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

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

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### Elective I

- EE14 704(A) Switched Mode Power Converters
- EE14 704(B) Electrical Machine Design
- EE14 704(C) Generalised Machine Theory
- EE14 704(D) Mechatronics (G)
- EE14 704(E) VLSI Design

### Elective II

- EE14 705(A) Soft Computing Techniques (G)
- EE14 705(B) High Voltage Engineering
- EE14 705(C) Electric Power Utilisation
- EE14 705(D) Professional Ethics
- EE14 705(E) Management Information Systems
- EE14 705(F) Satellite Communication
### 8th Semester

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**Elective III**

- EE14 804 (A) Power System Operation & Control
- EE14 804 (B) Biomedical Engineering(G)
- EE14 804 (C) Optimal Control Theory
- EE14 804 (D) Digital Image Processing
- EE14 804 (E) Robotics & Automation

**Elective IV**

- EE14 805 (A) Special Electrical Machines
- EE14 805 (B) Digital Control Systems
- EE14 805 (C) Organisational Behaviour(G)
- EE14 805 (D) Instrumentation Systems
- EE14 805 (E) Embedded Systems
- EE14 805 (F) Process Control & Instrumentation
TEACHING SCHEME

3 hours lecture and 1 hour tutorial per week

CREDITS: 4

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: \(e^z\), \(\sin z\), \(\cosh z\), \((z+\frac{1}{z})\) – Mobius Transformation.

MODULE II: FUNCTIONS OF A COMPLEX VARIABLE (13 hours)


MODULE III: LINEAR ALGEBRA (13 hours) – (Proofs not required)


MODULE IV: FOURIER TRANSFORMS (13 hours)


TEXT BOOKS

Module I:

Sections: 12.3, 12.4, 12.5, 12.6, 12.7, 12.9

Module II:

Sections: 13.1, 13.2, 13.3, 13.4, 14.4, 15.1, 15.2, 15.3, 15.4

Module III:

Sections: 6.1, 6.2, 6.3, 6.4, 6.7, 6.8, Appendix.B.1

Module IV:

Sections: 9.1, 9.3, 9.5
### Reference books

### Internal Continuous Assessment (Maximum Marks-50)

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<td>Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.</td>
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### 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.
- 8 questions × 5 marks = 40 marks

#### PART B: Analytical/Problem solving DESCRIPTIVE questions
- Two questions from each module with choice to answer one question.
- 4 questions × 15 marks = 60 marks

*Maximum Total Marks: 100*
EN14 302: COMPUTER PROGRAMMING IN C
(Common for all branches)

Teaching scheme
3 hours lecture and 1 hour practical per week

Credits: 4

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)

Module II (14 hours)

Module III (14 hours)

Module IV (14 hours)

Text Books
1. P. Norton, Peter Norton’s Introduction to Computers, Tata McGraw Hill, New Delhi

Reference Books
2. S. Kochan, Programming in C, CBS publishers & distributors
### Internal Continuous Assessment (Maximum Marks-50)

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### 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*
Objective:

- 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


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


Module III (12 hours)

Measurement of power and power factor: one wattmeter, two wattmeter 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)


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

**Reference Books**
3. B.C. Kuo, *Network Analysis & Synthesis*, Wiley-India
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*
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*
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
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)


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)


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


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)


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).
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.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions

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

Maximum Total Marks: 100
**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)**


**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**

2. V. Boylestad and Nashelsky, *Electronic Devices and Circuits*, Pearson Education

**Reference Books**

2. Theodore F. Bogart Jr., *Electronic Devices and Circuits*,
3. Coughlin and Driscoll, *Operational amplifiers and Linear Integrated Circuits*,

**Internal Continuous Assessment (Maximum Marks-50)**

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<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
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<tr>
<td>60%</td>
<td>Tests (minimum 2)</td>
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<td>30%</td>
<td>Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.</td>
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<tr>
<td>10%</td>
<td>Regularity in the class</td>
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**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
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.)

Thermodynamics
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, polytropic, 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.)

Module 4 (13 Hrs.)
Heat Transfer
Kirchhoff’s Law, Heat Exchangers, LMTD, Overall Heat Transfer Coefficient, parallel and counter flow heat exchangers (Simple numerical problems).

**Reference Books**

**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
3 hours practical per week

Credits: 2

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.
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

3 hours practical per week

Credits: 2

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

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
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)

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)

Module IV: Partial Differential Equations (13 hours)
Introduction – Solutions of equations of the form \( F(p,q) =0 \) ; \( F(x,p,q) =0 \) ; \( F(y,p,q) =0 \) ; \( F(z,p,q) =0 \) ; \( F(x,q) = F_y(y,q) \) ; Clairaut’s form, \( z = px + qv + F(p,q) \) ; Legendre’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:
Sections: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7.

Module III:
Sections: 4.1, 4.4, 4.5

Module IV:
Sections: 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9
Sections: 11.2, 11.3, 9.8 Ex.3, 11.5
Reference books

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
EN14 402 Environmental Science  
(Common for all branches)

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4

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)

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

References:
2. S.P Misra, S.N Pandey, Essential Environmental studies, Ane books, Pvt Ltd, 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% - 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*

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**EE14 403 ELECTRICAL MACHINES I**

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

**Credits: 4**

**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 (14 hours)**: 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 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

Reference Books

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
Objective

- Understand the concepts of signals and systems

Module 1 (14 hours)

Module II (16 hours)

Module III (12 hours)

Module IV (10 hours)
### Text Books

### Reference Books
3. Roy Choudhury, *Networks & Systems*, New Age International publishers
5. V. Krishnaveni & R. Rajeswari, *Signals & Systems*, Wiley-India
6. Anand Kumar, *Signals & Systems*, Prentice-Hall of India

### Internal Continuous Assessment *(Maximum Marks-50)*
- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as homework, 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

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*
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
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
5. Maini, Digital Electronics-Principles & Integrated Circuits, Wiley-India
University of Calicut

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

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

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

*Maximum Total Marks: 100*
EE14 406 ELECTROMAGNETIC FIELD THEORY

Teaching scheme
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.

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.

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**Text Books**

**Reference Books**
5. Pramanik, *Electromagnetism, Theory and Applications*, Prentice Hall of India

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**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

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**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.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions

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

**Maximum Total Marks: 100**
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 Bernoulli’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


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
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 Wheatstone'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
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

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


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 —


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

Reference Books
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
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)

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
4. V K Mehta, Electric Power Systems, S Chand & Sons

Reference Books
2. S L Uppal, Electrical Power, Khanna Publishers
### Internal Continuous Assessment *(Maximum Marks-50)*

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<thead>
<tr>
<th>Percentage</th>
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### 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.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions

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

*Maximum Total Marks: 100*
EE14 503 ELECTRICAL MACHINES II

Teaching scheme
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)

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

Reference Books
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)*

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<tr>
<td>10%</td>
<td>Regularity in the class</td>
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</table>

Note: One of the assignments shall be drawing of the construction of synchronous machines using Autocad

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**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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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

Module I (13 hours)

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books
2. Simon Haykin, *Digital Communication*, 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
University of Calicut

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 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
   Design, McGraw Hill(ASM)

Reference Books
1. Ian Grout, Digital Systems Design with FPGAs,Elsevier.
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
8. B.Holdsworth, R.C Woods, Digital Logic Design, Newnes, Elsevier
**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

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**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.

**PART B:**  Analytical/Problem solving DESCRIPTIVE questions

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

*Maximum Total Marks: 100*
**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, SF₆ and hydrogen) – ageing of insulators.

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

References
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
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
University of Calicut

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.

<table>
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<th>Internal Continuous Assessment (Maximum Marks-50)</th>
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<tr>
<td>60%-Laboratory practical and record</td>
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<tr>
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<td>10%- Regularity in the class</td>
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<th>Semester End Examination (Maximum Marks-100)</th>
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<tbody>
<tr>
<td>70% - Procedure, conducting experiment, results, tabulation, and inference</td>
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<td>20% - Viva voce</td>
</tr>
<tr>
<td>10% - Fair record</td>
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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
**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)**


**Module II (13 Hrs)**


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

**Text Books**


**Reference Books**


**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)

Reference Books
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
6. Weist and Levy, A Management guide to PERT and CPM, Prantice Hall of India
<table>
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<td><strong>PART A:</strong> Analytical/problem solving SHORT questions (4 \times 5 \text{ marks} = 20 \text{ marks})</td>
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<td>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.</td>
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| **PART B:** Analytical/Problem solving DESCRIPTIVE questions \(2 \times 15 \text{ marks} = 30 \text{ marks}\) |
| Two questions from each module with choice to answer one question. |

*Maximum Total Marks: 50*
Objective

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

Module 1 (13 Hrs) Principle of Automatic control- Open loop and closed loop systems – examples


Module III (12 Hrs) 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)


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, Modern 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 homework, 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
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)

Module II (13 Hrs)
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
Induction generator – principle of operation - self-excited & line-excited induction generators - applications

Module IV (12 Hrs)

Text Books
1. M.G. Say, Performance & Design of AC machines, Pitman ELBS
2. P.S. Bhimbra, Electrical Machinery, Khanna Publishers
4. M.N.Bandyopadhyay, Electrical Machines-Theory & Practice, PHI

Reference Books
5. E.G. Janardhanan, Special Electrical Machines, PHI Learning
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

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**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*
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)

Module II (13 hours)
Introduction to Pentium microprocessor – Special features - Pentium registers – Pentium memory management

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books
2. Brey B.B., *The Intel Microprocessor system – Architecture, programming and Interfacing*
5. Dr. K. Uma Rao, Dr. Andhe Pallavi, *The 8051 Microcontroller*, Sanguine Technical Publishers

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
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)


Module II (14 Hours)


Module III (12 Hours)

Finite word length effects – fixed point and floating point formats – quantization errors – limit cycle oscillations.

Module IV (14 Hours)

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

Reference Books
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
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)
Polynomial interpolation - Lagrange interpolation polynomial - Divided differences- Newton divided difference interpolation polynomial - finite differences - operators \( \Delta, \delta, V, E \) - Gregory Newton forward and backward difference interpolation polynomials- central differences - sterlings interpolation formula.

Module II (13 Hours)

Module III (13 Hours)

Module IV (13 Hours)
Transportation, Assignment and routing problems - Dynamic programming - (Introduction and mathematical formulation only) Belman's optimality principle.

Text Books
Reference Books
1. S. S. Sasthry, Numerical Analysis, Prentice Hall of India
2. Gerald, Applied Numerical Analysis, Addison Wesley
4. Hadley G., Linear Programming, National Publishing Company
5. Dr. M. K. Venkataraman, Linear Programming, National Publishing Company

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
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

<table>
<thead>
<tr>
<th>Internal Continuous Assessment (Maximum Marks-50)</th>
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<tbody>
<tr>
<td>60%-Laboratory practical and record</td>
</tr>
<tr>
<td>30%- Test/s</td>
</tr>
<tr>
<td>10%- Regularity in the class</td>
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<table>
<thead>
<tr>
<th>Semester End Examination (Maximum Marks-100)</th>
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</thead>
<tbody>
<tr>
<td>70% - Procedure, conducting experiment, results, tabulation, and inference</td>
</tr>
<tr>
<td>20% - Viva voce</td>
</tr>
<tr>
<td>10% - Fair record</td>
</tr>
</tbody>
</table>
EE14 608 (P) MINI PROJECT

Teaching scheme
3 hours practical per week

Credits: 2

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.

<table>
<thead>
<tr>
<th>Internal Continuous Assessment by the Guide (Maximum marks - 50)</th>
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<tbody>
<tr>
<td>40% - Design and development</td>
</tr>
<tr>
<td>30% - Final result and Demonstration</td>
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<tr>
<td>20% - Report</td>
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<tr>
<td>10% - Regularity in the class</td>
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<table>
<thead>
<tr>
<th>Semester End Examination (Maximum Marks-100)</th>
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</thead>
<tbody>
<tr>
<td>60% - Demonstration and Presentation of mini project</td>
</tr>
<tr>
<td>30% - Viva voce</td>
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<tr>
<td>10% - Final Report</td>
</tr>
</tbody>
</table>
EE14 701 POWER SYSTEM ANALYSIS

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 5

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 (13 Hours)
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

Reference Books
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
Objectives

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

Module I (12 Hours)
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)
Describing function Analysis - Basis of Describing function approach - Definition - Describing functions of common non-linearities namely dead zone, 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 (13 hours)

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, Modern Control Engineering, PHI

Reference Books
1. Norman S. Nise, Control Systems Engineering, Wiley India Pvt. Ltd.
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  
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  
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
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)

Module III (14 hours)

Module IV (14 hours)

Text Books
2. M. H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson Education

Reference Books
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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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)

Module II (14 Hours)

Module III (15 Hours)

Module IV (11 Hours)

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

Reference Books
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

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**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.

- \(8 \times 5 \text{ marks} = 40 \text{ marks}\)

**PART B:** Analytical/Problem solving DESCRIPTIVE questions

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

- \(4 \times 15 \text{ marks} = 60 \text{ marks}\)

*Maximum Total Marks: 100*
Objective

- Design of electrical machines and transformers for the given specifications

Module I (14 Hours)

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 ratio and 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)

Text Books

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
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<tbody>
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<td><strong>PART A:</strong> Analytical/problem solving SHORT questions</td>
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<tr>
<td><strong>PART B:</strong> Analytical/Problem solving DESCRIPTIVE questions</td>
</tr>
<tr>
<td>Two questions from each module with choice to answer one question.</td>
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</table>

Maximum Total Marks: 100
EE14 704(C) GENERALIZED MACHINE THEORY

Objective

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

Module I (12 Hours)


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)


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


Text Books


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
**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

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**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**
3 hours lecture and 1 hour tutorial per week

**Credits:** 4

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

**Module I (13 hours)**
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)**

**Module III (13 hours)**

**Module IV (13 hours)**

**Reference Books**
Internal Continuous Assessment *(Maximum Marks-50)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as homework, 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.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
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 -nWell -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-Pwell 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
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.
**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

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**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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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

Module I (12 Hours)

MODULE II (14 Hours)

Module III (13 Hours)

Module IV (13 Hours)

Text Books
Reference Books

4. T.Ross, *Fuzzy Logic with Engineering Applications*, TMH
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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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 (13 Hours)
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. Townsend's criterion

Module II (13 Hours)

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)

Text Books
2. Kuffel and Abdulla M., High Voltage Engineering, Pergman Press

Reference Books
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
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
   British Standards: B5: 3659, B5: 3070, B%: 2914- 1957

SYLLABUS - B.Tech - Electrical & Electronics Engineering - 2014
**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
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

Reference Books
3. Soni, Gupta, Bhatnagar, A Course in Electric Power, Dhanapat Rai & sons
4. Web sites: bee-india.org
**Internal Continuous Assessment (Maximum Marks-50)**

<table>
<thead>
<tr>
<th>Percentage</th>
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<tr>
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<td>30%</td>
<td>Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.</td>
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<td>10%</td>
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</table>

**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.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
EE14 705(D) PROFESSIONAL ETHICS

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 issues - 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)

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)

Text Books

Reference Books
1. Charles D. Fleddermann, Engineering Ethics, Pearson Education
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 homework, 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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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)

Module II (16 hours)

Module III (12 hours)

Module IV (12 Hours)

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

Reference Books
2. Effy Oz, Management Information Systems, Thomson Course Technology.

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
Teaching scheme
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 Communication*, 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**  
8 x 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*
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
**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.

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<td>10% - Fair record</td>
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EE14 708 (P) PROJECT

Teaching scheme
4 hour practical per week

Credit: 4

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.

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<td>20% - Technical relevance of the project</td>
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<td>40% - Literature survey and data collection</td>
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<td>20% - Progress of the project and presentation</td>
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<td>10% - Report</td>
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<td>10% - Regularity in the class</td>
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EE14 801 ELECTRICAL SYSTEM DESIGN

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)


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, SF6 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.
5. Gupta J.B., Electrical Installation, Estimation & Costing, S. K. Kataria & Sons
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  
3 hours lecture and 1 hour tutorial per week

Credits: 4

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)
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 constant 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)

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 
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)
Reference Books

2. Muhammad H Rashid, Power Electronics – Circuits, Devices and Applications, Pearson Education (Module I)
4. K.R. Padiyar, FACTS controllers in power transmission & distribution, New Age International Publishers (Module IV)
6. Math H. Bollen, Understanding Power Quality Problems, 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 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
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, Transducer 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, Recent Developments in Digital protection;- Fibre Optics based Relaying, Microwave Relaying, Undetectable electric power system failures, Mains Protection.

Text Book

References
**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

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**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.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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 (13 hours)
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
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

Reference Books
2. John J. Grainger, W. D. Stevenson, Power System Analysis, TMH
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 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

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**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
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- This course gives a brief introduction to human physiology and presents various instrumentation systems 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 cardiovascular 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 – bioelectric potentials example (ECG, EEG, EMG,ERG, EOG,EGG etc.)

Module II (13 hours)
Cardiac pacemakers – internal and external pacemakers, defibrillators.

Module III (13 hours)
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.

Text Books
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
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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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

Module I (12 hours)

Module II (14 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books

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
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*Maximum Total Marks: 100*
EE14 804(D) DIGITAL IMAGE PROCESSING

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

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)

Module II (16 hours)

Module III (12 hours)
Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM.

Module IV (12hours)

Text Books

Reference Books
**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

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**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
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives
- To give an introduction of industrial robotics and automation

Module I (13 Hours)

Module II (13 Hours)

Module III (13 Hours)

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
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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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-phaser 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
4. Athani V.V. “Stepper motors – Fundamentals, Applications & Design” New Age International

Reference Books
1. Dr.E.G Janardhanan, “Special Electrical Machines”, PHI Learning

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

3 hours lecture and 1 hour tutorial per week

Credits: 4

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)


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

Reference Books

1. B. C. Kuo, 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 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(C) ORGANIZATIONAL BEHAVIOR

Objectives

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

Module I (14 hours)

Module II (12 hours)

Module III (13 hours)
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 processes- 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
2. L.M. Prasad, Organizational Behaviour, S. Chand & Sons
3. Luthans, Organizational Behavior, McGraw Hill International
### Internal Continuous Assessment *(Maximum Marks-30)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as homework, 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*  
8 x 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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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 refractometre, 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
5. Ramakant Gaikwad, *Operational Amplifiers*, PHI

References
3. GK. Banerjee, *Electrical and Electronic Measurements*, PHI
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
3 hours lecture and 1 hour tutorial per week

Credits: 4

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)

Module II (14 hours)
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, Earliest deadline fast algorithm, Qualities of a good RTOS.
Text Books

Reference Books

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

3 hours lecture and 1 hour tutorial per week

Credits: 4

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)


Module III (13hours)

Controller Principles - Process characteristics, control system parameters, controller modes, discontinuous controller modes, continuous controller modes, composite controller modes.


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

Reference Books
1. Curtis D. Johnson, Microprocessors in Process Control, PHI
2. Deshpande and Ash, Elements of Computer Process Control of Industrial Processes, ISA

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*
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.

<table>
<thead>
<tr>
<th>Internal Continuous Assessment (Maximum marks – 100)</th>
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<tbody>
<tr>
<td>20% - Relevance of the topic and literature survey</td>
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<tr>
<td>50% - Presentation and discussion</td>
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<tr>
<td>20% - Report</td>
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<tr>
<td>10% - Regularity in the class and Participation in the seminar</td>
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EE14 807 (P) PROJECT

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.

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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
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.

<table>
<thead>
<tr>
<th>Assessment in Viva-voce (Maxim marks – 100)</th>
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<tbody>
<tr>
<td>40% - Subjects</td>
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<tr>
<td>30% - Project and Mini Project</td>
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<tr>
<td>20% - Seminar</td>
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<tr>
<td>10% - Industrial training/industrial visit/educational tour or Paper presented at National-level</td>
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Credits: 3