of continuity and kirchoff's current law-power dissipation and joule's law-Boundary condition for current density-Resistance calculations.

Static Magnetic field: Fundamental postulates of magnetostatics in free space-Vector magnetic Potential-The Biot-Savart law and its applications-The magnetic dipole-Scalar magnetic potential-Magnetisation and equivalent current density-Magnetic field intensity and relative permeability – Behaviour of magnetic materials-Boundary condition for magnetostatic fields - Inductance and inductors-Magnetic energy—Magnetic torque and force-hall effect-Forces and torque on current carrying conductors-forces and torques in terms of stored magnetic energy-in terms of Mutual inductance.

Module III (11 hours)

Faraday's law of electromagnetic Induction: Stationary loop in a time varying magnetic field-Ideal transformer - moving conductor in a Static magnetic field - the electromagnetic generator-Moving conductor in a time varying field - displacement current - continuity equation, Displacement current

Maxwell's equation: Differential and integral forms-its physical interpretations- Potential functions - **Electromagnetic boundary conditions**: Interface between two lossless media-Interface between a dielectric and perfect conductor - **Wave equation and their solution:** Solution of wave equation for potentials-source free wave equations - **Time Harmonic Fields**: The use of phasors-Time harmonics electromagnetics-source free field in simple media-the electromagnetic spectrum

Module IV (11hours)

Plane Electromagnetic Waves: Plane waves in lossless media—Doppler effect-Transverse electromagnetic waves-Polarization of plane waves-Plane waves in lossy media-low loss dielectrics-good conductors-ionized gases-Group velocity

Flow of electromagnetic Power and Poynting vector: instantaneous and average power densities.

Normal incidence: normal incidence at plane conducting boundaries-plane dielectric boundaries-multiple dielectric interface.

General Transmission line equations: Wave characteristics on an infinite transmission lines-Transmission line parameters-Characteristic impedance-Reflection fundamentals -at short circuit and open circuit reflection coefficients.

Text Books

1 David K. Cheng, *Field and Wave Electromagnetics* , Pearson Education
2 Fawwaz T.Ulaby, *Electromagnetic for engineers,* Pearson Education

Reference Books

1 Nannapaneni Narayana Rao, *Elements of Engineering Electromagnetics*, Pearson Education
2 W. H. Hayt, *Engineering Electromegnetics*, McGraw Hill
3 Mattew N.O Sadiku, *Elements of Electromagnetics,* Addison – Wesley,2-nd edition
4 Guru and Hiziroglu, *Electromagnetic Field Theory- Fundamentals*,
5 Pramanik, *Electromagnetism, Theory and Applications*, Prentice Hall of India
6 David J. Griffiths, *Introduction to Electro Dynamics*, Prentice Hall of India
7 Umran S Inan & Aziz S Inan, *Engineering Electromagnetics*, Pearson
8 John Reitz, Frederick Milford & Robert Christy, *Foundations of Electromagnetic Theory*, Pearson
9 Gottapu Sasibhushana Rao, *Electromagnetic Field Theory & Transmission Lines*, Wiley-India
10 Dash & Khundia, *Fundamentals of Electromagnetic Theory*, PHI
11 Lonngren, *Fundamentals of Electromagnetics with MATLAB*, PHI
12 Somanathan Nair & Deepa, *Applied Electromagnetic Theory*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 407(P): MECHANICAL ENGINEERING LAB

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To strengthen the knowledge on principles of fluid mechanics and hydraulic machineries through experiments.*
- *To equip the students to carry out experiments, and to train them to analyse, report and infer the results.*
- *To acquaint the students with the measurement of various mechanical parameters.*

1. Study of plumbing tools and pipe fittings
2. Study of discharge measuring instruments
3. Measurement of pressure and velocity
4. Calibration of venturimeter, orifice meter, notches and weirs, nozzle meters, and rotameters
5. Pipe friction – Darcy's and Chezy's constants, Minor losses in pipes - verification of Bernouli's theorem
6. Performance of turbines – operating characteristics: Pelton and Francis turbine
7. Performance of pumps - Operating characteristics : Centrifugal and Reciprocating pumps
8. Study of heat transfer equipments
9. Measurement of thermal conductivity of a metal rod
10. Performance studies on a shell and tube heat exchanger
11. Study of systems of petrol and diesel engines
12. Constant speed performance characteristics of petrol and diesel engines.

Reference Books

1. I. H. Shames, *Fluid Mechanics*, 4th Edition, McGraw Hill
2. J. P. Holman, *Experimental Methods for Engineers*, McGraw Hill
3. D. G. Shepherd, *Principles of Turbo Machinery*, McMillan
4. J. P. Holman, *Heat Transfer*, McGraw Hill
5. P. L. Bellani, *Thermal Engineering*, Khanna Publishers

Internal Continuous Assessment *(Maximum Marks-50)*

60%- Laboratory practical and record
30%- Test/s
10%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EE14 408(P) ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB

Teaching Scheme **Credits**: 2
3 hours practical per week

Objective

- *Calibration of various electrical measuring instruments*
- *Measurement of different physical parameters using transducers*

MEASUREMENTS LAB

1. a) Calibration of single phase energy meter by direct loading
   b) Calibration of single phase static energy meter
2. Calibration of single phase energy meter by phantom loading with and without phase shifting transformer
3. Calibration of 3-phase energy meter a) phantom loading b) using phase shifting transformer
4. Measurement of self and mutual inductance a) air cored coil b) iron cored coil
5. a) Determination of B- H curve
   b) Determination of hysteresis loop using six point method .
6. Calibration of ammeter, voltmeter and wattmeter using vernier potentiometer

INSTRUMENTATION LAB

1. Measurement of resistance using Wheastone's Bridge and Kelvin Double bridge
2. Extension of range of wattmeter using CT & PT
3. Measurement of displacement using LVDT
4. Measurement of current/ voltage using Hall effect transducer
5. Thermocouple based ON – OFF controller
6. Measurement of physical quantities – strain, torque and angle
7. Measurement of temperature by RTD method

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EE14 501: POWER ELECTRONICS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *Study the basic concepts of power electronics*
- *Study the different types of power electronic converters*
- *Analyse power electronic circuits*

Module I (14hours) Structure, static characteristics & switching (turn-on & turn-off) characteristics of Power Diode, Silicon Controlled Rectifier (SCR) - di/dt & dv/dt protection - structure of TRIAC, GTO, Power Transistor, Power MOSFET & IGBT –Comparison – turn-on methods of SCR – gate triggering circuits – R, RC, UJT triggering circuits - two transistor analogy - series and parallel connection of SCRs – commutation circuits for SCR – class A, B, C, D, E & F commutation.

Module II (14 hours)
Controlled rectifiers – half-wave controlled rectifier with R load – 1-phase fully controlled bridge rectifier with R load – with RL load with continuous & discontinuous conduction - with RLE load with continuous conduction (ripple free) -1-phase half controlled bridge rectifier with R, RL, RLE loads – 3-phase half-wave converter with R load – 3-phase fully controlled & half-controlled converter with RLE– waveforms – 1-phase & 3-phase dual converter with & without circulating current – four-quadrant operation

Module III (14 hours) : Inverters – 1-phase half-bridge & full bridge inverter with R & RL loads — voltage control - Pulse Width Modulation – single pulse width, multiple pulse width & sine PWM 3-phase bridge inverter with R load - 120° & 180° conduction mode –-
AC voltage controllers ACVC – 1-phase full-wave ACVC with R, L & RL loads – waveforms – RMS output voltage, input power factor with R load . Cycloconverter – midpoint type & bridge type - 1-phase step-up & step-down – with R & RL loads - waveforms

Module IV (10 hours)
DC-DC converters –DC choppers- (for dc motor load) – two-quadrant & four quadrant operation – pulse width control & current limit control –buck-boost converters –Switched Mode Power Supply (SMPS) – Block Diagram of SMPC-comparison with linear power supply

Text Books

1. Muhammad H. Rashid, *Power Electronics Circuits, Devices and Applications*, Pearson Education
2. Mohan, Undeland, Robbins, *Power Electronics, Converters, Applications & Design*, Wiley-India
3. L. Umanand, *Power Electronics – Essentials & Applications*, Wiley-India

Reference Books

1. P.S. Bimbhra, *Power Electronics*, Khanna Publishers, New Delhi
2. Alok Jain, *Power Electronics: Devices, Circuits and Matlab Simulations*, Penram International Publishing (India) Pvt. Ltd.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
Note : One of the assignments shall be simulation/hardware implementation of any one power electronic converter

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 502 ELECTRICAL POWER GENERATION TRANSMISSION AND DISTRIBUTION

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To understand the various conventional and non- conventional energy sources.*
- *To develop an understanding about transmission and distribution systems.*
- *To evaluate the performance of transmission lines*

Module I (13 Hrs)

Conventional & non-conventional sources of energy (basic concepts only)– thermal, hydroelectric, diesel, nuclear power plants - solar, wind geothermal, tidal, MHD power Generation.[Layout & description needed] – Power Plant economics-load factor – demand factor – diversity factor – plant factor – tariff – depreciation – economics of pf improvement – capacity of phase advancing plant.

Module II (13 Hrs)

Overhead Transmission Systems**:** Arrangement of conductors, calculation of sag and tension, transmission line supports and their location, economic span, choice of transmission voltage, line insulation types, string efficiency, impulse ratio, arcing horns and rings, failure of insulation.
Corona: Disruptive critical voltage, advantages and disadvantages of corona

Module III (13 Hrs)

Distribution systems – classification and arrangement of distribution systems –Voltage drop calculations in radial and ring mains – comparison of different systems - DC, AC - single phase, three phase 3 wire - 4 wire systems
Underground cables: Different types, insulation resistance, capacitance of single core cables, grading of cables, capacitance of three core cables, sheath effects.

Module IV (13 Hrs)

Performance of Transmission Lines: Calculation of transmission line inductance and capacitance, GMD and GMR, bundled conductors, transposition, representation of short, medium and long lines, ABCD constants**,** Effect of capacitance: Nominal **T** and π methods of calculations, rigorous solution of long lines., power flow through a transmission line.

Text Books

1. Soni, Gupta, Bhatnagar, *A Course in Electrical Power*, Dhanpat Rai & Sons
2. S. Sivanagaraju & S Satyanarayana, *Electric Power Transmission and Distribution*, Pearson Education
3. S N Singh, *Electric Power Generation, Transmission and Distribution*, PHI
4. V K Mehta, *Electric Power Systems*, S Chand & Sons

Reference Books

1. C L Wadhwa, *Electric Power Systems*, Wiley Eastern Ltd
2. S L Uppal, *Electrical Power*, Khanna Publishers
3. A S Pabla, *Electric Power Distribution Systems*, Tata McGraw Hill
4. B R Gupta, *Power System Analysis and Design*, Wheeler Publishing Company, New Delhi

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 503 ELECTRICAL MACHINES II

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To understand the basic working principle of synchronous machines*
- *To analyse the performance of synchronous machines*

Module I (15 hours)

Synchronous machines- types-constructional details-types of armature windings- double layer -integral & fractional slot – lap – single layer – hemitropic, whole-coil & mush windings - (developed winding diagram for assignment only.) - principle of operation - synchronous generators - EMF equation-winding factor- space and time harmonics - flux density distribution and their analysis- armature reaction in 3-phase and 1-phase alternators - leakage reactance - synchronous reactance - phasor diagram under loaded condition - load characteristics.

Module II (15 hours)

Voltage regulation of alternators- methods for finding regulation - emf, mmf, Potier methods-salient pole machines - two reaction theory – regulation by slip test- reluctance power - short circuit conditions-concept of transient and sub transient reactances - parallel operation of alternators- synchronising methods - two alternators in parallel – governor characteristics – load sharing - synchronising power- operation on infinite bus bars - torque angle - maximum power – power angle diagram – methods of excitation - automatic voltage regulators

Module III (10 hours)

Synchronous motors- principle of operation- operation on infinite bus bars - phasor diagrams- constant excitation and constant power output circle diagram - V curves and inverted V curves for motor and generator operations - hunting and suppression - starting methods – synchronous condenser – applications of synchronous motor

Module IV (12 hours)

Design of synchronous machines - specific loading- choice of specific electric and magnetic loadings – output equation- classification-turbo alternators- water wheel generators- -separation of D and L- main dimensions - short circuit ratio and its importance in design.

Text Books

1. M.G. Say, *Performance & Design of AC machines*, Pitman ELBS
2. P.S. Bhimbra, *Electrical Machinery*, Khanna Publishers
3. A.K. Sawhney, *A Course in Electrical Machine Design*, Dhanpat Rai & Co

Reference Books

1. Fitzgerald A.E and Kingsley, *Electrical Machinery*, Mc Graw Hill
2. Langsdorf A S, *Theory of A C Machinery*, Mc Graw Hill
3. Nagrath I J and Kothari D P, *Electric Machines*,Tata Mc Graw Hill
4. Stephen J Chapman, *Electric Machinery Fundamentals*, Mc Graw Hill.
5. Vincent Del Toro, *Electrical Machines and Power Systems*, Prentice Hall
6. Charles Hubert, *Electric Machines*, Pearson Education
7. K. Murukesh Kumar, *DC Machines and Transformers*, Vikas Publishing House

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
Note: One of the assignments shall be drawing of the construction of synchronous machines using Autocad

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 504: ANALOG & DIGITAL COMMUNICATION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of analog & digital modulation schemes*
- *To develop understanding about power line communication*

Module I (13 hours)

Amplitude Modulation: Spectrum of amplitude modulated signal-power relations-AM generation and detection- DSB SC generation and detection-SSB SC generation and detection-VSB modulation-AM transmitter and receiver-TRF and super heterodyne receivers. Frequency Modulation: Modulation index-Spectrum of FM signal-generation of FM signal-direct and indirect methods-FM demodulators- noise in FM reception- threshold effect-pre-emphasis and de-emphasis.

Module II (13 hours)

Frequency domain representation of finite energy signals and periodic signals-ESD,PSD. Convolution theorem. Random process-review of the theory of continuous random variables-joint distribution and density functions-conditional distribution functions averages-stationarity-wide sense stationarity- time averages, ergodicity. Winer-Khintchine-Einstein theorem-response of LTI system to random process, properties of Gaussian Random process-White noise.

Module III (13 hours)

Analog pulse modulation scheme: Sampling theorem for bandpass signals-PAM-generation and demodulation, PWM-PPM generation and demodulation. Digital pulse modulation scheme: PCM-DPCM and delta modulation, adaptive delta modulation. Digital pass band transmission: Principles of ASK, FSK and PSK (qualitative level) . Matched filter receiver and correlation receiver- ISI.

Module IV (13 hours)

Power line carrier Communication: Principle, purpose, types of coupling, interface equipment and communication standards. Power line modems and networks, Digital PLCC, broadband over power line, Applications .

Multiple Access: TDMA-FDMA-CDMA-Frequency hopped and direct sequence CDMA. Multiuser detection in CDMA. Cellular Concept- frequency reuse,cochannel interference-adjacent channel interference- improving capacity- cell splitting and sectoring-hand off strategies.

Computer network:- circuit switching- packet switching –basic concept of OSI Model.

Text Books

1. Simon Haykin**,** *Communication Systems*, Wiley India, New Delhi,4th Ed., 2008
2. Dennis Roddy and John Coolen**,** *Electronic Communication Systems,* PHI
3. B.P. Lathi, *Modern Digital & Analog Communication Systems*, 3rd Ed., Oxford University press
4. N.N.Biswas, *Power Line Communication*, Asia Publishing House
5. Rappaport T.S, *Wireless Communications, Principles and Practice,* PHI
6. Haykin, *An Introduction to Analog & Digital Communication,* Wiley-India

Reference Books

1. Sam Shanmugam, *Digital and Analog Communication Systems*; Wiley Student Edition McGraw Hill, New Delhi, 2003
2. Simon Haykin, *Digital Communication*, Wiley India
3. Ziemmer, *Principles of Communication*, Wiley India, New Delhi,5Ed., 2009
4. Wayne Tomasi, *Electronic Communication Systems: Fundamentals Through Advanced*, Pearson Education

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 505: DIGITAL SYSTEM DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To make students able to design and build real digital circuits*
- *To make students able to do VHDL programming*

Module I (13 hours)

Hardware description languages-HDL based digital design-VHDL hardware description language-Program structure-Types, constants and arrays-Functions and procedures-libraries and packages-structural design elements-data flow design elements- behavioural design elements-time dimension-simulation –test benches-VHDL features for sequential logic design.

Module II (13 hours)

Combinational logic design-analysis procedure-design procedure-documentation-block diagram-gate symbols-signal names and active levels-bubble-to- bubble logic design-signal naming in HDL programs-schematic structures. Circuit timing- timing diagrams- propagation delay- timing specifications.

Design using VHDL-decoders-encoders-tri state devices-multiplexer-parity generators-comparators- adders- subtractors and ALUs –combinational multiplexers.

Module III (13 hours)

Sequential logic design-clocked synchronous state machine analysis-state machine structure-output logic-characteristic equations-state table-state equations-state diagram-Flip-Flop input equations-Analysis of state machines with D Flip-Flops, JK Flip-Flops.

Synchronous state machine design- state table design example- state minimisation- state assignment- synthesis using D and JK Flip-Flops- Clocked sequential circuit design using VHDL-state machine design-state assignment-pipelined outputs.

Module IV (13 hours)

Feedback sequential circuit-basic analysis

Algorithmic state machine-introduction-components of ASM chart-salient features-examples.

Complex programmable logic devices and FPGAs-Xilinx XC 9500 CPLD family-function block architecture- nput output block architecture-switch matrix.

FPGAs-Xilinx XC4000 FPGA family-configurable logic block-input output block-programmable interconnect.

Text Books

1. John F Wakerly, *Digital Design*, Pearson Education, Delhi, 2002
2. Stephen Brown and Zvonoko Vranesic, *Fundamentals of Digital Logic with VHDL Design*, McGraw Hill(ASM)

Reference Books

1. Ian Grout, *Digital Systems Design with FPGAs*,Elsevier.
2. Morris Mano,*Digital Design*, Pearson Education, Delhi, 2002
3. Volnei A Pedroni *Digital Electronics and Design with VHDL*,Elsevier
4. R Padmanabhan, B Bala Tripura Sundari, *Design through Verilog HDL*,Wiley India
5. David Money Harris and Sarah L Harris, *Digital Design and Computer Architecture*, Elsevier
6. James R Armstrong, F Gail Gray, *VHDL Design/Representation and Synthesis*, Pearson Education, Delhi, 2002
7. Charles S. Roth, *Fundamentals of Logic Design*, Jaico Publishing House, 1999
8. B.Holdsworth, R.C Woods, *Digital Logic Design*, Newnes, Elsevier
9. Mohammad A. Karim, Xinghao Chen, *Digital Design. Basic Concepts and Principles*
10. A Anandakumar, *Digital Electronics*, Prentice Hall India Feb 2009.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of VHDL programs

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 506 ELECTRICAL MATERIAL SCIENCE

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *Understanding the properties of various materials used in electrical engineering*
- *To learn how to select proper material for a particular application.*

Module I (14 hours) : Conducting materials: Principles of Metallic conduction (free electron theory) – Fermi-Dirac distribution. Materials for resistances - (resistor, rheostat, thermostats), brushes of electrical machines, lamp filaments, fuses and solders. **Magnetic materials:** Classification of magnetic materials – Ferromagnetism – behavior below curie temperature – spontaneous magnetization and Weiss theory of ferromagnetism – Ferromagnetic materials at high temperatures, Curie- Weiss law (no derivation required) – Hard and Soft magnetic materials and applications – Ferrites – magnetic materials used in electrical machines, instruments and relays.

Module II (12 hours) : Dielectric parameters: Dielectric constant, dipole moment, polarization, polarisability, dielectric strength, homogeneity, linearity, isotropy. Dielectric polarization under static fields – derivation for Electronic, Ionic and Dipolar polarization – Internal fields in solids and liquids. **Types of dielectric materials and their static dielectric constants**: Elemental solid dielectrics, ionic – non polar solid dielectrics, polar solids. The Clausius – Mosotti Equation (Assumptions included) – Ferroelectric materials and their properties – spontaneous polarization, classification, application, ferroelectric domains (Qualitative explanations only)

Module III (14 hours) Dielectric breakdown: Mechanism of breakdown in gases – growth of current , electric discharge , factors affecting dielectric strength, field – intensified ionization by electrons ,avalanche mechanism , electron ionization coefficient, secondary ionization coefficient , Townsend's criterion for spark breakdown. **Breakdown in liquids:** colloidal theory, bubble theory, breakdown due to liquid globules, electronic theory. **Breakdown in solids:** Thermal, discharge, tracking. **Insulating materials:** Good insulator properties and classification on temperature basis – common insulator materials used in electrical apparatus – Inorganic materials(Mica , glass , porcelain ,asbestos) – Organic materials (paper, rubber ,cotton silk fiber ,wood ,plastics , Bakelite) – Liquid insulators (transformer oil) – Gaseous insulators (air , SF_6 and hydrogen) – ageing of insulators.

Module IV (12 hours) : 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. Photo voltaic conversion – Solar cells –Silicon , Cadmium sulphide and Gallium arsenide. Planner PN Junction. I-V curve of dark and illuminated junction. Solar cell parameters.

Text Books

1. Indulkar CS and Thiruvengadam S, *An Introduction to Electrical Engineering Materials, S.Chand & Co*.
2. N.P. Singh and Kotalana, *Essentials of solar cells*
3. G.N. Tiwari, *Solar Energy*, Narosa Publication
4. Seth S. P. & Gupta P. V., *A Course in Electrical Engineering Materials*, Dhanpath Rai & Sons.

References

1. A. J. Dekker, *Electrical Engineering Materials*, Prentice Hall of India
2. Agnihotri O. P. and Gupta B. K., *Solar Selective Surfaces*, John wiley.
3. Tereey, *Electrical Engineering Materials*, Mir Publishers.
4. Arumugham M., *Material Science*, Anuradha Agencies

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of continuous systems using any technical computing software

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 507(P) ELECTRICAL MACHINES LAB I

Teaching Scheme **Credits**: 2
3 hours practical per week

Objective

- *To conduct various tests on dc machines and transformers and to study the performance.*

1. Obtain the open circuit characteristics of self excited DC shunt generator at rated speed
Objectives:
a) Predetermine the OCC at different speeds
b) Determine the critical field resistance
c) Obtain maximum voltage built up with given shunt field resistance
c) Obtain critical speed for a given shunt field resistance

2. Load test on DC shunt generator
Objectives:
a) Determine the external & internal characteristics
b) Deduce the armature reaction curve

3. Brake test on DC shunt / series motor
Objectives:
Plot the following characteristics
i) Efficiency Vs Output
ii) Line current Vs Output
iii) Speed Vs Output
iv) Speed Vs Torque
v) Line current Vs Torque

4. Perform Swinburne's test on a DC shunt machine
Objectives:
Predetermine the armature current and percentage efficiency when the machine operates as a motor and as a generator for various load conditions and plot efficiency Vs output curves.

5. Hopkinson's test on a pair of DC machines
Objectives:
Determination of the efficiency of the given dc shunt machine working as a motor and generator under various load conditions.

6. Retardation test on a DC machine
Objectives:
a) Separation of hysteresis, eddy current, friction & windage losses
b) Find the moment of inertia of the rotating system

7. No load test at different excitations on a DC shunt motor
Objectives:
a) Separation of hysteresis, eddy current, friction & windage losses
b) Plot the losses vs. speed curves

8. O.C. & S.C. tests on the single phase transformer
Objectives:
Predetermination of the following
a) Efficiency at different load conditions and different power factors
b) Regulation at different load conditions and different power factors

c) Equivalent circuit referred to HV and LV sides
d) UPF load at which efficiency is maximum
f) Power factors at which regulation is maximum and zero
g) Plot % regulation vs. p.f. curves

9. Load test on the single phase transformer
Objectives:
a) Determination of the efficiency at different load conditions and unity power factor
b) Determination of the regulation at different load conditions and unity power factor
c) Plot efficient vs. output & regulation Vs output curves

10. Separation of losses in a single phase transformer
Objectives:
Separate the hysteresis & eddy current losses at different voltages & different frequencies keeping V/f constant & plot losses vs. frequency curves. Hence

i) Separate the hysteresis & eddy current losses at normal voltage & different frequencies & plot losses vs. frequency curves
ii) Separate the hysteresis & eddy current losses at normal frequency & different voltages & plot losses vs. voltage curves.

11. Sumpner's test
Objective:
a) Predetermination of efficiency at different load conditions and power factors
b) Predetermination of regulation at different load conditions and power factors
c) Plot efficiency vs. output & regulation vs. power factor curves
d) Obtain the equivalent circuit referred to LV & HV sides

12. Scott connection of the single phase transformers
Objectives:
Determine the efficiency at different load conditions when
a) Main transformer alone loaded
b) Teaser transformer along loaded
c) both transformers loaded under balanced conditions
d) both transformers loaded under unbalanced conditions
Plot efficiency vs. output curves for each case.

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EE14 508(P) INTEGRATED CIRCUITS LAB

Teaching Scheme **Credits**: 2
3 hours practical per week

Objective

- *Design and implementation of basic digital circuits*
- *Familiarisation of Hardware Description Language (VHDL)*
- *Introduction of 8085 microprocessor programming and interfacing.*

1. Design of Half adder and half subtractor circuits with NAND gates using mode control.
2. Design and realization of ripple counter using JK flip-flop.
3. Design and realization of Johnson & Ring Counter using a) JK Flip Flop b) Shift Register
4. Synchronous UP/DOWN Counter design and realization.
5. Implementation of multiplexer and demultiplexer using gates.
6. Logic circuit Implementation using multiplexer IC.
7. VHDL implementation of adder circuit and three bit counter.
8. VHDL simulation of adder circuit and counter.
9. IC 555 Applications
10. PLL IC 565/566 Frequency multiplying, FSK demodulation
11. 8085 simple programming addition, data transfer, multiplication.
12. 8085 interfacing –waveform generation-square wave generation, saw-tooth wave and triangular wave

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EE14 601: ENGINEERING ECONOMICS AND PRINCIPLES OF MANAGEMENT

(Common for CE, EE, EC, AI and BM)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Section 1: Engineering Economics

Objective

- *The prime objective of the Engineering Economics course is to make students familiar with the economic way of thinking. This course provides the students with the foundations of economic theory, tools and techniques for use in the process of efficient economic decision-making in their engineering and managerial profession*

Module I (13 Hrs)

Introduction to Engineering Economics – Technical efficiency, Economic efficiency – Cost concepts: Elements of costs, Opportunity cost, Sunk cost, Private and Social cost, Marginal cost, Marginal revenue, Profit maximisation, Break-even analysis.

Supply and Demand: Determinants of demand, Law of demand, Determinants of supply, Law of supply, Market equilibrium. Elasticity of demand – Types of elasticity, Factors affecting the price elasticity of demand.

National Income Concepts: GDP and GNP, Per capita income, Methods of measuring national income. Inflation and Deflation: Concepts and regulatory measures – Monetary policy and Fiscal policy.

Module II (13 Hrs)

Value Analysis - Time value of money - Interest formulae and their applications: Single-payment compound amount factor, Single-payment present worth factor, Equal-payment series compound amount factor, Equal-payment series sinking fund factor, Equal-payment series present worth factor, Equal-payment series capital recovery factor, Effective interest rate.

Investment criteria: Pay Back Period, Net Present Value, Internal Rate of Return, Benefit-cost ratio.

Text Books

1. Panneer Selvam, R, *Engineering Economics*, Prentice Hall of India
2. Dwivedi, D.N., *Managerial Economics*, , Vikas Publishing House

Reference Books

1. Chan S. Park, *Contemporary Engineering Economics*, Prentice Hall of India
2. Sullivan, W.G, Wicks, M.W., and Koelling. C.P., *Engineering Economy*, Prentice Hall of India
3. Prasanna Chandra, *Financial Management: Theory & Practice,* Tata-McGraw Hill,

Internal Continuous Assessment *(Maximum Marks-25)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *4x 5 marks=20 marks*

Candidates have to answer FOUR questions out of FIVE. There shall be minimum of TWO and maximum of THREE questions from each module with total FIVE questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *2 x 15 marks=30 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 50

Section 2: Principles of Management

Objective

- *To provide knowledge on principles of management, decision making techniques, accounting principles and basic management streams*

Module I (13 hours)

Principles of management – Evolution of management theory and functions of management Organizational structure – Principle and types. Decision making – Strategic, tactical & operational decisions, decision making under certainty, risk & uncertainty and multistage decisions & decision tree

Human resource management – Basic concepts of job analysis, job evaluation, merit rating, wages, incentives, recruitment, training and industrial relations

Module II (13 hours)

Financial management – Time value of money and comparison of alternative methods. Costing – Elements & components of cost, allocation of overheads, preparation of cost sheet, break even analysis. Basics of accounting – Principles of accounting, basic concepts of journal, ledger, trade, profit &loss account and balance sheet. Marketing management – Basic concepts of marketing environment, marketing mix, advertising and sales promotion. Project management – Phases, organisation, planning, estimating, planning using PERT & CPM

Reference Books

1. F. Mazda, *Engineering Management*, Addison Wesley, Longman Ltd., 1998
2. Lucy C Morse and Daniel L Babcock, *Managing Engineering and Technology*, Pearson Prentice Hall
3. O. P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai and Sons, Delhi, 2003
4. P. Kotler, *Marketing Management: Analysis, Planning, Implementation and Control*, Prentice Hall, New Jersey, 2001
5. Prasanna Chandra, *Financial Management: Theory and Practice*, Tata McGraw Hill
6. Weist and Levy, *A Management guide to PERT and CPM*, Prantice Hall of India
7. Koontz H, O'Donnel C & Weihrich H, *Essentials of Management*, McGraw Hill.
8. Ramaswamy V.S & Namakumari S, *Marketing Management : Planning, Implementation and Control*, MacMillan

Internal Continuous Assessment *(Maximum Marks-25)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *4x 5 marks=20 marks*

Candidates have to answer FOUR questions out of FIVE. There shall be minimum of TWO and maximum of THREE questions from each module with total FIVE questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *2 x 15 marks=30 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 50

EE14 602 LINEAR CONTROL SYSTEMS

Teaching scheme **Credits:** 5
4 hours lecture and 1 hour tutorial per week

Objective

- *Understanding system analysis and design in classical control theory based on time domain and frequency domain approaches.*

Module 1 (13Hrs) Principle of Automatic control- Open loop and closed loop systems – examples System modeling & approximations - modeling of electrical systems – dynamic equations using KCL & KVL of RL, RC and RLC circuits - development of block diagrams of electrical networks - block diagram reduction - signal flow graphs - Mason's gain formula -Modeling of translational and rotational mechanical systems - differential equations for mass, spring, dashpot elements - D'Alembert's principle - dynamic equations & transfer function for typical mechanical systems - analogous systems - force-voltage & force-current analogy - toque-voltage & torque-current analogy – electromechanical systems - transfer function of armature controlled dc motor & field controlled dc motor

. **Module II (13 Hrs)** Time domain analysis – continuous systems -standard test signals - transient and steady state response –first order systems - unit impulse, step & ramp responses of first order systems - second order systems -- unit step response of under damped second order systems - time domain specifications - steady state error - static position, velocity & acceleration error constants -Concept of stability - stability & location of the poles in S-plane - Routh-Hurwitz stability criterion-Root Locus Method- Construction of root locus- Effect of poles and zeros and their location on the root locus.

Module III (12Hrs) Frequency Domain Analysis- Frequency Response representation- Polar Plot-Bode Plot-Frequency Domain Specifications- Minimum phase & Non-minimum Phase Systems-Transportation Lag- Nyquist Stability Criterion—Stability from polar and Bode Plots-Relative Stability- Gain Margin and Phase Margin- M- N Circles-Nichols Chart (Concept only)

Module IV (14Hrs) Cascade Compensation- Lead, Lag and Lead- Lag compensation using RC networks- Design of lead, lag and lead- lag compensators using frequency response and root locus methods. Transfer function of PI, PD and PID controllers.

Sampled data Control Systems - data reconstruction and hold circuits- zero and first order hold –Pulse transfer function- stability in the z- plane- extension of Routh's stability criterion for discrete data systems-Jury's stability test.

Text Books

1. Nagrath & Gopal, *Control Systems Engineering*, New Age International (P) Limited
2. Katsuhiko Ogata, *Modem Control Engineering*, PHI

Reference Books

1. Kuo, *Automatic Control Systems*, PHI
2. Norman S. Nise, *Control Systems Engineering*, Wiley-India
3. K. Ogata, *Discrete- Time Control Systems*, Pearson Education
4. A. Nagoorkani, *Control Systems*, RBA Publications
5. A. Anand Kumar, *Control Systems*, PHI
6. Roy Choudhary, *Modern Control Engineering*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of a second order system, polar plot, bode plot etc using MATLAB.

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 603 ELECTRICAL MACHINES III

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objective

- *To understand the basic working principle of induction machines and special electrical machines*
- *To analyse the performance of induction machines*

Module 1 (13 Hrs)

3-phase induction motor – types – constructional features – principle of operation – slip – phasor diagram – equivalent circuit – expression for torque – torque-slip characteristics - effect of voltage variation and rotor resistance on torque slip characteristics – starting torque, maximum torque & full-load torque - no load and blocked rotor test - circle diagram – predetermination of characteristics from circle diagram – measurement of slip

Module II (13 Hrs)

Starting – methods of starting – DOL starter – autotransformer starter – star-delta starter – rotor resistance starter – design of rotor resistance starter

Improvement of starting torque – deep bar and double cage rotor – torque-slip characteristics - effects of space harmonics – cogging & crawling – single phasing

Speed control – stator voltage control – stator frequency control – pole changing – rotor resistance control – injecting emf into rotor circuit

Module III (14 Hrs)

3-phase induction motor design- specific loading-factors affecting specific electric and magnetic loadings -Output equation-separation of D and L-main dimensions only

1-phase induction motor – Principle - Double revolving field theory - equivalent circuit – analysis with equivalent circuit - types of 1-phase induction motors – split-phase motor, capacitor start motor, capacitor start & run motor, shaded pole motor, repulsion start induction motor

Induction generator – principle of operation - self-excited & line-excited induction generators - applications

Module IV (12 Hrs)

Special machines -– linear induction motors – principle of operation – construction - applications - stepper motors - reluctance motor - switched reluctance motor - Principle of operation & construction - applications - brushless DC motors - principle of operation –construction and applications

Text Books

1. M.G. Say, *Performance & Design of AC machines*, Pitman ELBS
2. P.S. Bhimbra, *Electrical Machinery*, Khanna Publishers
3. A.K. Sawhney, *A Course in Electrical Machine Design*, Dhanpat Rai & Co
4. M.N.Bandyopadhyay, *Electrical Machines-Theory & Practice*, PHI

Reference Books

1. Fitzgerald A.E and Kingsley, *Electrical Machinery*, Mc Graw Hill
2. Langsdorf A S, *Theory of A C Machinery*, Mc Graw Hill
3. Nagrath I J and Kothari D P, *Electric Machines*,Tata Mc Graw Hill
4. Stephen J Chapman, *Electric Machinery Fundamentals*, Mc Graw Hill.
5. E.G. Janardhanan, *Special Electrical Machines*, PHI Learning
6. Vincent Del Toro, *Electrical Machines and Power Systems*, Prentice Hall
7. Charles Hubert, *Electric Machines*, Pearson Education
8. K. Murukesh Kumar, *DC machines and Transformers*, Vikas Publishing House

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
Note: One of the assignments shall be drawing of the construction of induction machines using Autocad

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 604: MICROPROCESSORS & MICROCONTROLLERS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *Understanding the architecture and programming of 8086 microprocessor.*
- *Interfacing the microprocessor with the peripherals for a specific application.*
- *Understanding the architecture, programming and interfacing of basic microcontrollers.*

Module I (13 hours)
Architecture of Intel 8086 processor – Pin description – Internal Operation – Memory Decoding– 8086 configurations: Minimum mode and Maximum mode - Instruction execution – system bus timing - Timing diagrams – Interrupts : Interrupt mechanism – Types and priority – Interrupt vector table – Software interrupts – Non maskable interrupts. Direct memory access

Module II (13 hours)
8086 Addressing modes – Instruction set – Data transfer Instructions – String Instructions – Logical Instructions – Arithmetic Instructions – transfer control Instructions – Processor control instructions. Basic Concepts of modular programming – Assembler directives – Memory organization – full segments and models – Macros- Simple assembly language programs
Introduction to Pentium microprocessor – Special features - Pentium registers – Pentium memory management

Module III (13 hours)
Serial Communication Interfaces – Asynchronous communication – Synchronous communication – Programmable communication Interface (8251) – Interfacing programs –Programmable interval timer 8254 – Operating modes – Interfacing and Programming Intel 8254 – Interval timer application A/D interfacing. DMA Controller – Organization of Intel 8237 – Different modes of operation. Interrupt Controller - Organization of programmable interrupt controller 8259. Keyboard and Display interface – key board display controller – Internal block diagram of 8279. Interfacing of matrix key board, seven segment LED display using 8279 – Interfacing programs for key board and LED display.

Module IV (13 hours)
Overview of 8051 microcontrollers – Architecture – Assembly programming –data types and directives –flag bits – register banks and stack – loop and Jump instructions – call instructions – Arithmetic and Logic instructions and simple programs – 8051 interrupts – programming timer interrupts. Interfacing of microcontroller-stepper motor control

Text Books

1. Liu, Gibson, *Microcomputer systems: 8086/ 8088 family Architecture, Programming and Design*, Prentice Hall India 2004.
2. Walter A.Triebel, Avathar Singh, *The 8088 and 8086 Microprocessors Programming, interfacing Software and Hardware Applications*, Pearson Education 2008
3. Kenneth. J.Ayala, *The 8051 Microcontroller, Architecture, Programming & Applications*, Penram International .(Module IV)

Reference Books

1. John Uffen buck, *The 8086 / 8088 Family Design, Programming and Interfacing*, Prentice Hall of India, 2002
2. Brey B.B., *The Intel Microprocessor system – Architecture, programming and Interfacing*
3. Hall D.V. , *Microprocessor and Interfacing* , Tata McGraw Hill
4. Mohamed Ali Mazidi, Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded systems*, Pearson Education 2007. (Module IV- Interfacing)
5. Dr. K. Uma Rao, Dr. Andhe Pallavi, *The 8051 Microcontroller*, Sanguine Technical Publishers
6. Mathur, *Microprocessor 8086, Architecture, Programming & Interfacing*, PHI
7. Ramesh Goankar, *Fundamentals of Microcontrollers and Applications in Embedded System*s, Penram International Publishing (India) Pvt. Ltd.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be 8086 assembly language programming using microprocessor kit.

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 605: DIGITAL SIGNAL PROCESSING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *To study the various methods for the analysis of digital systems*
- *To design a digital filter for the given specifications*
- *To study the architecture of digital signal processors*

Module I (12 Hours)
Review of signals and systems – Review of discrete-time Fourier transform (DTFT) – Discrete Fourier Transform – properties – inverse DFT – relationship between DFT and Z-transform – circular convolution – linear convolution using DFT – overlap add and overlap save methods – Fast Fourier Transform (FFT) - Decimation-in-time (DIT) & Decimation-in-Frequency (DIF) FFT algorithms.

Module II (14 Hours)
Realization of IIR filters – direct form I & II – cascade – parallel – lattice-ladder – state space realizations – types I & II – realization of FIR filters – direct form – cascade – linear phase realizations – lattice form– conversion from lattice to direct form.
Analog to digital transformation – backward-difference technique – impulse invariant – bilinear transformation – warping effect.

Module III (12 Hours)
Digital filter design – design of IIR filter from analog filter – Butterworth & Chebyshev filter – low pass, high pass, band-pass and band-stop - FIR filter design – Fourier series method – design using windows – Rectangular, Bartlett, Hanning, Hamming, Blackman, Kaiser windows - comparison of FIR & IIR filters.
Finite word length effects – fixed point and floating point formats – quantization errors – limit cycle oscillations.

Module IV (14 Hours)
Multirate signal processing – sampling rate conversion methods – sampling rate conversion process – decimation & interpolation – decimation of sampling rate by integer factor – interpolation of sampling rate by integer factor – sampling rate alteration by a rational factor – implementation of sampling rate alteration – Direct-form FIR digital filter structure – polyphase digital filter structure – time-varying digital filter structure – sampling-rate conversion –first order approximation method – applications of multi-rate signal processing.
Digital signal processors – selection of digital signal processors – Von Neumann & Harvard architecture – Multiply Accumulate Unit (MAC) - architecture of DSP processor - fixed point (TMS320C54x) & floating point (TMS320C67x) (block diagram approach) - applications of digital signal processors.

Text Books

1. Oppenheim A. V. & Schafer R. W., *Discrete- time Signal Processing*, Pearson Education
2. Proakis J. G. & Manolakis D. G., *Digital Signal Processing, Principles, algorithms & applications*, Pearson Education.

Reference Books

1. Li Tan, *Digital Signal Processors- Architectures, Implementations and applications*, Academic Press (Elsevier)
2. A. V. Oppenheim & R. W. Schafer, *Digital Signal Processing*, PHI
3. Sanjit K. Mitra, *Digital Signal Processing- A computer based approach*, TMH
4. Emmanuel C. Ifeachor, Barrie W. Jervis, *Digital Signal Processing- A practical approach*, Pearson Education.
5. Ludeman, *Fundamentals of Digital Signal Processing*, Wiley-India
6. A. Nagoor Kani, *Digital Signal Processing*, TMH
7. Anand Kumar, *Digital Signal Processing*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 606 NUMERICAL ANALYSIS AND OPTIMIZATION TECHNIQUES

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart knowledge in:*
  - *Finding the numerical solution of algebraic and transcendental equations*
  - *Finding the solution of a system of linear algebraic equations*
  - *Finding the numerical solution of ordinary and partial differential equations*
  - *Different optimization techniques*

Module I (13 Hours)

Numerical Analysis - Errors in numerical calculations - sources of errors - significant digits - Numerical solution of polynomial and transidental equations - Bisection method - Regula falsi method - Newton - Raphson method - Fixed point method of iteration - Rates of convergence of these methods - solution of system of algebraic equations - Exact methods - Guass elimination - Crout's triangularization method - Iterative methods - Guass-Jacobi and Guass siedal method - Relaxation method.

Polynomial interpolation - Lagrange interpolation polynomial - Divided differences- Newton divided difference interpolation polynomial - finite differences - operators Δ,δ,V, E - Gregory Newton forward and backward difference interpolation polynomials- central differences - sterlings interpolation formula.

Module II (13 Hours)

Numerical differentiation - Differentiation formula in the case of equally spaced points - Numerical integration - Trapezoidal and Simpsons rules - Compounded rules - errors of interpolation and integration formulae - Numerical solution of ordinary differential equations - single step methods - Taylor series - Eulers and Modified Eulers methods - Picard's iteration method - Runga-Kutta methods (Second ,third and forth order formulae, third and forth order derivations not required) Multi step method - Milne's predictor and corrector formulae.

Module III (13 Hours)

Optimization Methods - Systems of linear equation and inequalities - Basic concepts of linear vector spaces - Mathematical formulation of linear programming problem - Theory of simplex method - Simplex algorithm - Charnes M method - Two phase technique - Duality - Dual simplex method.

Module IV (13 Hours)

Transportation, Assignment and routing problems - Dynamic programming - (Introduction and mathematical formulation only) Belman's optimality principle.

Text Books

1. Dr. M. K. Venkataraman, *Numerical Methods in Science and Engineering*, National Publishing Company
2. Kanti Swarup, Gupta and Manmohan, *Introduction to Linear Programming*, Tata Mc Graw Hill

Reference Books

1. S. S. Sasthry, *Numerical Analysis*, Prentice Hall of India
2. Gerald, *Applied Numerical Analysis*, Addison Wesley
3. Kandaswamy P., Thilakavathy K., Gunavathy K., *Numerical Methods*, S. Chand & Co.
4. Hadley G., *Linear Programming*, National Publishing Company
5. Dr. M. K. Venkataraman, *Linear Programming*,, National Publishing Company
6. Garwin W. W., *Introduction to Linear Programming*, Mc Graw Hill

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 607(P) ELECTRICAL MACHINES LAB II

Teaching Scheme **Credits**: 2
3 hours practical per week

Objective

- *To conduct various tests on different ac machines and transformers and to study the performance.*

1. No load & blocked rotor tests on 3 phase squirrel cage & slip ring induction motors
Objectives:

i) Determine the equivalent circuit parameters and hence predetermine the performance at full load from the equivalent circuit and
ii) Draw the circle diagram and hence predetermine the performance at full load from circle diagram.
iii) Plot the performance characteristics from circle diagram

2. Brake test on 3 phase squirrel cage & slip ring induction motors
Objectives:

i) Plot the following performance characteristics.
a) Electrical characteristics – Speed, line current, torque, power factor, efficiency & % slip Vs output power
b) Mechanical characteristics – Torque Vs speed/slip
ii) Find the additional kVAR and the value of capacitance required to improve the power factor to 0.95 at various loads.

3. Performance of induction machine as a generator and motor
Objectives:

i) Operate the given 3 phase induction machine as a) induction motor and b) induction generator
ii) Conduct load test in both generating and motor modes
iii) Plot efficiency vs. output curves
iv) Plot output vs. slip and hence determine the hysteresis power.

4. Slip test on 3-phase salient pole alternator
Objectives:

i) Determine the direct axis and quadrature axis synchronous reactances
ii) Predetermine the voltage regulation at different loads and power factors and plot regulation vs. power factor
iii) Draw the power vs. torque angle characteristics for a specified induced emf.

5. Voltage regulation of alternator
Objectives:

Predetermine the voltage regulation of the given 3 phase alternator by i) emf method ii) mmf method and iii) Zero power factor (Potier) method.

6. Load test on pole changing induction motor
Objectives:

i) Study the different modes of operation of a 3 phase pole changing induction motor
ii) Perform load test on pole changing induction motor and plot the various performance characteristics for low speed and high speed operation.

7. No load & blocked rotor tests on single phase induction motor
Objectives:

i) Conduct the no load and blocked rotor tests on single phase induction motor
ii) Find the equivalent circuit parameters
iii) Predetermine its performance at rated speed.

8. V curves on synchronous machine
Objectives:

i) Synchronize a 3 phase alternator to the supply mains using Dark/Bright lamp method
ii) Plot the V curves and inverted V curves when synchronous machine is acting as generator and motor at no load and constant power.

9. Speed control of induction motor by variable frequency method
Objectives:

Control the speed of the 3 phase induction motor by changing the supply frequency on no load and at given load and plot the speed vs. frequency curve.

10. Drawing of different types of windings using Autocad
11. Drawing of different types of machine with parts using Autocad

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EE14 608 (P) MINI PROJECT

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

- *To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of an electrical/electronic system.*
- *For enabling the students to gain experience in organisation and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.*

In this practical course, each group consisting of three/four members is expected to design and develop a moderately complex electrical/electronic system with practical applications; this should be a working model. The basic concepts of product design may be taken into consideration while designing the project.

Internal continuous assessment will be carried out by the Guide. End Semester evaluation of individual student will be carried out by a committee consisting of minimum three faculty members. Students have to submit a report on the mini project and demonstrate the mini project before the evaluation committee.

Internal Continuous Assessment by the Guide *(Maximum marks - 50)*

40% - Design and development
30% - Final result and Demonstration
20% - Report
10% - Regularity in the class

Semester End Examination *(Maximum Marks-100)*

60% - Demonstration and Presentation of mini project
30% - Viva voce
10% - Final Report

EE14 701 POWER SYSTEM ANALYSIS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *Development of a power system model*
- *Analysing the power system model under normal and abnormal conditions*

Module I (14 Hours)
Representation of power systems – one line diagrams, impedance and reactance diagrams, per unit and percent quantities , primitive networks , Y-bus matrix formulation by singular transformation and Direct determination, Z-bus matrices – Building algorithm.
Load flow studies: problem formulation, classification of buses, Gauss –Seidal method, Newton -Raphson method and fast decoupled load flow method

Module II (13Hours)
Economic load dispatch: system constraints, economic dispatch of thermal plants neglecting line losses, optimum load dispatch including transmission line losses,
Speed governing mechanism: speed governing of turbo generator, load sharing and governor characteristics, transfer function model of single area system, Load Frequency Control, Automatic Voltage Regulation, AGC (Basic concepts only)

Module III (13 Hours)
Short circuit studies : Faults on power systems , three phase to ground faults, SLG , DLG , LL faults, Sequence impedance and sequence networks, symmetrical component methods of analysis of unsymmetrical faults at the terminals of an unloaded generator, Faults on power systems, fault analysis using Z-bus, faults through impedance , short circuit capacity of a bus and circuit breaker rating

Module IV (12 Hours)
Power system stability studies: steady state, transient and dynamic stability, electrical stiffness, Swing equation, inertia constant , equal area criterion, Step by step method of solution of swing equation , factors affecting stability.
Multi machine stability analysis using forward Euler's method, electromechanical oscillations, sub-synchronous resonance.
Voltage stability problem, causes and improvement methods

Text Books

1. Stevenson Jr., *Elements of Power System Analysis*, TMH
2. I J Nagrath & D P Kothari, *Modern Power System Analysis*, TMH
3. C L Wadhwa, *Electric Power Systems*, New-Age International
4. J Wood, B F Woolenberg, *Power Generation, Operation and Control*, Wiley India
5. C W Taylor, *Power System Voltage Stability*, McGraw Hill Inc

Reference Books

1. S S Wadhera , *Power System Analysis and Stability*, Khanna Publishers
2. O I Elgerd, *Electric Energy System Theory- An introduction*, TMH
3. B R Gupta, *Power System Analysis and Design*, Wheeler publishing Company, New Delhi
4. Arthur R Bergen, Vijay Vittal, *Power System Analysis*, Pearson
5. Chakravarti & Halder, *Power System Analysis, Operation & Control*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 702 MODERN CONTROL THEORY

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To give an overview of system analysis and design based on state space techniques for linear and non- linear systems.*

Module I (12Hours)
State Space Analysis -Concept of State, state variables, state vector and state space - comparison with transfer function approach- state models for typical electrical, mechanical and electro-mechanical systems - state space representation of linear time- invariant systems- phase variable form- Diagonalisation - Diagonal and Jordan canonical forms- Transfer function from state model- Transfer function Decomposition- state diagrams- solution of time invariant state equation- Zero state and Zero input response- State transition matrix- properties-Discrete time state model. Introduction to CS tool box in Matlab.

Module II (14 Hours)
Non- linear Systems- Introduction- Characteristics of non- linear systems- Types of non-lineraities- Phase plane analysis- Construction of phase trajectory - Isocline method- delta method - Singular points- Classification of singular points.
Describing function Analysis- Basis of Describing function approach- Definition- Describing functions of common non- linearities namely dead zone$_5$ saturation, ideal relay, combined dead-zone and saturation, relay with hysteresis- Application of describing function for the stability analysis- Amplitude and frequency of limit cycle using DF.

Module III (13hours)
Liapunov Methods- Liapunov Stability- Definition of stability, Asymptotic stability and instability- Quadratic forms and sign definiteness of scalar function- Liapunov stability theorems- Liapunov stability analysis of LTI continuous and discrete time systems- methods of construction of Liapunov function for non- linear systems-Krasovskii' s method and variable gradient method.

Module IV (13 Hours)
Controllability and Observability - Concept and criteria for controllability and observability- Transfer function and controllability/ observability -State Feedback- Design for continuous and discrete systems via pole placement.

Introduction to optimal control- Formulation of the optimal control problem- Typical optimal control performance measures- Parameter optimisation based on second method of Liapunov-Optimal control based on Quadratic performance measures- Infinite time regulator problem- Solution of reduced matrix Ricatti equation.

Text Books

1. I. J. Nagrath & M. Gopal, *Control Systems Engineering*, New Age International (P) Limited
2. Katsuhiko Ogata, *Modem Control Engineering*, PHI
3. Dr. K. P. Mohandas, *Modern Control Engineering*, Sanguine Technical Publishers.

Reference Books

1. Norman S. Nise, *Control Systems Engineering*, Wiley India Pvt. Ltd.
2. M. Gopal, *Control Systems, Principles and Design*, Tata McGraw Hill
3. G. F. Franklin, David Powell, Abbas Emami- Nacini,*Feedback Control of Dynamic Systems*, Pearson Education
4. A. Nagoorkani, *Advanced Control Theory*, RBA Publications
5. A. Anand Kumar, *Control Systems*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 703: ELECTRIC DRIVES

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *Study the basic concepts of electrical drives*
- *Study the different types of DC & AC drives*
- *Study the different special electrical machine drives*

Module I (10 hours)
Concept of Electric Drives – parts of electric drives – review of different types of motors & power electronic converters - choice of electric drives - dynamics of electric drives – developed torque – components of load torque - types of load torque - four quadrant operation – Loads with rotational and translational motion – Steady state stability - load equalization

Module II (14 hours)
DC drives – DC motors and their performance – separately excited, shunt and series motors - starting – braking – regenerative braking, dynamic braking & plugging – speed control - methods of armature voltage control – 1-phase fully controlled & half controlled converter fed DC drives – continuous and discontinuous conduction - 3-phase fully controlled & half controlled rectifier fed dc drives – Four quadrant operation of dc drive using dual converter- Chopper fed dc drives- closed loop control scheme for control below and above base speed

Module III (14 hours)
3-phase induction motor drives – equivalent circuit - torque equation – starting - braking - regenerative braking, plugging, ac & dc dynamic braking - pole changing – stator voltage control - 3-phase AC voltage controller - stator frequency control – stator voltage & frequency control - 3-phase VSI fed induction motor using sine PWM - static rotor resistance control - slip power recovery scheme – static Kramer drive – static Scherbius drive – vector control – basic principle of vector control – comparison of vector control & V/f control

Module IV (14 hours)
Synchronous motor drives – cylindrical rotor motors - salient pole motors - reluctance motors - self-controlled synchronous motor drive - closed loop control of synchronous motor - permanent magnet ac motor drives – sinusoidal PMAC drives - brushless DC motor drives - stepper motor – variable reluctance, permanent magnet & hybrid type stepper motor - unipolar and bipolar drive circuits - switched reluctance motor (SRM) – operation and control requirements - modes of operation – closed loop speed control of SRM

Text Books

1. Gopal K. Dubey, *Fundamentals of Electrical Drives,* Narosa Publishing House, New Delhi
2. M. H. Rashid, *Power Electronics Circuits, Devices and Applications*, Pearson Education
3. Vedam Subrahmanyam, *Electric Drives, Concepts & Applications*, Tata McGraw Hill Education Pvt. Ltd, New Delhi

Reference Books

1. Sen P. C., *Thyristor DC Drives,* Tata McGraw Hill
2. B. K. Bose, *Modern Power Electronics and AC Drives*, PHI
3. Bose, *Power Electronics & Variable Frequency Drives*, Wiley-India
4. R. Krishnan, *Electric Motor Drives- Modelling, Analysis and control*, Pearson education
5. De & Sen, *Electric Drives*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
Note : One of the assignments shall be simulation/hardware implementation of DC or AC drives

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 704(A) SWITCHED MODE POWER CONVERTERS

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *Study & Analyse various types of switched mode dc- dc converters (with & without isolation transformers, dc- ac inverters and resonant converters*

Module I (12 Hours)

Switched Mode DC-to-DC Converter - buck converters – boost Converter – buck-boost converter - Continuous Conduction mode – design of filter inductance & capacitance - boundary between continuous and discontinuous conduction – critical values of inductance/load resistance - discontinuous conduction mode with constant output voltage - Output voltage ripple – Cuk converter – SEPIC converter – Full-bridge dc-dc Converter – PWM with bipolar voltage and unipolar voltage switching –comparison of dc-dc converters

Module II (14 Hours)

Linear Power Supply – disadvantages of linear power supply – switched mode power supply – dc-dc converters with electrical isolation –unidirectional core excitation & bidirectional core excitation - fly back converter – continuous & discontinuous conduction mode - double ended fly back converter – forward converters – basic forward converter – practical forward converter – continuous conduction mode only - double ended forward converter – push pull converter – half bridge converter – full bridge converter – continuous conduction mode – current source dc-dc converter – current source dc-dc converter - Power line disturbances – Power conditioners – Uninterruptible power supplies (block diagram approach)

Module III (15 Hours)

Switched Mode DC to AC converter – 1-phase square wave full-bridge inverter – square wave switching scheme - sine PWM switching scheme – PWM with bipolar & unipolar voltage switching - harmonic analysis of output voltage – output control by voltage cancellation – ripple in single phase inverter output - 3-phase voltage source inverter – 3-phase sine PWM inverter – RMS line to line voltage & RMS fundamental line-to-line voltage – square wave operation – switching utilisation ratio of 1-phase & 3-phase full-bridge inverters – effect of blanking time on voltage in PWM inverters - concept of space vector – space vector modulation – reference vector & switching times – space vector sequence – comparison of sine PWM & space vector PWM - programmed (selective) harmonic elimination switching – current controlled voltage source inverter - hysteresis current control

Module IV (11 Hours)

Resonant Converters- Classification of Resonant Converters – Basic Resonant Circuit concepts – series resonant circuits – parallel resonant circuits – load resonant converters – series loaded resonant dc-dc converters – discontinuous conduction mode only – parallel loaded resonant dc-dc converters – discontinuous conduction mode only – resonant switch converters – ZCS resonant switch converter – L type & M type - ZVS resonant switch converter – comparison of ZCS & ZVS

Text Books

1. Mohan Undeland Robbins, *Power Electronics – Converters Application and Design*, Wiley-India

Reference Books

1. Abraham Pressman, *Switching Power supply Design*, McGraw Hill
2. Muhammad H. Rashid, *Power Electronics – Circuits, Devices and Applications*, Pearson Education

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
Note : One of the assignments shall be simulation/hardware implementation of any one switched mode power converter

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 704(B) ELECTRICAL MACHINE DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *Design of electrical machines and transformers for the given specifications*

Module I (14 Hours)
DC Machines : 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-Design of field system -Height of the field winding-Design procedure for shunt and series field windings-Design of commutator and brushes- interpoles and compensating winding – Carter's coefficient – Real and apparent flux density – Design examples.

Module II (14 Hours)
Transformers: Single phase and three phase power transformers – Output equation –Core and shell type - main dimensions – Choice of specific electric and magnetic loadings – Design of core- Core cross sections-Window dimensions-Over all dimensions- Design of windings-Number of turns and conductor size-cooling tank-plain walled and tank with cooling tubes – leakage reactance and equivalent circuit based on design data- Prediction of no load current-Mechanical forces on winding– Design examples – Design principles of current transformers – Temperature rise calculations – continuous and intermittent rating.

Module III (12 Hours)
Alternators: Salient pole and turbo alternators – Output equation – Main dimensions – choice of specific electric and magnetic loadings – choice of speed and number of poles –short circuit ratioand its effects- 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 (12 Hours)
Induction machines: Output equation – Main dimensions – choice of specific electric and magnetic loadings –Design of stator-stator winding design- Different types of rotor-Design of squirrel cage rotor - rotor slots- calculation of rotor bar and end ring currents in cage rotor - Design of slip ring rotor-Design of airgap-– calculation of equivalent circuit parameters and prediction of magnetizing current based on design data – Design examples

Text Books

1. Sawhney A. K., *Electrical Machine Design*, Dhanpath Rai & Sons.

Reference Books

1. Clayton & Hancock, *Performance and Design of DC Machines*, ELBS
2. Say M. G., *Performance and Design of AC Machines*, Pitman, ELBS
3. Deshpande, *Design & Testing of Electrical Machines*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Analytical/problem solving SHORT questions* Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	*8x 5 marks=40 marks*
PART B:	*Analytical/Problem solving DESCRIPTIVE questions* Two questions from each module with choice to answer one question.	*4 x 15 marks=60 marks*

Maximum Total Marks: 100

EE14 704(C) GENERALIZED MACHINE THEORY

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *To provide the basic ideas of mathematical modelling and analysis of electric machines*

Module I (12 Hours)

Introduction to generalized machine theory -Essentials of rotating electrical machines – Basic two pole machine – Commutator machines – DC compound machine – DC shunt machine with interpoles – single phase AC series machine – Synchronous machine without and with dampers – three phase induction machine – transformer with movable secondary – transformer and speed voltages in armature – Kron's primitive machine – leakage flux in machines with more than two windings – voltage equations in matrix form – splitting up Z marix into R, L and G matrices – significance of R, L and G matrices

Module II (14 Hours)

Linear transformation in machines – transformation from a displaced brush axis – transformation from three phase to two phase (a, b, c to α, β, 0) transformation from two phase rotating axes to two phase stationary axes (α, β, 0 to d,q,0) Park's transformation – modelling of three phase synchronous machine and induction machine – general method of applying generalised machine theory – electrical torque – restrictions of generalised machine theory.

Module III (14 Hours)

Modelling and analysis of dc machines: separately excited DC generators – steady state and transient analysis – sudden short circuit – separately excited DC motor – steady state and transient analysis – sudden application of inertia load

Modelling and analysis of synchronous machines: Basic synchronous machine parameters – General machine equations – three phase synchronous machine without Amortisseurs – balanced steady state analysis – phasor diagrams and equations under open circuit and load conditions – steady state power angle characteristics – short circuit ratio – significance of low and high short circuit ratios.

Module IV (12 Hours)

Modelling and analysis of induction machines: Transformations of stator and rotor circuits – steady state analysis – analysis of equivalent circuit – torque slip characteristics – power slip characteristics – effect of voltage and frequency variations

Interconnected machine: Development of C matrices – DC generator and motor – alternator supplying a synchronous motor – Ward Leonard five machine system.

Text Books

1. Dr. P. S. Bhimbra, *Generalised Machine Theory*, Khanna Publishers.
2. Sengupta D. P. & Lynn J. B., *Electrical Machine Dynamics*, The Mac Millan Press Ltd.

Reference Books

1. Jones C. V., *The Unified Theory of Electrical Machines*, Butterworth
2. Kraus, *Analysis of Electrical Machinery & Drive System*, Wiley-India
3. Woodson & Melcher, *Electromechanical dynamics*, John Wiley
4. Kraus P. C., *Analysis of Electrical Machines*, McGraw Hill Book Company
5. Boldia I & Nasar S. A., *Electrical Machine Dynamics*, The Mac Millan Press Ltd.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 704(D): MECHATRONICS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide knowledge on the fundamentals of mechatronics, numerical control machine tools, part programming and robotics*

Module I (13 hours)
Introduction to Mechatronics.- Mechatronics in manufacturing- Mechatronics in products-Scope of Mechatronics.
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-Special tool holders

Module II (13 hours)
System devices: System drives-hydraulic systems, DC motors, stepping motors, AC motors-Feedback devices-Encoders, pulse digitizers, resolvers, Inductosyn, tachometers.- Counting devices-Flip Flops, counters ,decoders, digital to analog converters. Interpolation- linear interpolator-circular interpolators, CNC software interpolator-Flow of data in NC machines.

Module III (13 hours)
NC Part programming: Manual Programming-Concepts-tape formats- tab sequential- fixed block word address and variable block formats- Part Programming examples-Point to point programming and simple contour programming- Computer aided programming- Concepts – Post processor programming languages- APT programming-Part programming examples.

Module IV (13 hours)
Industrial Robotics: Basic concepts- Robotics and automation- Specification of Robots-Resolution, Repeatability and accuracy of manipulator- Classification of Robots- Industrial application- Robot drives- Characteristics of end of arm tooling- Sensors-Tactile, proximity and range sensors- contact and non-contact sensors- velocity sensors- touch and slip sensors- Force and torque sensors- Programming- Lead through programming- Textual programming- Programming languages - On line and offline programming- Intelligent Robots.

Reference Books

1. Yoram Koren, *Computer Control of Manufacturing Systems*, McGrawHill
2. Michel P. Groover, *Industrial Robots-Technology, Programming and Applications*, McGrawHill
3. Fu K.S , Gonzales et al, *Robotics-Control, sensing, vision and intelligence*, McGrawHill.
4. Yoram Koren and Ben Yuri, *Numerical Control of machine tools*, Khanna Publishers.
5. Ramachandran, *Mechatronics – Integrated Mechanical Electronics Systems*, Wiley-India

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 704(E) VLSI DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *Overview of VLSI System design and fabrication*

Module I (12 Hours)
Overview Of VLSI Design Methodology: VLSI design process -. Architectural design -Logical design -Physical design -Layout styles -Full custom -Semi custom approaches. .
VLSI Fabrication Techniques : .An overview of wafer fabrication –Wafer Processing -Oxidation -Patterning -Diffusion -Ion Implantation -Deposition –Silicon gate nMOS process -CMOS processes -nWel1 -PWell -Twin tub -Silicon on insulator-CMOS process (enhancements -Interconnect -Circuit elements. (5)

Module II (15 Hours)
Basic Electrical Properties Of MOS And CMOS Circuits: nMOS enhancement transistor -PMOS enhancement transistor -Threshold voltage - Threshold voltage equations -MOS device equations -Basic DC equations -Second order effects - MOS Modules -Small signal AC characteristics -nMOS inverter -Steered input to an nMOS inverter -Depletion mode and enhancement mode pull ups –CMOS inverter -DC characteristics -Inverter delay -Pass transistor -Transmission gate. (12)

Module III (12 Hours)
Layout Design Rules: Need for design rules -Mead conway design rules for the.silicon gate nMOS process -CMOS nwell-Pwel1 design rules -Simple layout examples - Sheet resistance -Area capacitance -Wiring capacitance -Drive large capacitive loads. (8)

Module IV (13 Hours)
Logic Design : Switch logic -Pass transistor and transmission gate -Gate logic - Inverter -Two input NAND gate -NOR gate -Other forms of CMOS logic –Dynamic CMOS logic -Clocked CMOS logic -Precharged domino CMOS logic -Structured design -Simple combinational logic design examples –Parity generator -Multiplexers –Clocked sequential circuits -Two phase clocking -Charge storage –Dynamic register element -nMOS and CMOS -Dynamic shift register -Semi static register - JK flip flop circuit. (12)

Text Books

1. Doglas A. PuckJ1ell and Kamran Eshranghian, *Basic VLSI design*, Prentice Hall of India, New Delhi
2. Neil H. E. West and Kamran Eshranghian, *Principles of CMOS VLSI Design: A System Perspective*, Addison- Wesley.
3. Amar Mukherjee, *Introduction to nMos and CMOS VLSI System Design*, Prentice Hall, USA.
4. Uyemura, *Introduction to VLSI circuits and systems*, Wiley-India

Reference Books

1. Caver Mead and LyTUI Conway, *Introduction to VLSI Systems*, Addison-Wesley, USA.
2. Eugene D. Fabricus, *Introduction to VLSI Design*, McGraw Hill International Edn.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 705(A) SOFT COMPUTING TECHNIQUES

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To acquaint the students with the important soft computing methodologies- neural networks, fuzzy logic, genetic algorithms and genetic programming*

Module I (12 Hours)
Artificial Intelligent systems – Neural Networks, Fuzzy Logic and Evolutionary Programming concepts. Artificial Neural Networks – Biological neural networks – Model of an artificial neuron- Comparison between biological neuron and artificial neuron– Basic models of artificial neural network –Learning methods – - Activation function and terminologies of ANN- - Mc Culloch Pitts Neuron – Linear Separability – Hebb network – Perceptron Networks , Adaline, Madaline.

MODULE II (14 Hours)
Back propagation Networks : Architecture - Multi layer perceptron –Back propagation learning – Input layer, Hidden Layer , Output Layer computations, Calculation of error, Training of ANN, Back propagation Algorithm, Momentum and Learning rate, Selection of various parameters in BP networks- Radial Basis Function Networks [T. B. 1].
Variations in standard BP algorithms – Decremental iteration procedure, Adaptive BP, GA based BP, Quick prop training, Augmented BP networks, Sequential learning Approach for single hidden layer Neural networks.

Module III (13 Hours)
Fuzzy sets and crisp sets-Fuzzy sets –Fuzzy set operations-Fuzzy relations- Membership functions – Features of the membership functions-Fuzzification- Methods of membership value assignments-Defuzzification- Defuzzification methods-Fuzzy Rule Base and approximate reasoning- Truth values and tables in fuzzy logic, Fuzzy propositions, Formation of rules, Decomposition of rules, Aggregation of fuzzy rules- Fuzzy Inference Systems- Construction and Working Principle of FIS- Methods of FIS- Mamdani FIS and Sugeno FIS- Fuzzy Logic Control Systems- Architecture and Operation of FLC System- FLC System Models- Application of FLC Systems.

Module IV (13 Hours)
Genetic Algorithms- Basic Concepts- Creation of off- springs- Working Principle- Encoding- Fitness function- Reproduction- Roulette- Wheel Selection, Boltzmann Selection- Tournament selection- Rank Selection- Steady- State Selection- Elitism- Generation gap and steady state replacement- Inheritance operators- Cross Over- Inversion and deletion- Mutation Operator- Bit-wise operators- Generational Cycle- Convergence of Genetic Algorithm- Differences and Similarities between GA and other traditional methods- Applications.

Text Books

1. S. N. Sivanandam, S. N. Deepa, *Principles of Soft Computing,* Wiley India Pvt. Ltd.[Module I& III]
2. R.Rajasekharan and G.A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms- Synthesis and Applications,* Prentice Hall of India. [Module II, & IV]

Reference Books

1. Fakhreddine O.Karray & Clarence De Silva, *Intelligent Systems Design, Theory, Tools and Application*, Pearson Education
2. S. Haykins, *Neural Networks – A Comprehensive Foundation* , Prentice Hall 2002.
3. L. Fausett, *Fundamentals of Neural Networks*, Prentice Hall 1994.
4. T.Ross, *Fuzzy Logic with Engineering Applications*, TMH
5. D.E. Goldberg, *Genetic Algorithms in search, Optimization and Machine Learning*, Addison Wesley MA, 1989.
6. John Yen, Reza Lengari, *Fuzzy Logic- Intelligence, Control and Information,* Pearson Education

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 705(B) HIGH VOLTAGE ENGINEERING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To study the breakdown mechanism in electrical insulators*
- *To study the generation and measurement of high AC, DC and impulse voltages*
- *Testing of high voltage equipments*

Module I (13Hours)

Breakdown mechanisms in solids , liquids, vacuum , gases & gas mixtures- breakdown in uniform fields- breakdown in composite dielectrics - partial discharge , penning effect time tag &paschen's law. Townsends criterion

Module II (13 Hours)

Generation of High Voltages and Currents: D.C.Voltages : voltage doubler, cascade circuits, electrostatic machines, voltage stabilization. A.C. Voltages : Cascade transformers, series resonance circuits. Impulse Voltages : Single stage and multistage circuits, wave shaping, tripping and control of impulse generators, synchronization with oscilloscope, generation of switching surge voltage, generation of impulse currents

Module III (13 Hours)

Measurement of High Voltages and Currents : D.C.,A.C. and impulse voltages and currents, CRO, electrostatic generating and peak voltmeters, sphere gaps, factors affecting measurements, potential dividers(capacitive and resistive), series impedance ammeters, Ragowski coils, magnetic links, Hall effect generators, PT's (magnetic and capacitive types) and CT's.

Module IV (13 Hours)

Dielectric loss measurements:- Schering's bridge- inductively coupled ratio arm bridge.
Partial discharge measurement technologies - radio interference measurements.
Over voltage phenomenon - travelling waves- line equations, wave transmission, reflection & attenuation, lightning phenomenon - Switching surges - protection against surges - Testing of circuit breakers and generators.

Text Books

1. Naidu M. S. &Kamaraju V., *High Voltage Engineering,* Tata Mc Graw Hill
2. Kuffel and Abdulla M., *High Voltage Engineering*,Pergman Press

Reference Books

1. Bewley L. V. Lines, *Travelling Waves on Transmission*, Dover Publishers.
2. S.K. Singh, *Fundamentals of High Voltage Engineering*, Dhanpat Rai & Co.
3. Alston L. L., *H. V. Technology*, Oxford University Press
4. Dieter Kind, *An Introduction to HV*, Wiley Ltd.
5. C.L. Wadhwa, *High Voltage Engineering*, New Age International
6. B. Thaparet. Al., *Power System Transients and High Voltage Principles*, Capital Pub
7. *IEEE Standard Technique for High Voltage Testing*, IEEE John Wiley and Sons
8. *Indian Standards:*

IS: 2070-1962 IS:2070- 1962
IS: 2544- 1963 IS: 2079- 1962
IS:2099-1962 IS:2026-1962
IS:166-1962 IS:5959- 1970
IS:1544-1964,1970 IS: 7098- 1973
IS: 3070- 1965 IS:4004-1967
IS:6209-1971 IS: 4950- 1968
British Standards: B5: 3659, B5: 3070, B%: 2914- 1957
IEC Publications: No. 99-1, Part1-1970

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 705(C) ELECTRIC POWER UTILISATION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To enable the students to understand the concept of electric heating, welding, illumination, traction and their uses in industry*

Module 1 (13 hours)
Electric Traction: Advantages, Choice of traction system, Features of an ideal traction system, systems of track electrification, Traction mechanics- speed-time curve, traction supply system- transmission system for traction substations, location of substations - 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 2 (13 hours)
Electric heating: Advantages, methods, requirements of heating element, efficiency- resistance furnace, radiant heating, induction heating, high frequency eddy current heating, dielectric heating, arc furnace, induction furnaces
Electric welding:- methods and equipments- electric supply for arc welding.
Basics of Electrolysis and Electroplating applications.

Module 3 (13 hours)
Illumination: - terms and definitions, laws of illumination, polar curves, photometry, MSCP, integrating sphere, luminous efficacy- electrical lamps, design of interior and exterior lighting systems, illumination levels for various purposes, light fittings, factory lighting- methods of lighting calculations, flood lighting, street lighting - general principles, energy conservation in lighting.

Module 4 (13 hours)
Refrigeration: Refrigeration cycle, different refrigeration systems, domestic refrigerator & different types of water coolers, Control of temperature - protection of motors - simple heat load and motor calculations.
Air-conditioning - Function of complete air conditioning system, types of air conditioning system, types of compressor motor, cool storage , estimation of tonnage capacity and motor power.
Heating of buildings: Types of heating equipment used for space heating, calculation of rating of electrical equipment.

Text Books

1. Partab H., *Art and Science of Utilisation of Electrical Energy*, Dhanpat Rai and Sons, New Delhi.
2. J B Gupta, *Utilization of Electric Power and Electric Traction*, S K Kataria & Sons, 2002.

Reference Books

1. Taylor E Openshaw, *Utilisation of Electric Energy*, Orient Longman, 1986
2. Wadhwa. C.L., *Generation, Distribution and Utilization of Electrical Energy*, Wiley Eastern Limited,1993.
3. Soni, Gupta, Bhatnagar, *A Course in Electric Power*, Dhanapat Rai & sons
4. Web sites: bee-india.org
5. IEEE bronze book-IEEE press

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 705(D) PROFESSIONAL ETHICS

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To instill moral and social values and loyalty.*
- *To appreciate the rights of others.*
- *To create an awareness on engineering ethics and human values.*

Module I (14 hours)

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

Module II (12 hours)

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

Module III (14 hours)

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India) IE(I), Indian Institute of Materials Management, IETE (Institution of electronics and telecommunication engineers ,India), etc.

Module IV (12 hours)

Human Values-Morals ,values and ethics-Integrity- Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character

Text Books

1. Govindarajan M., Natarajan S., Sentril Kumar V. S., *Engineering Ethics*, Prentice Hall India.
2. Mike Martin and Ronald Schinzinger, *Ethics in Engineering*, Tata McGraw Hill

Reference Books

1. Charles D. Fleddermann, *Engineering Ethics*, Pearson Education
2. Charles E. Harris, Michael S. Protchard and Michael J. Rabins, *Engineering Ethics-Concepts and Cases*, Wadsworth Thompson Learning, United States, 2000.
3. John R. Boatright, *Ethics and the Conduct of Business*, Pearson Education.
4. Edmund G. Seebauer and Robert L. Barry, *Fundamentals of Ethics for Scientists and Engineers*, OxfordUniversity Press
5. RinkuSanjeev and ParulKhanna, *Ethics and Values in Business Management*, Ane's Books, India

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 705(E) MANAGEMENT INFORMATION SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To understand the relationships among management, information, and systems.*
- *To understand how information technology can be used by a business organization to gain a competitive advantage.*
- *To understand the types of information systems that are needed to support the various levels of a business enterprise and the process of analyzing, designing, and developing an information system*

Module I (12 hours)
MIS Definition, Characteristics, Subsystem of MIS –evolution - logical foundations – typical MIS – future. Information Systems and organizations – Information system structure – Classification – support for functional areas of management – BIS – Organisational information systems – MIS in organizations

Module II (16 hours)
Influence of computers, information technology and communication on MIS. Data Base Management – Operations data base – managerial database – comparison of DBMS – Data base approach -use – architecture – DBMS – RDBMS – current developments.

Module III (12 hours)
Decision Making Process : Stages in Decision Making, Individual and Organizational Decision Making Models, Information System support for Decision Making Phases
Decision Support Systems – definition – evolution – model management – DSS generators – Multicriteriamodeling

Module IV (12 Hours)
The role of Expert systems and Artificial intelligence in intelligent decision making process. System analysis and design - The work of system analyst – The assignment brief and mutual investigation –feasibility study – system design – Data collection and preparation – Detailed system - Design – Implementation – Evaluation and maintenance of MIS

Text Books

1. S.Sadagopan, *Management Information Systems*, Prentice-Hall of India

Reference Books

1. James A. O' Brien, *Introduction to Information System*, Tata McGraw Hill
2. Effy Oz, *Management Information Systems*, Thomson Course Technology.
3. K. C. Louden & J. P. Louden, *Management Information Systems*, Prentice Hall
4. Gordon B Davis & Margrethe H Olson, *Management Information Systems – Conceptual Foundations, Structure and Development*, Tata McGrawHill

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14705(F) SATELLITE COMMUNICATION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To give an introduction of satellite communication systems*

Module I (13 hours)
Satellite orbits - solar day and sidereal day - orbital parameters - satellite trajectory - period, velocity and position of a satellite - geostationary satellites - non-geostationary constellations - launching of geostationary satellites - Hohmann transfer - effect of earth's shape - other heavenly bodies - atmospheric drag and radiation pressure on the satellite's orbit

Module II (13 hours)
Communication satellites - spacecraft subsystems - payload - repeater, antenna, attitude and control systems - telemetry, tracking and command - power sub system and thermal control
Earth stations - antenna and feed systems - satellite tracking system - amplifiers – fixed and mobile satellite service earth stations

Module III (14 hours)
Communication link design - frequency bands used - antenna parameters – transmission equations - noise considerations - link design - very small aperture terminals (VSAT) - VSAT design issues

Module IV (12 hours)
Multiple access techniques - frequency division multiple access - time division multiple access - code division multiple access - access protocols for data traffic

Text Books

1. Timothy Pratt, *Satellite Communicaion,* Wiley-India
2. Richharia M, *Satellite Communication Systems,* Macmillan Press Ltd
3. Gagliardi R.M., *Satellite Communication,* CBS
4. Ha T.T., *Digital Satellite Communicaion,* MGH
5. Maini, *Satellite Communicaion,* Wiley-India

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Analytical/problem solving SHORT questions* Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	*8x 5 marks=40 marks*
PART B:	*Analytical/Problem solving DESCRIPTIVE questions* Two questions from each module with choice to answer one question.	*4 x 15 marks=60 marks*

Maximum Total Marks: 100

EE14 706(P) POWER ELECTRONICS LAB

Teaching Scheme **Credits**: 2
3 hours practical per week

Objective

- *To familiarize different power electronic devices and circuits*

1. Static characteristics of SCR
   Aim: Determine latching current, holding current and static characteristics of SCR
2. R and RC firing circuits
   Aim: Design and set up R and RC firing circuits and observe waveforms across load resistance and SCR
3. UJT Trigger circuit with Single phase controlled Rectifier
   Aim: Design & Set up UJT Triggering Circuit and observe waveforms across load resistance, SCR, capacitance and pulse transformer output.
4. AC Voltage Controller using TRIAC
   Aim: Set a 1-phase AC voltage controller & observe waveforms across load resistance, TRIAC and capacitor for different firing angles
5. Single Phase fully Controlled SCR Bridge circuit
   Aim: Set up a 1-phase full converter with RL load & with and without freewheeling diode
6. Single-phase half bridge/full bridge inverter using power MOSFET/IGBT
   Aim: Design and set up a single phase half-bridge/full-bridge inverter and observe the waveforms across load and firing pulses.
7. Step down Chopper using MOSFET
   Aim: Control the speed of a DC motor using a step-down chopper
8. Simulation of 1-phase and 3-phase PWM inverter
   Aim: Simulate 1-phase and 3-phase inverter for RL load using Sine PWM; observe waveforms and analyse THD at a specified switching frequency
9. Simulation of 3-phase fully controlled converter
   Aim: Simulate 3-phase fully controlled bridge converter with RL load; observe the waveforms; measure THD in line current at a specified firing angle
10. Simulation of closed loop speed control of DC motor with different control schemes (PID, hysteresis current control, Fuzzy, ANFIS etc)
11. Simulation of open loop or closed loop speed control of 3-phase induction motor using V/f control and using sine PWM
12. Design and Simulation of buck, boost, buck-boost and Cuk converters

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EE14 707(P) SYSTEM SIMULATION & CONTROL LAB

Teaching scheme **Credits:** 2
3 hours practical per week

Objective

- *Familiarisation control system concepts using hardware and simulation experiments*
- *Experiments on microprocessors and microcontrollers and its interfacing*
- *Simulation study and analysis of power system circuits*

1. Determination of transfer function of DC motor a) armature control b) field control
2. Design and experimental determination of frequency response of lead/lag networks
3. Relay characteristics
4. Study of 8086 microprocessor and implementation of simple programs
5. Study of 8051 microcontroller and implementation of simple programs
6. Interfacing an ADC with microcontroller to read an analogue signal
7. Generate a square wave, saw tooth wave and triangular wave using 8051 microcontroller
8. Familiarization with MATLAB – simple programs
9. Simulation using MATLAB, SIMULINK, RL tool etc.
10. Familiarization of P, PI, PD & PID controllers
11. Power flow analysis of the system with the given single line diagram using the given power flow analysis package.
12. Transient stability analysis of the system with the given single line diagram using the given package. The disturbance is 3-phase to ground solid SC fault at t=0. The fault is cleared at time t=5 cycles by permanently removing the fault line.

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

EE14 708 (P) PROJECT

Teaching scheme **Credit:** 4
4 hour practical per week

Objectives

- *To judge the capacity of the students in converting the theoretical knowledge into practical systems/investigative analysis.*

Project work is for duration of two semesters and is expected to be completed in the eighth semester. Each student group consisting of not more than five members is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project may be implemented using software, hardware, or a combination of both. The project work may be undertaken in electrical power systems / machines/ electronics / computer / instrumentation / biomedical engineering or any allied area and must have relevance in electrical or electronics engineering. Project evaluation committee consisting of the guide and three/four faculty members specialised in the above field shall perform the screening and evaluation of the projects.

Each project group should submit project synopsis within three weeks from start of seventh semester. Project evaluation committee shall study the feasibility of each project work before giving consent. Literature survey and 40% of the work has to be completed in the seventh semester.

Students should execute the project work using the facilities of the institute. However, external projects can be taken up in reputed industries, if that work solves a technical problem of the external firm. Prior sanction should be obtained from the head of department before taking up external project work and there must be an internal guide for such projects.

Each student has to submit an interim report of the project at the end of the 7th semester. Members of the group will present the project details and progress of the project before the committee at the end of the 7th semester.

50% of the mark is to be awarded by the guide and 50% by the evaluation committee.

Internal Continuous Assessment
20% - Technical relevance of the project
40% - Literature survey and data collection
20% - Progress of the project and presentation
10% - Report
10% - Regularity in the class

EE14 801 ELECTRICAL SYSTEM DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of electrical installations for buildings*
- *To study the design and estimation of different electrical installations.*

Module I (13 hours)

General: Salient features of Indian Electricity Act 2003,Central Electricity Authority (Measures relating to Safety and Electricity supply) Regulations 2010, Role and scope of National Electric Code in the design of electrical installations, Graphical symbols, Safety in electrical work, accidents and treatment for electric shock.

Assessment of general characteristics of buildings, Classification of supply systems- TN, TT & IT systems,

Service Connection:- Receptions and distribution of main supply, sub-circuits, methods of internal wiring, Preparation of schematic and wiring diagram, Estimation of wiring materials used for a small residential building, Selection of switch gear for control and protection against overload, short circuit and earth fault, Neutral wire, Earth wire, pipe, rod and plate earthing, Testing of installation.

Module II (13 hours)

Electrical aspects of building services: **Lighting**- Qualities of good lighting schemes-Types of lighting schemes-Different types of lamps - Polar curves - Maintenance factor - Absorption factor - Reflection factor - Coefficient of utilization (COU) - Calculation of COU based on room index, Norms for comfort lighting - shielding angle, General rules for interior lighting - office building lighting –design of industrial lighting - hospital lighting - Design of interior lighting by average illumination - Design of street lighting - flood lighting.

Ventilation – Electrical aspects of air conditioning and Heating services, Calculation of tonnage capacity and motor power

Module III (13 hours)

Connected Load, Selection of LT Cables - Types and Testing of LT cables, Design of LT panels, Design, Layout and schematic diagram of electrical installations in High Rise Building (HRB) - Design of main switch board and distribution boards considering electrical services of building (including lift and escalator) and standby generating units, Selection of switch gear for control and protection (ACB, MCCB,VCB etc.), Power factor improvement, APFC.

Electrical design concepts of 1) Hospitals, 2) Cinema Theatre

Module IV (13 hours)

Design, layout and schematic diagram of substations (using transformers up to 630kVA) availing supply at 11 kV - Standard values of voltage and frequency – Selection of switch gear for control and protection (MCCB, ACB, VCB, SF_6 CB etc.), Selection of HT & LT cables - Types and Testing of HT cables, Design of Earthing System:- Measurement of Earth resistance using Earth Megger - soil resistivity - Types of earth electrodes - design of pipe earthing, rod earthing and plate earthing - Earth buses and Earth wires, grounding of electronic equipments, Concept of Earth mat, Shielding of Electric systems, Lightning protection - Materials, Shapes and Sizes of Lightning conductors - Joints and bonds - Isolation and bonding – Testing

Reference Books

1. National Electric Code (India)
2. Indian Electricity Act 2003, Central Electricity Authority (Measures relating to Safety and Electricity supply) Regulations 2010.
3. IEC standards, IS Codes, National Building Code, Bureau of Indian Standard Publications, Cinema Regulation (Rules)
4. K.B. Raina & S.K. Battacharya, *Electrical System Design, Estimation & Costing*, New Age international (P) Limited publishers
5. Gupta J.B., *Electrical Installation, Estimation & Costing*, S. K. Kataria & Sons
6. V. K. Jain & Amitabh Bajaj, *Design of Electrical Installations*, Lakshmi Publications Pvt. Ltd
7. ABB Switchgear Manual

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 802 FACTS CONTROLLERS & CUSTOM POWER DEVICES

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To study the basic concepts of flexible ac transmission and power quality issues*
- *To study the operation of different types of FACTS controllers and custom power devices*

Module I (15 hours)

Flexible AC transmission systems – principle of power transmission – active and reactive power – principle of shunt compensation – power Vs load angle - Thyristor Controlled Reactor (TCR) – principle of TCR operation - TCR susceptance – Thyristor Switched Capacitor (TSC) – TSC with a series reactor – shunt Static Var Compensator (SVC) – I-V characteristics of SVC
Principle of series compensation – power Vs load angle - Thyristor Switched Series Capacitor (TSSC) – Thyristor Controlled Series Capacitor (TCSC) – series static Var compensator (TCR-C)
Principle of phase-angle compensation – power Vs load angle – phase-shifting with costant voltage magnitude – phase shifting with quadrature phase shift voltage – thyristor transformer tap changer –unified power flow controller (UPFC) – configuration, operation & application of UPFC

Module II (11 hours)

Static Synchronous Compensator (STATCOM) – principle of operation – V-I characteristics of STATCOM – power exchange between the STATCOM and the ac system – configuration of VSI STATCOM – Static Synchronous Series Compensator (SSSC) – principle of operation – configuration of SSSC – Unified Power Flow Controller (UPFC) – principle of operation – configuration of UPFC – comparison of STATCOM, SSSC, SVC, TCSC, TSSC & UPFC

Module III (15 hours)

Electric Power Quality – power quality problems and their causes
Unbalance – unbalance in 3-phase power systems – sources of unbalance – effect of unbalance
Harmonics – sources of harmonics – magnetisation non-linearities of transformers – rotating machines – distortion caused by arcing devices – inverter fed AC drives – thyristor controlled reactors – AC regulators – effects of harmonics – resonance – poor damping – effects of harmonics on rotating machines, transformers, transmission systems, measuring instruments, capacitor banks & consumer equipments – harmonic standard – IEC 6100 series standard – IEEE 519-1992
Transients – power system transients – causes – effects
Sag – swell – interruption – sustained interruption - under voltage – over voltage
DC offset, electric noise, voltage fluctuation, flicker and power frequency variation
Power quality standards – IEEE & IEC – power quality monitoring

Module IV (11 hours)

Power quality Improvement techniques – conventional passive filters – tuned LC filters – merits & demerits - active filters – shunt active filters – series active filters – hybrid active filters - Custom power devices – configuration & operation of Distribution STATCOM (DSTATCOM) – configuration & operation of Dynamic Voltage Restorer (DVR) – basics of pre-sag compensation and in-phase compensation – configuration & operation of Unified Power Quality Conditioner (UPQC)

Reference Books

1. R. Mohan Mathur & Rajiv K. Varma, *Thyristor-based FACTS controllers for Electrical Transmission Systems*, Wiley-India (Module I & II)
2. Muhammad H Rashid, *Power Electronics – Circuits, Devices and Applications*, Pearson Education (Module I)
3. Surajit Chattopadhyay, Madhuchhanda Mitra & Samarjit Sengupta, *Electric Power Quality*, Springer (Module III)
4. K.R. Padiyar, *FACTS controllers in power transmission & distribution*, New Age International Publishers (Module IV)
5. Arindam Ghosh & Gerard Ledwich, *Power Quality Enhancement Using Custom Power Devices*, Kluwer Academic Publishers
6. Math H. Bollen , *Understanding Power Quality Problems*, Wiley-India
7. Narain G Hingorani & Laszlo Gyugyi , *Understanding FACTS – concepts and technology of flexile AC transmission*, IEEE press

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

Note : One of the assignments shall be simulation of any FACTs controller or custom power device using SIMULINK or any other software.

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 803 POWER SYSTEM PROTECTION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

protecting power system equipments

Module I 13Hrs)
Circuit breakers:- Insulating Fluids, Properties of Insulating and Arc quenching materials, Arc interruption, Current interruption, Effect of Power factor, Parallel capacitance, Arc interruption theories, Current Chopping, Resistance switching, Capacitance Current breaking, Restriking Voltage, Current zero pause, main parts of CB, Main types of CB, Rating of alternating current CB, Miniature CB, Residual current CB
High Voltage CB(Construction, Advantages and Limitations): - Bulk oil CB, Minimum oil CB, Air CB, Air Blast CB, Vacuum CB, SF6 CB, HVDC CB, Autoreclosing, CB Testing

Module II (13Hrs)
Surge Protection and Insulation Coordination;-Introduction, Classification of Insulations and their failure modes, Impact of contamination of electrical insulation, Insulation Co, ordination, Insulation Protection, Understanding Lightning phenomenon, Charge formation, Effect of Lightning on Power System, Protection against Lightning
Current limiting Reactors;-Introduction, Type of Reactors, Reactance calculation, Application of Reactors, Short Circuit, Current Limiting Coupling Circuits

Module III (14Hrs)
Structure of a Power System;-Need for Power System Protection, Development of Protective Relays, Basic Philosophy of Protection Schemes, Classification of Relays based on their construction, Electromechanical Relays, Thermal Relays, Transductor Relays, Rectifier Bridge Relays, Electronics Relays, Classification of Relay based on their function, Current Transformers, Potential Transformers, Summation Transformers, Phase Sequence Current Segregating Network, Routine Checks for Sensitivity and Secure performance, Basic Definitions
Protection Schemes;- Overcurrent Relaying, Differential Relaying, Directional Relaying, Distance Relaying, Translay Relaying
Pilot Relay Protection;- Introduction, Requirement of Pilot relaying, Wire Pilot Relaying, Carrier Current Pilot Relay, Carrier aided Distance Protection comparison of the transfer trip and blocking schemes

Module IV (12Hrs)
Microprocessor based digital Relaying;- Introduction, Digital Logic Communication, Direct Relay to Relay Digital Logic Communication, Digital message Security, Relay Interface with Utility, Microprocessor based Over Current Relay, Microprocessor based Impedance Relay, Microprocessor based Reactance relay, Microprocessor based MHO relay, SCADA Interfacing and metering, Application of Microprocessor based relay
Static Relays;- Introduction, Static Relay Components, Comparators, Static Overcurrent Relay, Static Distance Relay, Static Polyphase relay
Apparatus Protection;- Generator Protection, Electric Motor Protection, Transformer Protection,

Text Book
1. Ravindra P. Singh, *Switch Gear And Power System Protection*, PHI Learning Private Limited, 2011

References
1. Soni, Gupta & Bhatnagar, *A Course in Electrical Power*, Dhanpat Rai & Sons. NewDelhi, 1996
2. Sunil S Rao, *Switch Gear Protections*, Khanna Publications, Delhi 1999
3. T S Madhav Rao, *Power System Protection Static Relays with Microprocessor Applications*, Tata McGraw hill Publication,1998.
4. Badri Ram, D N Vishwakarma, *Power System Protection and Switchgear*, Tata Mc Graw Hill, 2005.
5. Paithankar & Bhide, *Fundamentals of Power System Protection*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 804(A) POWER SYSTEM OPERATION AND CONTROL

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To prepare students for a career as power system engineers with a basic understanding of modern tools and practices*
- *To impart an understanding of the activities in load dispatch centers*
- *To instill an awareness of current research topics*

Module I (12 hours)

Optimization: Unit Commitment- Problem Definition- System constraints- Priority ordering- Dynamic programming

Optimal Power Flow - Problem statement- Lagrangian Solution method- Algorithm- How violations of control and dependant variables are treated

Hydrothermal scheduling- Problem modeling and statement - Discretizaton- solution algorithm

Module II (14 hours)

Control area concepts -P-f control of single control area- ACE- Two area control- tie line bias control - extension to pool operation or multi control area systems

Deregulated power system – Restructure models – functional units – GENCOS, DISCOS, TRANSCOS, ISO, PX, TSP – Transmission open access- Power wheeling- ABT-Distributed generation and spot prices, Micro grid, smart grid (Basic concepts only)

Module III (13 hours)

Power System Security: Definition- Security functions- State transition diagram- selection of contingency and modeling for analysis- Contingency analysis using (a) sensitivity method- derivation of generalized constants- Analysis of a contingency case of removal of a line or transformer of series impedance Z_S (b) using ac load flow method

Module IV (13hours)

State Estimation: Introduction to SCADA - block diagram concept -definition of state estimation and requirement for an estimator- Problem statement and LSE and weighted LSE - Basic solution- Sequential solution- extension to power system

Text books

1. A. K. Mahalanabis, D. P. Kothari, S I Ahson, *Computer Aided Power System Analysis and Control*, Tata McGrawHill.
2. O. L.Elgerd, *Electrical Energy System Theory: An Introduction* ,TMH
3. J. Wood, B. F. Woollenberg, *Power Generation, Operation & Control*, Wiley-India
4. Dr.Loi Lei Lai, *Power System Restructuring and Deregulation*, John Wiley Inc. 2001
5. P Venkatesh et al , *Electrical Power Systems- Analysis, Security & Deregulation*, PHI

Reference Books

1. G. W. Stagg, A H. El- Abiad,*Computer Methods in Power System Analysis*, TMH
2. John J. Grainger, W. D. Stevenson, *Power System Analysis*, TMH
3. B. R. Gupta, *Power System Analysis and Design*, A. H. Wheeler & Co.
4. S. Sivanagaraju, G. Sreenivasan, *Power System Operation And Control*, Pearson Education
5. Dr. K. Uma Rao, *Power system Operation And Control*, Wiley-india

Internal ContinuousAssessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 804(B) BIOMEDICAL ENGINEERING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *This course gives a brief introduction to human physiology and presents various instrumentations system for measurement and analysis of physiological parameters.*

Module I (13 hours)
Development of biomedical instrumentation, biometrics, man instrument system components block diagram, physiological systems of the body (brief discussion on Heart and cardio vascular system, Anatomy of nervous system, Physiology of respiratory systems) problems encountered in biomedical measurements.
Sources of bioelectric potentials – resting and action potentials - propagation of action potentials – bio electric potentials example (ECG, EEG, EMG,ERG, EOG,EGG etc.)
Bio potential electrodes – theory – microelectrodes – skin surface electrodes – needle electrodes – biochemical transducers – transducers for biomedical applications.

Module II (13 hours)
Electro-conduction system of the heart. Electro cardiography – electrodes and leads – Einthoven triangle, ECG read out devices, ECG machine – block diagram. Measurement of blood pressure – direct and indirect measurement – oscillometric measurement – ultrasonic method, measurement of blood flow and cardiac output, plethysmography – photo electric and impedance plethysmographs, measurement of heart sounds – phonocardiography.
Cardiac pacemakers – internal and external pacemakers, defibrillators.

Module III (13 hours)
Electro encephalogram –neuronal communication – EEG measurement. Muscle response – Electromyogram (EMG) – Nerve Conduction velocity measurements- Electromyogram measurements. Respiratory parameters – Spiro meter, pneumograph, gas exchange and distribution, respiratory therapy equipment.
Ventilators, artificial heart valves, heart lung machine, hemodialysis, lithotripsy, infant incubators

Module IV (13hours)
X-rays- principles of generation, uses of X-rays- diagnostic still picture, fluoroscopy, angiography, endoscopy, diathermy. Basic principle of computed tomography, magnetic resonance imaging system and nuclear medicine system – radiation therapy. Ultrasonic imaging system - introduction and basic principle.
Instruments for clinical laboratory – test on blood cells – chemical tests - electrical safety – physiological effects of electric current – shock hazards from electrical equipment – method of accident prevention, introduction to tele- medicine.

Text Books

1. L. Cromwell, F. J. Weibell and L. A. Pfeiffer, *Biomedical Instrumentation Measurements*, Pearson education, Delhi, 1990.
2. J. G. Webster, *Medical Instrumentation, Application and Design*, Wiley-India

Reference Books

1. R. S. Khandpur, *Handbook of Biomedical Instrumentation*, Tata Mc Graw Hill
2. J. J. Carr and J. M. Brown, *Introduction to Biomedical Equipment Technology*, Pearson Education.
3. Anand Natarajan, *Biomedical Instrumentation & Measurements*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 804(C) OPTIMAL CONTROL THEORY

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To give an overview of the optimal control problem and different solution methods.*

Module I (12 hours)

Introduction . Optimal control problem . Problem Formulation . Performance measures for various types of optimal control problems- -Minimum time problem- Minimum fuel problem- Minimum energy problem- Tracking problem- Regulator problem—selection of a performance measure-Example..

Module II (14 hours)

Dynamic programming-The optimal control law- principle of optimality-Recurrence relation of dynamic programming- computational procedure for solving optimal control problems-Characteristics of Dynamic programming solution-Discrete linear regulator problem-Hamilton Jacobi Bellman equation-Continuous linear regulator problem.

Module III (13 hours)

Calculus of variations- Fundamental concepts . Functional of single function- Euler - equation-General variation of a functional-Functionals of several independent functions- Boundary conditions. Piecewise smooth extremals. Constrained extremisation of functionals-Point constraints-differential equation constraints-isoperimetric constraints.

Module IV (13hours)

Variational approach to optimal control problems-Necessary conditions for optimal control -Boundary conditions in optimal control problem. Linear regulator problem . Linear Tracking problem. Pontryagin.s minimum principle- State inequality constraints - Minimum time problems-Minimum control effort problems.

Text Books

1. Donald E. Kirk, *Optimal Control Theory: An introduction*, Dover Publications 2004.

Reference Books

1. Andrew P. Sage, *Optimum Systems Control*, Prentice Hall,1977.
2. HSU and Meyer, *Modern Control- Principles and Applications*, McGraw Hill,1968.
3. Brian D.O. Anderson, John B Moore, *Linear Optimal Control*, Prentice hall, 1991.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Analytical/problem solving SHORT questions* Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	*8x 5 marks=40 marks*
PART B:	*Analytical/Problem solving DESCRIPTIVE questions* Two questions from each module with choice to answer one question.	*4 x 15 marks=60 marks*

Maximum Total Marks: 100

EE14 804(D) DIGITAL IMAGE PROCESSING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To study the image fundamentals and mathematical transforms necessary for image processing.*
- *To study the image enhancement techniques*
- *To study image restoration procedures.*
- *To study the image compression procedures*
- *To study the image segmentation and representation techniques*.

Module I (12 hours)
Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

Module II (16 hours)
Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing, sharpening filters – Laplacian filters – Frequency domain filters : Smoothing – Sharpening filters – Homomorphic filtering.
Model of Image Degradation/restoration process – Noise models – Inverse filtering -Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse – Singular value decomposition.

Module III (12 hours)
Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM.
Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG, basics of Vector quantization.

Module IV (12hours)
Edge detection – Thresholding - Region Based segmentation – Boundary representation: chair codes- Polygonal approximation – Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptor.

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Pearson Education.

Reference Books

1. B Chanda, D. Dutta Majumdar, *Digital Image Processing and Applications,* Prentice Hall of India.
2. S. Jayaraman, S. Essakkiraja, T. Veerakumar, *Digital Image Processing,* Tata Macgraw Hill.
3. A. K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall of India
4. William K. Pratt, *Digital Image Processing,* John Wiley & Sons

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 804(E) ROBOTICS &AUTOMATION

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To give an introduction of industrial robotics and automation*

Module I (13 Hours)

Automation and Robotics - Robotics in Science Fiction - A Brief History of Robotics - The Robot and Its Peripherals-Robot Activation and Feedback Components - Position Sensors - Velocity Sensors - Actuators - Power Transmissions Systems - Robot Joint Control Design- Introduction to Manipulator Kinematics - Homogeneous Transformations and Robot Kinematics -Manipulator Path Control - Robot Dynamics - Configuration of a Robot Controller.

Module II (13 Hours)

Types of End Effectors - Mechanical Grippers - Other Types of Grippers - Tools as End Effectors - The Robot/End Effector Interface - Considerations in Gripper Selection and Design - Sensors in Robotics - Tactile Sensors - Proximity and Range Sensors - Miscellaneous Sensors and Sensor-Based Systems - Uses of Sensors in Robotics - Introduction to Machine Vision - The Sensing and Digitizing Function in Machine Vision - Image Processing and Analysis - Training and Vision System - Robotic Applications.

Module III (13 Hours)

Methods of Robot Programming – Lead through Programming Methods - A Robot Program as a Path in Space - Motion Interpolation - WAIT, SIGNAL, and DELAY Commands - Branching - capabilities and Limitations of Lead through Methods - The Textual Robot Languages - Generations of Robot Programming Languages - Robot Language Structure - Constants, Variables, and Other Data Objects - Motion Commands - End Effector and Sensor Commands - Computations and operations - Program Control and Subroutines - Communications and Data Processing - Monitor Mode Commands.

Module IV (13 Hours)

Introduction to robot intelligence and task planning- state space search-problem reduction-use of predicate logic-means –end analysis-problem-solving –robot learning-robot task planning-expert systems and knowledge learning.

Text Books

1. Mikell P. Groover- et. Al, *Industrial robotics, Technology, programming and Applications*, McGraw Hill
2. K. S. Fu, R. C. Gonzalez, C. S. G. Lee, *Robotics, Control, Sensing and Intelligence*, McGraw Hill
3. Schilling, *Fundamentals of Robotics: Analysis & Control*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 805(A) SPECIAL ELECTRICAL MACHINES

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To introduce special types of electric machines and their control.*

Module I (14hours)

Stepper Motors – Construction of single stack and three stack variable reluctance, permanent magnet and hybrid stepper motors and their modes of operation (1-Phase on, 2- Phase on and half step modes)- Torque equation – static and dynamic characteristics- definition and explanation of the terms (step single, resolution, positional error, pull in torque, pull out torque, detent torque, mid frequency resonance, response range, slew range- closed loop control of stepper motors – Microprocessor based control of stepper motor,(block diagram, interface and flow chart of open loop control)- comparison of the above mentioned stepper motors – Applications

Switched Reluctance Motor(SRM)- constructional features- principle of operation-L-θ Profile-constraints on pole arc and tooth arc- torque equation- characteristics (Rotor position Vs Torque, inductance, flux linkage and current: torque Vs speed) – power converter circuits((n+1) switching devices and split link circuits)- sensorless control of SRM- Applications

Module II (12hours)

Synchronous Reluctance Motors (SyRM) - Constructional features, working- Phasor diagram-. Torque equation, Characteristics – constant direct axis current control (block diagram and applications)

Permanent Magnet Synchronous Motor(PMSM) constructional features- torque equation-Phasor diagram-circle diagrams- vector control of PMSM(Principle, block diagram and explanation)-Transfer function of PMSM

Module III (12hours)

Permanent Magnet Brushless DC Motors – Constructional features- electronic commutation -Comparison between mechanical and electronic commutation- analysis of BLDC square wave motor with 180 deg pole arc-self control and DSP based control of BLDC Motor(principle, block diagram, flow chart.

AC servomotors-constructional features-working-Analysis based on symmetrical components-transfer function- applications

Module IV (14hours)

Single phase special machines-construction and working of AC series motor, repulsive motor and universal motor-phasor diagrams-applications.

Linear induction motors(LIM)- Construction of double sided primary flat, tubular and transverse flux-LIMS- Thrust equation- Performance characteristics(SlipVs ηPF and thrust)-output equation (no derivation),- choice of specific magnetic and electric loading-applications

Linear Synchronous Motor-(LSM) Construction of single sided, double sided and slotless LSMs-Applications

Linear Reluctance motor(LRM) Construction and principle of operation of LRM

Linear Levitation Machine(LLM) Principle of levitation-construction and working of repulsion type and attraction type LLM

Text Books

1. Miller T J E, *"Switched Reluctance Motor and Their Control"*, Clarendon Press, Oxford, 1993.
2. Miller T J E, *"Brushless Permanent Magnet and Reluctance Motor Drives"*, Clarendon Press, Oxford,1989.
3. B K Bose, *"Modern Power Electronics & AC drives"*, Pearson, 2002.
4. Athani V.V. *"Stepper motors – Fundamentals, Applications &Design*" New Age International

Reference Books

1. Dr.E.G Janardhanan, *"Special Electrical Machines"*, PHI Learning
2. Kenjo T, Sugawara A, *"Stepping Motors and Their Microprocessor Control"*, Clarendon Press, Oxford, 1994.
3. Kenjo T, *"Power Electronics for the Microprocessor Age"*, Oxford University Press, 1990.
4. Ali Emadi (Ed), *"Handbook of Automotive Power Electronics and Motor Drives"*, CRC Press, 2005.
5. R Krishnan, *"Electric Motor Drives – Modeling, Analysis and Control"*, PHI, 2003.
6. H A Toliyat, S Campbell, *"DSP Based Electro Mechanical Motion Control"*, CRC Press, 2004.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 805(B) DIGITAL CONTROL SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To familiarise digital controllers.*
- *To understand the analysis and design of digital control system.*

Module I (13 Hours)

Introduction to discrete time control system- Block diagram of a digital control system- Review of z- transforms and inverse z- transforms- solution of difference equations- pulse transfer function- pulse transfer function with dead time- system time response- Realization of pulse transfer functions (Digital Controllers)- Direct Programming- Standard Programming- Series programming- parallel programming- ladder programming.

Module II (15 Hours)

Review of stability analysis in z- plane- Jury's stability test –Bilinear transformation and extension of Routh's stability criterion to discrete systems- Transient and Steady state response analysis- transient response specifications- steady state error analysis- effect of sampling period on transient response - frequency response specifications- Nyquist stability criterion in the z- plane- Digital Controllers- PI, PD & PID Controllers- Lag, lead, and lag-lead compensators- Design of lag compensator and lead compensator based on root locus and Bode plot approaches.

Module III (12 Hours)

State Space analysis of digital control systems- state space representation of discrete time systems- Transfer function from state model- Controllable, Observable, Diagonal/ Jordan Canonical forms from transfer function- Solution of linear time invariant discrete time state equations- discretization of continuous time space equation- representing state models in DCF/ JCF using transformation matrix.

Module IV (12 Hours)

Concept of controllability and observability for a linear time invariant discrete time control system- condition for controllability and observability - state feedback- design via pole placement- state observers- design of full order state observer.

Text Books

1. K. Ogata, *Discrete- time Control Systems*, Pearson Education
2. M. Gopal, *Digital Control and State Variable Methods*, Tata McGraw Hill

Reference Books

1. B. C. Kuo, *Digital Control Systems*, Prentice Hall
2. Charles L. Philip and Troy Nagle, *Digital Control Systems*, Prentice Hall

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Analytical/problem solving SHORT questions* Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	*8x 5 marks=40 marks*
PART B:	*Analytical/Problem solving DESCRIPTIVE questions* Two questions from each module with choice to answer one question.	*4 x 15 marks=60 marks*

Maximum Total Marks: 100

EE14 805(C) ORGANIZATIONAL BEHAVIOR

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To develop positive attitude, leadership qualities, effective organizational skills and to attain proficiency in communication skills*

Module I (14 hours)

Organization-Role-Definition of Organizational Behaviour(OB) _challenges and oppurtunities to OB-Factors determining individual behavior – .models of man - Personality – Theories of personality – determinants of personality
Perception – perceptual process –Nature and importance – management of perception
Learning and behaviour modification – factors affecting leaning –theories-cognitive-conditioning-social learning theories- reinforcement- organisational behaviour modification
Attitudes and Values – concept of attitude- Factors in attitude formation – Values – concepts -factors affecting value formation

Module II (12 hours)

Motivation – Theories of Motivation – Need theory – Hygiene theory – Theory X and Y – Expectancy model – ERG Theory –Relationship between attitude, Motivation and performance Job Design and Motivation- Behaviour modification.
Communication – Dynamics of Communication – Process and Forms of Communication – Barriers in Communication – Managing Communication.

Module III (13 hours)

Interpersonal Behaviour – Nature of Groups-Types- Group Dynamics – Group Behaviour – Group Effectiveness.
Leadership – Theories of Leadership – Triat Theory – Behavioural Theory – Situational and Contingency model – Leadership Styles-Recent approaches to leadership
Emotions - feelings –OB aspects of emotions- Emotional intelligence
Transactional analysis- Ego states-Types of transactions

Module IV (13hours)

Organizational Change – Nature and Factors – Change processs- Role of change agents-Resistance to Change –Models of organisational effectiveness- Factors affecting organisational effectiveness
Organizational Development – Concept, need and significance of Organizational Development - characteristics –Organizational Development Interventions techniques

Text Books

1. Stephen Robbins, *Organisational Behaviour*, Pearson Education
2. A.K.Chiale, R.P Mohanty, N R Dubey *Organizational Behaviour,* PHI Learning Pvt Ltd

Reference Books

1. Schermerhom J. R. Jr., Hunt J. G. & Osborn R. N., *Managing Organizational Behavior,* John Wiley & Sons
2. LM. Prasad, *Organizational Behaviour*, S. Chand & Sons
3. Luthans, *Organizational Behavior*, McGraw Hill International
4. Kieth Davis, *Human Relations at Work*, Mc Graw Hill Inc

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 805(D) INSTRUMENTATION SYSTEMS

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *Understanding the basic working principle of electrical Instrumentation systems*
- *To select appropriate instruments for application*
- *Develop an instrumentation system for a particular application*

Module I (15 hours)

General measurement systems: specifications of instruments, their static and dynamic Characteristics. Active and passive transducers and their classification.

Transducers: Resistance type - potentiometer, strain gauge; **Inductive type** – LVDT, RVDT

Sensing elements: Temperature sensing elements – RTD, thermistor, thermocouple, semiconductor IC

sensors; Pressure sensing elements – manometers, elastic elements, Bourdon tube, diaphragm, bellows; **Electrical type -** McLeod gauge, Pirani gauge; Flow sensing transducers. Velocity measurement.

Electromagnetic flow meter, Coriolis flow meter, Ultrasonic flow meter; capacitive sensors. Photo conductive sensors – Capacitive sensors- Variable area – Variable distance – Variable dielectric type sensors.

Analytical sensors – pH measurement. Hall effect transducer.

Module II (12 hours)

Feedback transducer systems, data display and recording systems: Self balancing systems, servo operated system, data- loggers, analog and digital data acquisition systems, Analog and magnetic tape recorders, digital input-output devices.

MEMS- principle of operation, materials, basic process, manufacturing technology.

Module III (13 hours)

Telemetry- Data transmission – methods of data transmission, current, voltage, and position telemetry systems.

Modulation techniques: FM, AM, ASK, FSK, Time division and frequency division multiplexing, applications, signal isolation techniques (MCT2E). Digital methods of frequency, phase and time period measurements.

Module IV (12 hours)

Optical instruments - Eye, telescopes, microscopes, photographic lenses, optical projection systems, cameras, Abbe's refractromete, monochromatic. Thermal detectors and Quantum detectors, bolo meter, Photodiodes- PIN and avalanche photodiodes, phototransistors, photo multipliers, IR detectors.

CCD devices – principle and operation.

Text Books

1. A.K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and sons.
2. D. V. S. Murty, *Transducers and Instrumentation*, PHI, New Delhi, 2003.
3. E.O. Doebelin, *Measurement Systems Application and Design*, McGraw Hill, 4th Edition, 1990
4. Arun K Ghosh, *Introduction to Measurements and Instrumentation*, PHI
6. Ramakant Gaikwad, *Operational Amplifiers*, PHI

References

1. William David Cooper, *Electronic Instrumentation and Measurement Techniques*, Prentice Hall, India
2. K.B. Klaassan, *Electronic Measurements and Instrumentation*, Cambridge University Press
3. GK. Banerjee, *Electrical and Electronic Measurements*, , PHI
4. John Bentley, *Principles of Measurements Systems*, Pearson Education
5. Patranabis, *Principles of Electronic Instrumentation*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 805(E) EMBEDDED SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To give sufficient background for undertaking embedded system design*
- *To introduce students to the embedded systems, its hardware and software.*
- *To explain programming concepts*
- *To explain real time operating systems*

Pre-requisites: *Knowledge of analog electronics, digital electronics, microprocessors and microcontrollers*

Module I (12 hours)
Introduction to Embedded Systems: Characteristics of Embedded Systems, Microprocessor basics, Microprocessor architectures: CISC and RISC- Von Neumann and Harvard- Instruction pipelining, Microcontroller: characteristics, Classification.
Hardware Design(with PIC16F84 example):PIC16F84-Architecture, Instruction set, Programming model, Interfacing with peripherals, Interrupts, Parallel I/O ports-Simple Interfacing, Timers and counters, Watchdog timer, Power supply and reset, Clock oscillator.

Module II (14 hours)
Hardware Design (contd): Memory for embedded systems: Introduction, Volatile memories, Non volatile memories, Microcontroller memory implementation.
DACs-stand alone converter-PWM, Data acquisition systems- Sensors-temperature sensors-light sensors, ADCs.
Buses and Protocols: Processor memory bus- peripheral buses-parallel vs serial buses.
Serial communication- types-features-bus arbitration, serial standards and protocols, serial ports.

Module III (14 hours)
Software Design:
Preliminary programming: Assembly language programming
Systematic software: Developing program structure, Choice between assemblers and high level languages.
Operating system concepts: Embedded operating systems, Network operating systems, Layers of an OS, Components of an OS, Kernel, Tasks, Scheduling algorithms, Threads, Interrupt handling, IPC, Task synchronisation, Semaphores

Module IV (12 hours)
Real Time operating System: Real time tasks, Real time systems, Types of real time tasks, Real time operating systems, Real time scheduling algorithms, Rate monotonic algorithm, Earlist deadline fast algorithm, Qualities of a good RTOS.

Text Books

1. Tim Wilmshurst, *The Design of Small Scale Embedded Systems*, Palgrave Publishers
2. Lyla B. Das, *Embedded systems: An Integrated Approach*, Pearson Education

Reference Books

1. Rajkamal, *Embedded Systems Architecture, Programming and Design*, Tata McGraw Hill
2. Steve Heath, *Embedded Systems Design*, Newnes
3. David E. Simon, *An Embedded Software Primer*, Pearson Education
4. Wayne Wolf, *Computers as Components: Principles of Embedded Computing System Design*, Harcourt India, Morgan Kaufman Publishers
5. Frank Vahid and Tony Givargis, *Embedded Systems Design- A Unified Hardware/ Software Introduction*, Wiley-India

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EE14 805(F) PROCESS CONTROL & INSTRUMENTATION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To create an awareness of the different transducers used in industry and signal conditioning*
- *To familiarize the process control elements and their control characteristics*

Module I (12 hours)
Signal Conditioning – Analog – Digital - Signal conversions - Process Control Principles - Identification of elements, block diagram, the loop, control system evaluation stability, regulation, evaluation criteria, and cyclic response.

Module II (14 hours)
Final Control Element: Final control operation, signal conversions, analog electrical signal, digital electrical signals, Direct action – pneumatic signals, Actuators – electrical actuators, pneumatic actuators, control elements – fluid valves. Signal Conditioning of Transducers- Temperature Transducers - flow transducers

Module III (13hours)
Controller Principles - Process characteristics, control system parameters, controller modes, discontinuous controller modes, continuous controller modes, composite controller modes.
Analog Controllers - Electronic controller – Direct action, reverse action, proportional mode, integral mode, derivative mode, composite controller modes. Pneumatic controllers – implementation of PI, PID, PD. Design consideration.

Module IV (13hours)
Control Loop Characteristics: Control system configurations, cascade control, multivariable control, feed forward control, Split range control, inferential control, Adaptive control, control system quality – loop disturbance, optimum control, measure of quality, Stability, process loop tuning

Text Books

1. Curtis D. Johnson, *Process Control Instrumentation Technology,* Pearson Education

Reference Books

1. Curtis D. Johnson, *Microprocessors in Process Control*, PHI
2. Deshpande and Ash, *Elements of Computer Process Control of Industrial Processes*, ISA
3. S. K. Singh, *Computer Aided Process Control*, PHI
4. Jayantha K. Paul, *Real- Time Microcomputer Control of Industrial Processes*, Kluwer Publications, Netherlands

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Analytical/problem solving SHORT questions* Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	*8x 5 marks=40 marks*
PART B:	*Analytical/Problem solving DESCRIPTIVE questions* Two questions from each module with choice to answer one question.	*4 x 15 marks=60 marks*

Maximum Total Marks: 100

EE14 806(P) SEMINAR

Teaching scheme **Credits:** 2
3 hours per week

Objective

- *To assess the ability of the student to study and present a seminar on a topic of current relevance in electrical/electronics/computer/ biomedical/ instrumentation engineering or allied areas.*

It enables the students to gain knowledge in any of the technically relevant current topics and acquire the confidence in presenting the topic. The student will undertake a detailed study on the chosen topic under the supervision of a faculty member, by referring papers published in reputed journals and conferences. Each student has to submit a seminar report, based on these papers; the report must not be reproduction of any original paper. A committee consisting of three/four faculty members will evaluate the seminar.

Internal Continuous Assessment *(Maximum marks – 100)*
20% - Relevance of the topic and literature survey
50% - Presentation and discussion
20% - Report
10% - Regularity in the class and Participation in the seminar

EE14 807 (P) PROJECT

Teaching scheme
4 hours practical per week

Total Credits: 4
Credits for interim evaluation: 4
Credits for final evaluation: 4

Objectives

- *To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model or a system.*

This project work is the continuation of the project initiated in seventh semester. The performance of the students in the project work shall be assessed on a continuous basis by the project evaluation committee through progress seminars and demonstrations conducted during the semester. Each project group should maintain a log book of activities of the project. It should have entries related to the work done, problems faced, solution evolved etc.

There shall be at least an Interim Evaluation and a final evaluation of the project in the 8th semester. Each project group has to submit an interim report in the prescribed format for the interim evaluation.

Each project group should complete the project work in the 8th semester. Each student is expected to prepare a report in the prescribed format, based on the project work. Members of the group will present the relevance, design, implementation, and results of the project before the project evaluation committee comprising of the guide and three/four faculty members specialised in electrical power system / machines/electronics / power electronics/ computer/ instrumentation/ biomedical Engg. etc.

50% of the mark is to be awarded by the guide and 50% by the evaluation committee.

Internal Continuous Assessment *(Maximum Marks - 50)*
40% - Design and development/Simulation and analysis
30% - Presentation & demonstration of results
20% - Report
10% - Regularity in the class

End semester Examination *(Maximum Marks - 100)*
Report Evaluation by external examiner: 50 marks
Presentation evaluated by external / internal examiner: 50 marks

EE14 808 (P) VIVA VOCE

Credits: 3

Objective

- *To examine the knowledge acquired by the student during the B.Tech. course, through an oral examination*

The students shall prepare for the oral examination based on the theory and laboratory subjects studied in the B.Tech. Course, mini project, seminar, and project. There is only university examination for viva-voce. University will appoint two external examiners and an internal examiner for viva-voce. These examiners shall be senior faculty members having minimum five years teaching experience at engineering degree level. For final viva-voce, candidates should produce certified reports of mini project, seminar, and project (two interim reports and main report). If he/she has undergone industrial training/industrial visit/educational tour or presented a paper in any conference, the certified report/technical paper shall also be brought for the viva-voce.

Allotment of marks for viva-voce shall be as given below.

Assessment in Viva-voce *(Maxim marks – 100)*

40% - Subjects
30% - Project and Mini Project
20% - Seminar
10% - Industrial training/industrial visit/educational tour or Paper presented at National-level