Electrical and Electronics Engineering (EE)

EN010301A ENGINEERING MATHEMATICS II
(Common to all branches except CS & IT)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives

- *To apply standard methods and basic numerical techniques for solving problems and to know the importance of learning theories in Mathematics.*

MODULE 1 Vector differential calculus (12 hours)

Scalar and vector fields – gradient-physical meaning- directional derivative-divergence an curl - physical meaning-scalar potential conservative field- identities - simple problems

MODULE 2 Vector integral calculus (12 hours)

Line integral - work done by a force along a path-surface and volume integral-application of Greens theorem, Stokes theorem and Gauss divergence theorem

MODULE 3 Finite differences (12 hours)

Finite difference operators Δ, ∇, E, μ and δ - interpolation using Newtons forward and backward formula – problems using Stirlings formula, Lagrange's formula and Newton's divided difference formula

MODULE 4 Difference Calculus (12 hours)

Numerical differentiation using Newtons forward and backward formula – Numerical integration – Newton's – cotes formula – Trapezoidal rule – Simpsons $1/3^{rd}$ and $3/8^{th}$ rule – Difference equations – solution of difference equation

MODULE 5 **Z** transforms (12 hours)

Definition of Z transforms – transform of polynomial function and trignometric functions – shifting property , convolution property - inverse transformation – solution of 1^{st} and 2^{nd} order difference equations with constant coifficients using Z transforms.

Reference

1. Erwin Kreyszing – Advance Engg. Mathematics – Wiley Eastern Ltd.
2. B.S. Grewal – Higher Engg. Mathematics - Khanna Publishers
3. B.V. Ramana - Higher Engg. Mathematics – McGraw Hill
4. K Venkataraman- Numerical methods in science and Engg -National publishing co
5. S.S Sastry - Introductory methods of Numerical Analysis -PHI
6. T.Veerarajan and T.Ramachandran- Numerical Methods- McGraw Hill
7. Babu Ram – Engg. Mathematics -Pearson.
8. H.C.Taneja Advanced Engg. Mathematics Vol I – I.K.International

EN010 302 Economics and Communication Skills

(Common to all branches)

Teaching scheme
2hours lecture and 2 hours tutorial per week **Credits: 4(3+1)**
Objectives

- To impart a sound knowledge of the fundamentals of Economics.

Economics

Module I (7 hours)
Reserve Bank of India-functions-credit control-quantitative and qualitative techniques
Commercial banks-functions- Role of Small Industries Development Bank of India and National Bank for Agriculture and Rural Development
The stock market-functions-problems faced by the stock market in India-mutual funds

Module II (6 hours)
Multinational corporations in India-impact of MNC's in the Indian economy
Globalisation-necessity-consequences
Privatisation-reasons-disinvestment of public sector undertakings
The information technology industry in India-future prospects
Module III (6 hours)
Direct and indirect taxes- impact and incidence- merits of direct and indirect taxes-progressive and regressive taxes-canons of taxation-functions of tax system-
tax evasion-reasons for tax evasion in India-consequences-steps to control tax evasion
Deficit financing-role-problems associated with deficit financing

Module IV (5 hours)
National income-concepts-GNP, NNP, NI, PI and DPI-methods of estimating national income-difficulties in estimating national income
Inflation-demand pull and cost push-effects of inflation-government measures to control inflation

Module V (6 hours)
International trade-case for free trade-case for protectionism
Balance of payments-causes of disequilibrium in India's BOP-General Agreement on Tariffs and Trade-effect of TRIPS and TRIMS in the Indian economy-impact of WTO decisions on Indian industry

Text Books

1. Ruddar Datt, Indian Economy, S.Chand and Company Ltd.
2. K.K.Dewett, Modern Economic Theory, S.Chand and Company Ltd.

References

1. Paul Samuelson, Economics, Tata McGraw Hill
2. Terence Byres, The Indian Economy, Oxford University Press
3. S.K.Ray, The Indian economy, Prentice Hall of India
4. Campbell McConnel, Economics, Tata McGraw Hill

Communication Skills

Objectives

- To improve Language Proficiency of the Engineering students
- To enable them to express themselves fluently and appropriately in social and professional contexts
- To equip them with the components of different forms of writing

MODULE – 1 (15 hours)

INTRODUCTION TO COMMUNICATION

Communication nature and process, Types of communication - Verbal and Non verbal, Communication Flow-Upward, Downward and Horizontal, Importance of communication skills in society, Listening skills, Reading comprehension, Presentation Techniques, Group Discussion, Interview skills, Soft skills

MODULE – II (15 hours)

TECHNICAL COMMUNICATION

Technical writing skills- Vocabulary enhancement-synonyms, Word Formation-suffix, affix, prefix, Business letters, Emails, Job Application, Curriculum Vitae, Report writing-Types of reports

Note: No university examination for communication skills. There will be internal evaluation for 1 credit.

REFERENCES

1. The functional aspects of communication skills, P.Prasad and Rajendra K. Sharma, S.K. Kataria and sons, 2007
2. Communication skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning private limited, 2010
3. Professional Communication, Kumkum Bhardwaj, I.K. International (P) House limited, 2008
4. English for technical Communication, Aysha Viswamohan, Tata Mc Graw Publishing company limited, 2008

EE 010 303: Electric Circuit Theory

Teaching scheme **Credits:** 4

2 hours Lecture and 2 hours Tutorial per week

Objectives: 1. To provide sound knowledge in the analysis of electrical networks
2. To impart basic knowledge of computer based analysis of electrical networks

Module 1 (14hrs)

Application of Kirchoff's laws and network theorems to DC and AC circuits. Mesh analysis and Nodal analysis-with dependent and independent sources. Driving point and Transfer impedance and admittance. Network theorems – Super position, Thevenin's , Norton's, Maximum power transfer, reciprocity , Millman's, substitution, compensation and Tellegen's theorems.

Module 2 (10hrs)

AC&DC Transient analysis of simple circuits using time domain equations. Natural , forced and complete response analysis with and without initial conditions. Application of Laplace transform for the transient analysis of RL, RC and RLC series circuits (Transient and complete).

Module 3 (12hrs)

Introduction to network topology and graph theory. Fundamental cut-set and cut-set schedule ,tie-set and tie-set schedule. Analysis of networks using graph theory – network equilibrium equations on KVL basis and KCL basis.

Introduction to PSPICE. Representation of passive elements, independent and dependent sources. D.C and AC analysis of simple circuits . Introduction to MATLAB & SCILAB. Solution of ordinary differential equation. Transient analysis of simple RLC circuits using MATLAB & SCILAB.

Module 4 (12hrs)

Coupled circuits.- Dot convention-conductively coupled circuit-Ideal transformer-analysis of multi-winding coupled circuits. Analysis of single tuned and double tuned circuits. Steady state solution of circuits with coupled elements.
Synthesis:- Hurwitz polynomial-Routh's criterion- Positive real function-Synthesis of one port network-LC,RC &RL function

Module 5 (12hrs)

Review of three phase systems –Analysis with balanced and unbalanced loads. Symmetrical components- Analysis of unbalanced systems using symmetrical components. Neutral shift and Neutral current. Sequence impedances. Power in terms of symmetrical components.

Text Books

1. D. Ganesh Rao, R.V. Srinivasa Murthy, *Network Analysis, A Simplified Approach*, Sanguine Technical Publishers.
2. Samarajit Ghosh, *Network Theory, Analysis and Synthesis*, PHI

Reference Books

1. Joseph A Edminister, *Electric Circuits*, Schaum's Outline Series
2. William H Hayt, Jack E Kemmerly, Steven M Durbin, *Engineering Circuit analysis*, 7e, Tata McGraw Hill Education. New Delhi, 2010
3. Gopal G Bhise, *Engg. Network analysis and filter design*, Umesh publishers
4. K S Suresh Kumar, *Electric circuits and networks* , Pearson
5. A Sudhakar, P Shyammohan, *Circuits and Networks: Analysis and Synthesis*, 4e, Tata McGraw Hill Education, New Delhi, 2010
6. R.K. Bansal, A.K. Goel, M.K. Sharma, *MATLAB and its Application in Engineering*, Second ,Pearson, 2010.
7. 7.Muhammad H. Rashid, *Introduction to PSpice Using Orcad for Circuits and Electronics*, Third Edition, PHI 2009.

EE 010 304: Electrical Measurements and Measuring Instruments

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

Objectives

- *To provide knowledge in the specific area of electrical measurements*
- *To expose students various measuring instruments*

Module 1 (12 Hours)
General Principle of measurements: Absolute and working standards- in Measurements, Classification of instruments: Essentials of indicating instruments - moving coil , Moving iron, dynamometer, Induction, Thermal ,electrostatic and rectifier meter (Principles and concepts only)-shunts and multipliers

Module 2 (12 Hours)
Potentiometers –General principle - dc potentiometer and ac potentiometer. Applications of dc and ac potentiometer
Bridges: Wheatstone bridge-PO Box- Kelvin's double bridge, Maxwell's bridge – Schering Bridge, Anderson Bridge, Wien's bridge (Analysis and Phasor diagram required)

Module 3 (14 Hours)
Measurement of resistance, power & energy, Measurements of low, medium & high resistance, Measurement of earth resistance - Earth Megger - Dynamometer type Wattmeter, Error & compensation – single phase energy meter – errors & compensation three phase Energy meter (construction only) – Electronic energy meter (block diagram) Trivector meters, Maximum Demand meters and TOD meters (concepts only) , Power factor Meters

Module 4 (10 Hours)
Instrument Transformers: Principle of Current and Potential transformers – ratio & phase angle error, applications-Measurement of speed-Measurement of frequency
Calibration of meters: Ammeters, voltmeters, watt meters, energy meters.

Module 5 (12 Hours)
Magnetic Measurements: Measurement of flux and permeability **–** flux meters, BH Curve and permeability measurements
Digital Measurements : Electronics voltmeter, basic dc voltmeter and ac voltmeter using rectifiers.
CRO – principle - measurement of voltage, current and frequency - multi channel oscilloscopes – digital storage oscilloscope (Concepts only)

Text Books

1. Golding E.W, Electrical *Measurements and Measuring Instruments*, Wheeler and Co.
2. Sawhney A.K, *Electrical and Electronic Instrumentation and Measurements*, Dhanpat Rai and Co.

Reference Books

1. Albert D. Helfrick and William D. Cooper, *Modern Electronic Instrumentation and measurement Technique*, PHI,
2. JB Gupta, *Electrical and Electronic Instrumentation and Measurements*, S.K.Kataria &Sons
3. Deobelin, *Measurement systems: Application and Design*, 5e, Tata McGraw –Hill Education New Delhi
4. S.Kamakshaiah, *Electrical Measurements and measuring instruments*, I K international Publishing House.

EE 010 305: Electronic Circuits

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

Objectives

- *To impart sound knowledge and basic concepts of electronic circuits and applications to students.*
- *To develop the student's ability to design and analyse practical circuits.*

Module 1 (14 hrs)
Wave shaping: Clipping and Clamping circuits using diodes – RC differentiating and Integrating Circuits.
Transistor Biasing – Operating Point – Operating point instability – thermal runaway – bias stability – Stability factor – stabilization techniques – Fixed bias – Collector to Base bias – Emitter bias – Voltage divider bias – Stability against variation in I_{CO}.
FET: Principle of operation and characteristics of JFET and MOSFET – biasing of JFET – self bias – FET amplifier.
UJT: Principle of operation and characteristics.

Module 2 (12 hrs)
Small Signal Analysis: h-parameter equivalent circuit of a BJT – comparison of CB, CE, and CC configurations – Determination of h – parameters from static characteristics – current and voltage gains, input impedance and output admittance of a basic amplifier in h-parameters.
Multi-stage Amplifiers: RC coupling – Frequency response characteristics – bandwidth – cascading of amplifiers – gain and bandwidth.

Module 3 (10 hrs)
Power Amplifiers: Class A, B, AB and C operation – Efficiency of Class A and B – Push-pull amplifier – Distortion in amplifiers – harmonic and crossover distortion - Complementary Symmetry amplifiers.
Tuned Amplifiers: Single tuned and double tuned amplifiers – Frequency response – applications.

Module 4 (12 hrs)
Feedback amplifiers: Positive and Negative feedback – types of negative feedback – Typical circuits –effect of negative feedback in amplifier performance.
Oscillators: Barkhausen criterion – classification of oscillators – Principle of operation of RC phase-shift, Hartley and crystal oscillators. (Analysis not required).

Module 5 (12 hrs)
Multivibrators: Principle of Operation and Design of Astable multi vibrator – principle of operation of Bi-stable and Mono-stable multi-vibrators.
Sweep generators: Principle of Sweep generation – basic transistor sweep circuit – Equation for sweep amplitude. Miller and Boot Strap circuits. Sweep generation using UJT relaxation oscillator circuit.
Voltage Regulators: Zener shunt regulator – transistor series regulator.

Text Books

1. Jacob Millman, Christos C. Halkias, Chetan Parikh Millman and Halkias, Millman's *Integrated Electronics*, 2e, Tata McGraw Hill Ediucation, New Delhi, 2010
2. Floyd, *Electronic devices and circuits*, Pearson Publications

Reference Books

1. Robert L. Boylestad and Louis Nashelsky, *Electronic Devices and Circuit Theory*, Pearson Education Asia, LPE.
2. J.B.Gupta, *Electronics Devices and Circuits* , S.K Kataria and sons.
3. Albert Paul Malvino, *Electronic Principles* , TMH
4. Allen Mottershead, *Electronic Devices and Circuits, An Introduction*, PHI
5. G.K.Mithal, *Electronic Devices and Circuits* :
6. Robert T. Paynter, *Introductory Electronic Devices and Circuits* , Pearson Education Asia, LPE

EE010 306(ME): Mechanical Technology

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

Objectives

- *To impart the basic concepts of Fluid properties, hydraulic machines and pumping machinery*
- *To develop an idea about pressure measurements working and properties of hydraulic machines and various types of pumping machineries.*

Module 1 (12 hours)

Properties of Fluids**:** Pressure, density, bulk modulus, dynamic and kinematic viscosity, surface tension, capillary – fluid at rest, Pascal's law, applications, pressure head, vapor pressure, pressure measurement, manometers, gauges and pressure on immersed surfaces – floating body.

Module II (12 hours)

Fluid in Motion**:** Euler's equation in one dimension. One dimensional incompressible Bernoulli's equation. Flow through Orifices – measurement of fluid velocity, pitot tube – discharge measurement, venturimeter, orifice meter, Rota meter and notches.
Flow of compressible fluids through pipes – types of flow – critical Reynolds number – friction factors for laminar and turbulent flow – minor losses – transmission of power through pipes.

Module III (12 hours)

Hydraulic Turbines**:** Evolution of present day hydraulic turbines from the water wheel – classification degree of action – Pelton wheel, Francis and Kaplan Turbines – constructional details and characteristics only (no problems based on velocity triangles) – governing of turbines – draft tube – specific speed.

Module IV (12 hours)

Pumping Machinery**:** General classification – Dynamic pumps – working of centrifugal pumps, priming, vapour pressure, wear rings, hydraulic balancing, Classification of impellers, single and double suction impellers – types of casings – effect of vapour pressure on lifting of liquid – specific speed – performance pump characteristics: main, operating, ISO efficiency characteristics curves – NPSH _ multistage pumps – propeller pumps – pump in parallel & series operation – Theory, efficiency, performance curves & application of self-priming pump, jet pump, airlift pump, slurry pump & hydraulic ram (description only).

Module V (12 hours)

Positive Displacement Pumps**:** reciprocating pumps, effect of vapour pressure on lifting of liquid – indicator diagram – acceleration head – effect of friction – use of air vessels – work saved – slip – efficiency – pump characteristics – applications – Cavitation and its effects in fluid machines – Rotary pumps: Gear, Screw, vane, root pumps – rotary axial & rotary radial piston pumps – thory, efficiency, performance curves – applications (Description only).

Text Books

1. Abdulla Sheriff, *Fluid Mechanics & Hydraulic Machines*: Standard Publ.
2. R.K Bansal, *Fliud Machines and Hydraulic Machines* , Lakshmi publications New Delhi

Reference Books

1. K Subramanya , *Fluid Machines and Hydraulic Machines* , TMH.
2. Govinda Rao N.S, *Fluid Flows Machines*, TMH.
3. Shiv Kumar, *Fluid Mechanics & Fluid machines* , Ane books.
4. Massey B. S, *Fluid Mechanics*, ELBS
5. Stepanoff John A. J, *Centrifugal and Axial Flow Pump*, Wiley & Sons

EE 010 307 Electrical Measurements Lab

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

Objectives

- *To expose the students to a variety of practical electrical circuits and to prove the theories behind them.*

1. Verification of superposition theorem in a dc circuit
2. Verification of Thevenin's theorem in a dc circuit.
3. RLC series and parallel circuit: measurement of current in various branches and verification by calculation – drawing of phasor diagram.
4. Measurement of single phase power – (a) Three ammeter method (b) Three voltmeter method and (c) Single wattmeter
5. Determination of Power and Power factor of a given single phase circuit using dynamometer watt meter and power factor meter – power factor improvement of the above circuit.
6. Measurement of 3 phase power using
   a.)Single watt meter
   b)Two watt meters
   c)Three-phase watt meters
7. Determination of BH characteristics
8. Calibration of flux meter using
   a)Standard solenoid
   b)Hibbertz magnetic standard
9. Determination of locus diagram of RL and RC circuit.
10. Measurement of resistance using-Wheatstone Bridge and Kelvin's Double bridge and extension of range of Voltmeter and Ammeter
11. Measurement of self inductance, mutual inductance and coupling coefficient.
12. Calibration of meters and measurement of resistance using slide-wire potentiometer
13. Calibration of single-phase Energy meter at various power factors by a)Direct loading b) Phantom loading c)Phase shifting transformer
14. Calibration of three-phase Energy meter by Direct loading and Phantom loading
15. Extension of instrument range by using Instrument transformers(CT and PT)
16. Characteristics of LVDT.
17. Measurement of neutral shift voltage
18. Study and measurement of symmetrical Components for unbalanced system for an unbalanced star connected system.

References

1. Golding E.W, *Electrical Measurements and Measuring Instrument*, Wheeler and Co
2. D. Ganesh Rao, R.V. Srinivasa Murthy, *Network Analysis , A Simplified Approac,* Sanguine Technical Publishers.

EE010 308(ME) Mechanical Laboratory

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

Objectives

To impart practical knowledge in heat engines and hydraulics laboratories

HYDRAULICS LABORATORY

1. Study of centrifugal pumps and components.

2. Study of reciprocating pump and components-single cylinder and multicylinder.

3. Study of impulse and reaction turbines.

4. Performance characteristics of centrifugal pump.

5. Performance characteristics of reciprocating pump

6. Performance characteristics of Pelton wheel.

7. Performance characteristics of Francis Turbine...

8. Performance characteristics of Kaplan Turbine...

HEAT ENGINES LABORATORY

1. Load Test (Constant speed test) on petrol engine.

2. Load Test (Constant speed test) on diesel engine.

3. Variable speed test on petrol engine.

4. Variable speed test on diesel engine.

5. Cooling curve of I.C.Engine.

6. Performance test on air compressors and blowers.

7. Performance test on refrigeration unit...

8. Performance test on air conditioning unit...

REFERENCES

1. Hydraulic Machines-Jagadishlal

2. Thermal Engineering- P.L Ballaney

EN010 401 Engineering Mathematics III

(Common to all branches)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives: *Apply standard methods of mathematical &statistical analysis*

MODULE 1 Fourier series (12 hours)

Dirichlet conditions – Fourier series with period 2 π and 2l – Half range sine and cosine series – Harmonic Analysis – r.m.s Value

MODULE 2 Fourier Transform (12 hours)

Statement of Fourier integral theorem – Fourier transforms – derivative of transforms- convolution theorem (no proof) – Parsevals identity

MODULE 3 Partial differential equations (12 hours)

Formation by eliminating arbitrary constants and arbitrary functions – solution of Lagrange's equation – Charpits method –solution of Homogeneous partical differential equations with constant coefficients

MODULE 4 Probability distribution (12 hours)

Concept of random variable , probability distribution – Bernoulli's trial – Discrete distribution – Binomial distribution – its mean and variance- fitting of Binominal distribution – Poisson distribution as a limiting case of Binominal distribution – its mean and variance – fitting of Poisson distribution – continuous distribution- Uniform distribution – exponential distribution – its mean and variance – Normal distribution – Standard normal curve- its properties

MODULE 5 Testing of hypothesis (12 hours)

Populations and Samples – Hypothesis – level of significance – type I and type II error – Large samples tests – test of significance for single proportion, difference of proportion, single mean, difference of mean – chi –square test for variance- F test for equality of variances for small samples

References

1. Bali& Iyengar – A text books of Engg. Mathematics – Laxmi Publications Ltd.
2. M.K. Venkataraman – Engg. Mathematics vol II 3rd year part A & B – National Publishing Co.
3. I.N. Sneddon – Elements of partial differential equations – Mc Graw Hill
4. B.V. Ramana – Higher Engg. Mathematics – Mc Graw Hill
5. Richard A Johnson – Miller Fread's probability & Statistics for Engineers- Pearson/ PHI

6. T. Veerarajan – Engg. Mathematics – Mc Graw Hill
7. G. Haribaskaran – Probability, Queueing theory and reliability Engg. – Laxmi Publications
8. V. Sundarapandian - probability ,Statistics and Queueing theory – PHI
9. H.C.Taneja – Advanced Engg. Mathematics Vol II – I.K.International
10. A.K.Mukhopadhyay-Mathematical Methods For Engineers and Physicists-I.K.International

EE 010 402 DC Machines and Transformers

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

Objectives

- *Understanding the basic working principles of DC machines and Transformers*
- *Analysing the performance of DC machines and Transformers*

Module I (10 hours)
DC Machines: Constructional features – principle of operation of DC generator - armature winding - types - e.m.f. equation - armature reaction – effects of armature reaction - demagnetizing and cross magnetizing ampere- turns - compensating winding - commutation – methods to improve commutation – e.m.f. in coil undergoing commutation – reactance e.m.f.- effect of brush shift- inter poles.

Module II (12 hours)
DC Generator: Types of excitation – separately excited- self excited shunt, series and compound machines – the magnetization curve – condition for self excitation- field critical resistance- critical speed- load characteristics of generators – load critical resistance – voltage regulation - parallel operation of shunt, series and compound generators – power flow diagram- losses and efficiency- condition for maximum efficiency- applications.

Module III (15 hours)
DC Motors: principle of operation of DC motor – developed torque - performance characteristics and operating characteristics of shunt, series and compound motors.
Starting – three point and four point starters – design of starter resistance for shunt motor - methods of speed control of shunt , series and compound motors – solid state speed control (block diagram) – power flow diagram- losses and efficiency- testing of D C machines – Swinburne's test - Hopkinson's test - Field's test – retardation test- applications

Module IV (14 hours)
Single Phase transformers: Principle of operation - constructional details - e.m.f equation - operation on no load - magnetizing current wave form - load operation - phasor diagram - equivalent circuit – per unit impedance - losses and efficiency - condition for maximum efficiency – voltage regulation- approximate expression for voltage regulation- harmonics in single phase transformers - OC and SC tests - Sumpner's tests - parallel operation – applications.

Module V (9 hours)
Three phase transformers: Constructional details- choice of transformer connections- Scott connection (three phase to two phase only) - oscillating neutral- tertiary winding - vector groups- equivalent circuits- tap changing transformers- no load tap changing – on load tap changing- cooling of transformers.
Distribution transformers- all day efficiency- auto transformers- saving of copper- applications.

Text Books

1. Dr. P S Bimbhra, *Electrical Machinery*, Khanna Publishers
2. Clayton and Hancock, *The Performance and design of DC Machines*, ELBS/CBS Publishers,Delhi

Reference Books

1. Alexander Langsdorf A S, *Theory of AC Machinery*, Tata McGraw-Hill
2. J B Gupta, *Electrical Machines* , S K Kataria and Son
3. Fitzgerald, Kingsley, Electric machinery, 6e, Tata McGraw – Hill Education, New Delhi, 2003
4. Say M G, *Performance and design of AC Machines*, ELBS
5. Nagarath I J and Kothari D P, *Electrical Machines* ,4e, Tata McGraw- Hill Education, New Delhi, 2010
6. Vincent Deltoro, *Electrical Machines and Power System*, Prentice Hall

EE 010 403: Linear System Analysis

Teaching scheme **Credits: 4**

2 hours lecture and 2 hours tutorial per week

Objectives

- *To Provide sound knowledge in the analysis of linear time invariant continuous systems*

Module 1(12 Hrs)

Review of system concepts –classification of systems- linear, non - linear, static, dynamic, time variant and time invariant, continuous time and discrete time, distributed and lumped parameter systems. Open loop and closed loop systems. Transfer function of linear systems. Mathematical modelling of electrical systems, operational amplifier circuits, Mechanical translational and rotational systems, electromechanical systems, linearization of nonlinear models.

Module 2(12 Hrs)

Block diagram representation of systems-Block diagram reduction. Signal flow graph-signal flow graph from equations. Maison's gain formula. Construction of Signal flow graph from Block diagram and vice –versa. Modelling in State Space-state space- representation of dynamic systems.

Module 3(12Hrs)

Effect of parameter variation in open loop control systems, closed loop control systems, sensitivity, gain and stability.

Time domain analysis for linear systems-response to standard inputs-type and order of a system-response of first order system to unit step, unit ramp and unit impulse signals-step response of second order systems-time domain specifications.

Error analysis - steady state error and error constants- Dynamic error coefficients.

Module 4(12Hrs)

Concept of stability, BIBO stability. Effect of location of poles on stability. Routh- Hurwitz criterion. Relative stability analysis. Root locus- effect of addition of poles and zeros on root locus. Analysis of stability by Lyapunov's Direct method – Concept of definiteness-Liapunov's stability theorem, Sylvester's theorem.

Module 5(12Hrs)

Network functions-network function for two port –pole and zeroes of network functions-restriction on poles and zeroes for driving point functions and transfer functions-characterization of two port networks in terms of impedance' admittance-hybrid and transmission parameters –inter-relationship among parameter sets-inter connection of two port networks-series, parallel and cascade-ideal two port devices- ideal transformer –Gyrator-negative impedance converter.

Text Books:

1. David .k. Cheng , *Analysis of linear systems* ,Oxford
2. M. Gopal, *Control Systems Principles and Design,-For Linear System Analysis & Control System,* 3e,Tata McGraw Hill Education ,2008
3. Samarajit Ghosh, *Network Theory, Analysis and Synthesis,* PHI, New Delhi

Reference Books

1. S. Hassan Saeed , *Automatic Control Systems* , Katson Books
2. Katsuhiko Ogatta, *Modern control engineering* , Pearson Education
3. Dr. S. Palani, *Control Systems Engineering,* 2e, Tata McGraw-Hill Education,2009
4. Richard C. Dorf and Robert H. Bishop, *Modern control systems,* Pearson Education
5. Franklin, Powell-*Feedback controlof dynamic systems,* Pearson Education
6. C.T. Chen , *Linear system theorey and design* .
7. D.Roy Choudhry , *Modern Control Engineering*-, PHI
8. Burton T.P, *Introduction to dynamic systems*.

EE 010 404: Electromagnetic Theory

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

Objectives

To impart knowledge on

- *basic concepts and principles of electromagnetic fields*
- *practical significance of the theory to develop a clear perspective for appreciating engineering applications .*

Module I (15 hours)
Review of Vector Analysis - Cartesian coordinate system - The Vector field- dot and cross products - introduction to cylindrical and spherical coordinate systems.
Static Electric Field: Coulomb's law - electric field intensity -field intensity due to point charge, line charge and volume charge distributions- electric flux- electric flux density- Gauss's law and its applications- divergence of a vector –curl of a vector - Maxwell's first equation- the Del operator- Divergence theorem

Module II (12 hours)
Energy and potential - Energy expended in moving a point charge in an electric field - Electric Potential between two points – potential at any point due to a point charge - potential at any point due to discrete as well as distributed charges- Electrical field lines and equipotential contours –electric dipoles - dipole moment - potential gradient- conservative nature of a field- Laplace and Poisson equations (Derivation only and not solution) – Maxwell's Curl equation for electrostatic fields.

Module III (11 hours)
Conductors and Dielectrics– current and current density- continuity equation- -point form of Ohm's law- conductor properties – polarization - dielectric strength and break down - dielectric boundary conditions
Capacitance - parallel plate capacitor - capacitance of isolated sphere, spherical shell, coaxial cylinders and parallel wires - effect of earth on capacitance - method of images – capacitors in series and parallel – energy stored in static electric field

Module IV (12 hours)
The steady Magnetic Field - Biot-Savart's law - Ampere's circuital law – H due to a long wire - H due to a long solenoid - H due to an infinite current sheet - H due to a circular wire loop - Stoke's theorem - magnetic flux and flux density – Maxwell's equations for magnetostatic fields - the scalar and vector magnetic potentials - magnetic force on a moving charge - force on a current element - force between current carrying wires - torque on closed circuits - magnetic boundary conditions, energy stored in a magnetic field, skin effect.
Self and mutual inductances –Inductance of solenoids, torroids and two wire transmission lines– inductances in series and parallel.

Module V (10 hours)
Time varying fields- Faraday's laws of electromagnetic induction- Motional emf - concept of displacement current- Maxwell's equation in point form and integral form.

Wave equation in free space – applications in transmission lines - power flow and Poynting vector - Poynting theorem- interpretations- instantaneous, average and complex pointing vector- power loss in conductors.

Numerical methods in electromagnetics (overview only).

Text Books

1. Mathew N O Sadiku, *Principles of Electromagnetics*, Oxford University Press
2. T V S Arun Murthy, *Electromagnetic Fields*, S. Chand

Reference Books

1. W H Hayt, J A Buck, *Engineering Electromagnetics*, Mc Graw Hill
2. John D Kraus, *Electromagnetic*., Mc Graw Hill
3. Guru and Hiziroglu, *Electromagnetic Field Theory Fundamentals*, Cambridge University Press
4. Fawwaz T Ulaby, *Electromagnetics for Engineers*, Pearson education
5. Gangadhar KA, *Field Theory*, Khanna Publishers
6. David K Cheng, *Field and Wave Electromagnetics*, Pearson education

EE 010 405: Digital Systems and Computer Organisation

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

Objectives

- *To provide insight into design of Digital systems and Digital computer system components and their organizational aspects.*
- *To provide a foundation for the advanced courses like Microprocessor Systems, Microcontrollers & Embedded systems and Computer related elective courses.*

Module 1 (12 hours)
Combinational Digital Circuits: Logic operations and Gates- De Morgan's Theorem - Realization of combinational circuits using SOP and POS forms - K-map up to 4 variables. Decoders: BCD to decimal, BCD to 7-segment - Encoders- Multiplexer- Demultiplexer.
Logic Families: TTL and CMOS families- TTL NAND gate internal circuit- TTL characteristics- sinking and sourcing- fan-in and fan-out – CMOS characteristics – CMOS NAND and NOR gates.

Module 2 (11 hours)
Sequential Circuits: Flip-Flops- SR, JK, T and D flip-flops- JK master-slave FF. Truth table and excitation table- conversion of flip-flops from one type to another.
Asynchronous counters: Ripple counter- disadvantages-Decoding errors– modulo N ripple counter using CLEAR and PRESET inputs. Asynchronous UP - DOWN counter.

Module 3 (13 hours)
Synchronous Counters: Synchronous counter design – modulo N counter design for completely specified count sequence – lockout- design without lockout – Synchronous UP/DOWN counters..
Shift Registers: SISO, SIPO, PISO, PIPO types -Universal shift register.
Counters using Shift Registers: Ring counter – twisted ring counter.

Module 4 (13 hours)
Computer Organisation
Processor Organization –Block diagram of a processor - typical operation cycle: fetch, decode and execute — processor bus structures.
Arithmetic and Logic unit: Adders- Half adder, full adder circuits. half subtraction and full subtraction circuits. serial and parallel adders- fast adders- carry look ahead adder- 2's complement adder / subtractor- design of Logic unit- one stage ALU.

Module 5 (11 hours)
Memory Organisation: Memory hierarchy- Semiconductor RAM – typical static RAM cell – Dynamic RAM cell- Internal organization of memory chips -ROM – PROM – EPROM – E^2PROM – Flash Memory. Cache memory – Hit and miss – cache mapping functions — memory interleaving — virtual memory organization – Address translation.
Input/Output Organisation: Buses- Single bus structure-I/O interfacing- Standard I/O interfaces: PCI, SCSI and USB (block diagram description only)

Text Books:

1. Anandkumar, *Fundamentals of digital circuits*, PHI
2. V. Hamacher, *Computer Organisation*, Mc Graw Hill

References:

1. Thomas L. Floyd , *Digital Fundamentals*, Pearson Education
2. Malvino & Leach, *Digital Principles and Applications*, TMH
3. Taub & Schilling, *Digital Integrated Electronics*, McGraw Hill Intl.
4. Salivahanan, *Digital circuits & design*, Vikas
5. M.Morris Mano, *Logic and Computer Design Fundamentals*:, 2/e Pearson
6. P. Pal Chaudhari , *Computer Organisation and Design*, PHI

EE 010 406: Computer Programming

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

Objectives

- *To impart the concepts of structured programming.*
- *To develop programming skill in students*

Module 1 (10 hours)
Introduction to C: Steps in executing a C program – C Tokens- C character set – identifiers and keywords – data types – constants and variables – declarations – type casting - operators – expressions – statements – special operators: comma and sizeof operators- library input-output functions.
Branching control statements: if, if-else, nested if-else, switch, goto statements – conditional operators.

Module 2 (14 hours)
Looping control statements : 'while', 'do-while', 'for' statements – nested loops, break and continue statements.
Arrays: single dimensional arrays — declaring and initializing arrays- searching & sorting in arrays.
Strings: Declaration – initialization.
Multidimensional arrays -declaration – initialization - matrix operations – addition, transpose and multiplication.

Module 3 (13 hours)
Functions: Declaration, definition and access – passing arguments to a function – pass by value and pass by reference – recursion- - passing arrays to a function — string handling functions – comparison, concatenation and sorting of strings.
Storage classes: automatic variables – external variables – register variables – scope and life time of variables.
Pointers: Concept of pointers– pointer declaration – operations on pointers-pointers as function arguments.

Module 4 (12 hours)
Structures and union: definition – declaration of structure variables- initialization – accessing structure members – array of structures – passing structure to a function – sorting of structures — union.
Dynamic memory allocation – self referential structures – basic concepts of linked lists.

Module 5 (11 hours)
Files: File pointers – data files: text mode & binary mode – file operations- opening and closing – reading and writing- file handling functions.
Command line arguments – macros – C pre processor

Text books:

1. Balagurusamy, *Programming in ANSI C* , TMH
2. K.R. Venugopal and S.R. Prasad, *Mastering C* , TMH

Reference Books

1. Kernighannn & Ritchie, *The C programming language*, Pearson Education, Asia
2. Mullish & Cooper, *The Spirit of C, An Introduction to modern programming*,, Jaico Publishing Co.
3. Yashwant Kanetkar, *Let us C*, BPB publ.
4. Byron S. Gottfried, *Programming with C*, Schaum Outlines –,McGraw Hill.
5. Ashok Kamthane, *Programming with ANSI & Turbo C*-, Pearson Education Asia

EE 010 407 Computer Programming Lab

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

Objectives

- *To develop computer programming skills*

Programming Experiments in C

Programming experience in C to cover control structures, functions, arrays, structures, pointers and files in accordance with syllabus of EE 010 406.

1. Familiarization using simple programs.
2. Familiarization of branching and looping operations
3. Summation of series
4. Preparation of Conversion tables
5. Solution of quadratic equations
6. Array manipulation
7. Functions
8. Recursive functions
9. Matrix operations
10. String manipulation – compare, copy, reverse operations
11. Pointers- Sorting of single dimensional arrays and strings
12. Structures - sorting
13. Tabulation of marks and declaration of results – input and output using files
14. Creation of numeric and text files, merging and appending of files.
15. Simple programs using linked lists

References:

1. Balagurusamy, *Programming in ANSI C*, TMH
2. K.R. Venugopal & S.R. Prasad, *Mastering C* , TMH

EE 010 408: Electronic Circuits Lab

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

Objectives

To expose the students to a variety of practical electronic circuits to prove the theories behind them.

1. Diode Characteristics
2. BJT, FET and UJT characteristics.
3. Design and testing of clipping and clamping circuits
4. Design and testing of RC integrator and differentiator circuits.
5. Design and testing of rectifier circuits – Half wave – Full wave (centre – tapped and bridge) circuits. Filter circuits.
6. Design and testing of Zener Shunt and Transistor Series Voltage Regulator.
7. Design and testing of RC coupled amplifier– frequency response.
8. Design and testing of Feedback amplifiers.
9. Design and testing of FET amplifier.
10. Sweep circuits – UJT and BJT based sweep generators – sweep circuit using constant current source (BJT).
11. Design and Testing of RC phase-shift Oscillator and LC Oscillator.
12. Design and Testing of Astable and Bi-stable Multi-vibrators.
13. Relay driving circuit using transistors.

Optional

Simulation of the above circuits using EDA tools like PSPICE.
(Any experiment relevant to **EE 010 305** may be added)

References

1. A.P. Malvino, *Electronic Principles*– TMH
2. Floyd, *Electronic Devices*, Pearson Education, LPE
3. Robert L. Boylestad and Louis Nashelsky, *Electronic Devices and Circuit Theory*, Pearson Education Asia, LPE.
4. Navas, *Electronic Circuits Lab Manual*

EN010501A ENGINEERING MATHEMATICS IV

(Common to all branches except CS & IT)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives: *Use basic numerical techniques to solve problems and provide scientific techniques to decision making problems.*

MODULE 1 Function of Complex variable (12 hours)

Analytic functions – Derivation of C.R. equations in cartision co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal mapping of z^2 , $\frac{1}{z}$ - Bilinear transformation – cross ratio – invariant property (no proof) – simple problems

MODULE 2 Complex integration (12 hours)

Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's series- Laurent's series – Zeros and singularities – types of singularities – Residues – Residue theorem – evaluation of real integrals in unit circle – contour integral in semi circle when poles lie on imaginary axis.

MODULE 3 Numerical solution of algebraic and transcendental equations (10 hours)

Successive bisection method – Regula –falsi method – Newton –Raphson method - Secant method – solution of system of linear equation by Gauss – Seidel method

MODULE 4 Numerical solution of Ordinary differential equations (10 hours)

Taylor's series method – Euler's method – modified Euler's method – Runge – Kutta method (IV order) - Milnes predictor – corrector method

MODULE 5 Linear programming problem (16 hours)

Definition of L.P.P., solution, optimal solution, degenerate solution – graphical solution –solution using simplex method (non degenerate case only) Big -M method – Duality in L.P.P. – Transportation problem –Balanced T.P. – initial solution using Vogel's approximation method - modi method (non degenerate case only)

References

1. B.V. Ramana – Higher Engg. Mathematics – Mc Graw Hill
2. M.R.Spicgel , S.Lipschutz , John J. Schiller, D.Spellman – Complex variables, schanm's outline series - Mc Graw Hill
3. S.Bathul – text book of Engg.Mathematics – Special functions and complex variables –PHI
4. B.S. Grewal – Numerical methods in Engg. and science - Khanna Publishers
5. Dr.M.K Venkataraman- Numerical methods in science and Engg -National publishing co

6. S.S Sastry - Introductory methods of Numerical Analysis -PHI
7. P.K.Gupta and D.S. Hira – Operations Research – S.Chand
8. Panneer Selvam– Operations Research – PHI
9. H.C.Taneja – Advanced Engg. Mathematics Vol II – I.K.International

EN010 502(ME): Principles of Management

(Common with EN010 402(ME))

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To develop an understanding of different functional areas of management.*
- *To understand the functions and duties an individual should perform in an organisation.*

Module I (12 hours)

Management Concepts: Vision, Mission, Goals and Objectives of management-MBO-Scientific management- Functions of management- Planning- Organizing- Staffing-Directing- Motivating- Communicating- Coordinating- Controlling- Authority and Responsibility- Delegation- Span of control- Organizational structure- Line, Line and staff and Functional relationship.

Module II (12 hours)

Personnel Management: Definition and concept- Objectives of personnel management-Manpower planning- Recruitment and Selection of manpower- Training and development of manpower- Labour welfare- Labour turnover- Quality circle- Industrial fatigue- Industrial disputes-Method of settling disputes- Trade unions.

Module III (12 hours)

Production management: Objectives and scope of production management- Functions of production department- production management frame work- product life cycle-Types of production- Production procedure- Project planning with CPM and PERT- Basic concepts in network.

Module IV (12 hours)

Financial Management: Objectives and Functions of Financial Management- Types of Capital- Factors affecting working capital- Methods of financing.
Cost Management: Elements of cost- Components of cost- Selling Price of a product.

Module V (12 hours)

Sales and Marketing Management: Sales management- Concept- Functions of sales department- Duties of sales engineer- Selling concept and Marketing concept- Marketing-Definition and principles of marketing- Marketing management and its functions- Sales forecasting- Pricing- Advertising- Sales promotion- Channels of distribution- Market research.

Text Books

1. Koontz and Weihrich, *Essentials of Management*, Tata McGraw Hill.
2. Mahajan M., *Industrial Engineering and Production Management*, Dhanpat Rai and Co.
3. Kemthose and Deepak, *Industrial Engineering an Management*, Prentice Hall of India.

Reference Books

1. Martand Telsang, *Industrial Engineering and Production Management.*
2. Khanna O.P., *Industrial Engineering and Management*, Dhanpat Rai and Co.
3. Philip Kotler, *Marketing Management*, Prentice Hall of India.
4. Sharma S. C. & Banga T. R., *Industrial Organisation and Engineering Economics*, Khanna Publishers.
5. Prasanna Chandra, *Financial Management*, Tata McGraw Hill.

EE 010 503 Signals and Systems

Teaching scheme **Credits: 4**
2 hours lecture and 2 hour tutorial per week

Objectives

- *To understand different types of signals and systems*
- *To provide sound knowledge in different transforms in the analysis of signals and systems*

Module 1 (12hrs)
Signals- Classification of signals Basic operations on signals. Representation of a wave as sum of elementary functions. - Systems-Classification of systems.
Fourier series analysis of continuous time periodic signals-Fourier coefficients, exponential Fourier series, properties of continuous time Fourier series, power representation using Fourier series, Fourier spectrum. Steady state solution of electric circuits with non- sinusoidal non periodic input by Fourier series.

Module 2 (12hrs)
Fourier Transform- Fourier transform of standard signals, properties of Fourier transform, Amplitude and phase spectrum, Fourier Transform of periodic signals. . Inverse Fourier transform for a given spectra. System analysis with Fourier Transform-Transfer function of LTI system. Signal transmission through linear system-signal distortion-Signal band width and system bandwidth-band width and rise time, band width requirement for signal transmission.

Module 3 (12hrs)
Convolution and correlation of signals- Convolution theorems, Power spectral density and energy spectral density. Comparison of ESD and PSD, cross correlation of energy and power signals. Auto correlation-Auto correlation for energy signals, periodic signals, auto correlation and spectral density, relationship between convolution and correlation, Detection of periodic signals in presence of noise by correlation.

Module 4 (12hrs)
Sampling theory- Sampling theorem, nyquist rate, reconstruction of signal, effects of under sampling, sampling of band pass signals, sampling techniques, comparison of various sampling methods. Time domain analysis of discrete time system- solution of difference equation, natural and forced response. Impulse response and convolution-convolution of two sequences, Causality ,FIR and IIR systems, Stability, Step response, Correlation of two sequences. Inverse system and Deconvolution.

Module 5 (12hrs)
Symmetrical two port network-image impedance –characteristics impedance-and propagation constant of a symmetrical two port network-properties of symmetrical two port network - symmetrical two port network as a filter- filter fundamentals-pass and stop bands-behaviour of iterative impedance- constant –k, low pass, high pass and band pass filters- m derived T and ∏ sections and their applications for finite attenuation at filter terminals – band pass and band elimination filters

Text Books:

1. Alan V Openhein and Schafer, S*ignals and Systems*, Pearson.
2. Ravikumar , *Signals and Systems* ,PHI
3. Dr. S. Palani, Signals and Systems, Ane Books Pvt. Ltd. First Edition, 2009

References

1. Luis F Chapparo, *Signals and systems*; Elsevier Publications,2011
2. Roberts, *Fundamentals of Signals and Systems* (SIE), 2e, Tata McGraw –Hill Education New Delhi,2010
3. D.C. Dhubkarya , *Networks and Systems*, University Press, New Delhi,2008.
4. P.Ramesh Babu and R. Ananda Natarajan, ,*Signals and systems*, SCITECH
5. Simon Haykin and Barry Van Veen , *Signals and Systems*, Second Edn,John Wiley,India ,2010.
6. Robert A. Gabel and Richard A. Robert, *Signals and Systems*, Wiley, India
7. D.Ganesh Rao, R.V. Srinivasa Murthy, *Network Analysis, A Simplied Approach* Sanguine Technical Publishers.

EE 010 504: Power Electronics

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

Objectives

To understand the characteristics and operational features of important power electronic devices and circuit topologies that are useful in applications demanding high energy efficiency and compact power conversion stages

Module 1 (17 hours)
Static switches: Uncontrolled and controlled switches. Directional voltage and current properties. Loss calculation and selection of heat sink, Snubbers. Power diodes - reverse recovery characteristics and its effects, Current and Voltage ratings. Power Transistors, Power Darlingtons, Power MOSFETS, IGBTs- Principle of operation, Static and Dynamic Performance, Safe operating area, Drive circuits.

SCRs- Static and dynamic characteristics, two transistor analogy, ratings and specifications, Device protection, Gate circuit requirements, timing control and firing of thyristors, amplification and isolation of SCR gate pulses, Timing and synchronization, R, RC, UJT based firing, Diac based triggering circuit for TRIAC, Firing circuits incorporating pulse transformers and opto couplers, Single pulse and multi pulse triggering.

Module 2 (15 hours)
Phase controlled rectifiers: single phase half wave controlled rectifier circuit – single phase full wave controlled rectifier circuit – R, RL Loads – free wheeling – half controlled and fully controlled bridge with continuous current – Expression for output voltage – wave forms – active and reactive power – Line current distortion, displacement power factor and distortion factor, THD, effect of source inductance – line commutated inverter . Generation of gate timing pulses for single phase controlled rectifiers. 3-phase half wave and full wave controlled rectifier – expression for output voltage.

Module 3 (10 hours)
Choppers and cyclo converters: Voltage step down chopper- Power circuit configuration and working principle, Voltage and current relationships. Choice of filter inductance and/frequency. Voltage step up chopper- Basic principle of operation, Two quadrant and four quadrant choppers (Analysis not required). Generation of timing pulses for a single phase chopper. Voltage and current commutation.
Basic Principle of Cyclo converters: single phase and three phase. (Analysis not required).

Module 4 (10 hours)
Inverters: Types of Inverters-Voltage source inverters, Current Source inverters - Half bridge inverter-analysis with inductive load. Full bridge inverter- adjustment of ac frequency and ac voltage, Harmonic analysis - Principle of Sinusoidal PWM- Unipolar and Bipolar schemes - Three phase VSI-circuit configuration and switching sequence, square wave mode of operation, phase and line voltage waveforms, Sine triangle PWM.

Module 5 (8 hours)
Switch Mode Power Supply Systems: Switch mode regulators- Buck, Boost and Buck boost topologies- voltage and current relationships- output voltage ripple. Isolated converters (Analysis not required) Forward, fly back, push pull, half bridge and full bridge converters- basic principle of operation.

Text Books

1. Joseph Vithayathil, *Power Electronics-Principles and applications*, TMH, 2010
2. M.H. Rashid , *Power Electronics – Circuits, Devices and Applications*, PHI/Pearson 2005

Reference Books

1. Mohan, Undeland, Robins, *Power Electronics- Converters, Applications and Design*, 3rd Edition, John Wiley India, 2003.
2. M. S. Jamil Asghar, *Power Electronics*, PHI, 2009.
3. M. D. Singh, K.B Kanchandani, *Power Electronics*, TMH-2007
4. Philip T Krein, *Elements of Power Electronics*, Oxford University Press, 2008.
5. Jai P. Agrawal , *Power Electronic Systems – Theory and Design*, Pearson Education Asia, LPE, 2002
6. 6. L. Umanand, *Power Electronics- Essentials and Applications*, Wiley India 2009

EE 010 505: Linear Integrated Circuits

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

Objectives

- *To impart the basic concepts of operational amplifiers and applications.*
- *To develop the student's ability to design and analyze a wide variety of Linear Integrated circuits.*

Module 1 (14 hrs)

Operational Amplifiers: Differential amplifier-current mirror- block diagram of a typical op amp- characteristics of an ideal op-amp-definitions of CMRR -slew rate- input offset voltage - differential input resistance-input voltage range - SVRR - large signal voltage gain - output voltage swing - output resistance – single voltage biasing - open loop configurations - disadvantages-closed loop configurations –offset compensation-offset minimizing resistor-non inverting amplifier - voltage follower-inverting amplifier - summing and scaling amplifier - integrator -differentiator- V to I and I to V converter-log and antilog amplifier **.**

Module 2 (10 hrs)
Basic comparator- Astable multivibrator – mono stable multivibrator – Triangular wave generator-schmitt trigger - zero crossing detector - precision rectifier - peak detector - sample and hold circuit-RC Phase Shift Oscillator- Pulse width controller , voltage limiter. Function generator 8038.

Module 3 (12 hrs)

Active Filters - low pass filter, high pass filter, band pass filter, band reject filter (first and second order). D/A converter-binary weighted resistor type -ladder type.-DAC 0808- A/D converter – simultaneous (flash) A/D converter - counter type - successive approximation converter – sigma delta converter - dual slope converter -Digital voltmeter–ADC 0800

Module 4 (13 hrs)

Phase locked loop - basic principles of PLL –VCO, NE 566- block diagram - transfer characteristics –PLL NE 565- applications of PLL as frequency multiplier, frequency translator, AM demodulator, FM demodulator, FSK demodulator.
The 555 timer - functional block diagram. The 555 astable multivibrator and monostable multivibrator.

Module 5 (11 hrs)
Instrumentation Amplifier-LM 380 power amplifier-application of LM 380 as audio power amplifier-Intercom using LM 380.
Regulated power supplies - Series op-amp regulator-General purpose IC Voltage regulator 723 –low voltage regulator using 723 – 780X series. Switching regulator-SMPS.

Text Books

1. Ramakant A. Gayakwad, *Op- Amp and Linear I.C.*, PHI
2. Robert F Coughlin, *Operational Amplifiers and Linear Integrated Circuits* , PHI

Reference Books

1. Bali, *Linear Integrated Circuits* (Sigma Series), 1e, Tata McGraw –Hill Education, New Delhi 2008
2. D.Roy Choudhury. *Linear Integrated Circuits*
3. S Salivahanan, *Linear Integrated Circuits*,2e, Tata McGraw –Hill Education New Delhi,2009
4. Botkar KR, *Integrated circuits* -
5. U.A.Bakshi, *Linear Integrated Circuits,* Technical Publishers
6. David L Terrell, *Op-Amps, Design ,Application and Trouble shooting* , Elsevier Publications

EE 010 506: Microprocessors and Applications

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

Objectives

- *To provide in-depth knowledge about 8085 microprocessor architecture, programming and interfacing.*
- *To introduce the 16-bit microprocessor 8086.*

Module 1 (10 hours)
Evolution of Processors – single chip microcomputer – Intel 8085 Microprocessor – signals architecture of 8085 – ALU – register organization – timing and control unit – microprocessor operations – instruction cycle – fetch, decode and execute operation – T-state, machine cycle and instruction cycle – timing diagram of opcode fetch, memory read, I/O read, memory write and I/O write cycles – wait state

Module 2 (13 hours)
Instruction set of 8085: Classification of instructions – different addressing modes – writing assembly language programs – typical examples like 8 bit and 16 bit arithmetic operations, finding the sum of a data array, finding the largest and smallest number in a data array, arranging a data array in ascending and descending order, finding square from look-up table.

Module 3 (11 hours)
Stack and Subroutines: Stack pointer – stack operations – call-return sequence – examples - Counters and time delays
Interrupts of 8085: Software and hardware interrupts- restart instructions – interrupt structure of 8085 – interrupt procedure- vectored and non-vectored interrupts – SIM and RIM instructions

Module 4 (12 hours)
Interfacing: Memory interfacing **-** ROM and RAM – interfacing I/O devices – address space partitioning – memory mapped I/O and I/O mapped I/O schemes – interfacing I/Os using decoders –programmable peripheral devices –8255 block diagram, programming simple input and output ports- DMA controller 8257-– interfacing of 8279 keyboard /display controller- 8275 CRT controller

Module 5 (14 hours)
Intel 8086: Logical Pin diagram –Internal Architecture- pipelining- registers and flags - Operating modes: Minimum mode and Maximum mode.
Physical address generation – memory segmentation –even and odd memory banks.
Addressing modes- instruction set classification – writing simple programs : arithmetic operations.

Text books:

1. Ramesh Gaonkar, *Microprocessor Architecture, Programming and Applications with 8085*, Penram Intl.
2. A.K. Ray and K.M. Burchand , *Advanced Microprocessors and Peripherals* , TMH

Reference books:

1. B.Ram, *Fundamentals of Microprocessors and Microcomputers*, Dhanpat Rai and Sons
2. A.Nagoor Kani , *Microprocessor(8085) and its Applications* , RBA Publications
3. Douglas V. Hall, *Microprocessors and Digital Systems*, McGraw Hill
4. A.P Mathur, *Introduction to Microprocessors*, TMH
5. Douglas V. Hall , *Microprocessors and Interfacing: Programming and Hardware*, TMH
6. **A.** Nagoor Kani , *Microprocessor 8086 Programming and Interfacing*, RBA Publications

EE 010 507: Electrical Machines Lab I

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

Objectives

- *To conduct various tests on DC machines and transformers and to study their performance*

1. Study of 3-point and 4-point starters for D.C machines – mode of connection – Protective arrangements
2. OCC of self and separately excited D.C machines – critical resistances of various speeds. Voltage built-up with a given field circuit resistance. Critical speed for a given field circuit resistance
3. Load test on shunt and compound generator – deduce external, internal and armature reaction characteristics. Find load critical resistance.
4. Characteristics of D.C series machine as motor and generator.
5. Swinburne's and retardation test on D.C machines.
6. Brake test on D.C shunt, compound motors and determination of characteristics.
7. Hopkinson's test on a pair of D.C machines.
8. Separation of losses in a D.C machine.
9. Field's test on D.C machine.
10. Polarity, transformation ratio tests of single phase transformers
11. O.C and S.C tests on single phase transformers – calculation of performance using equivalent circuit – efficiency, regulation at unity, lagging and leading power factors. Verification by direct loading.
12. Sumpner's test on single phase transformers.
13. O.C and S.C tests on three-phase transformers.
14. Scott connection – check for 2 phase – predetermination of primary current for balanced and unbalanced secondary currents – verification by actual loading.
15. Parallel operation and load sharing of two single phase dissimilar transformers.
16. Separation of losses of single phase transformer into hysteresis and eddy current losses.

References

1. Dr. P S Bimbra, *Electrical Machinery*, Khanna Publishers
2. R K Rajput, *A text book of Electrical Machines*, Laxmi publishers

EE 010 508: Integrated Circuits Lab

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

Objectives

- *To expose the students to a variety of practical circuits using various ICs to prove the theories behind them.*

Digital IC

1. Study of TTL gates
2. Characteristics of TTL gates
3. Realisation of sequential circuits –Adder and Subtractor Circuits.
4. Study of SR, JK, D, T and JK Master-Slave Flip Flops
5. Interfacing of seven segment display.
6. Testing of different shift registers.
7. Design and Testing of decoders and encoders.
8. Design and testing of asynchronous counters and modulo N counter.
9. Design and testing of synchronous counters and specified sequence counter.
10. Design and testing of counters using shift registers

Linear IC

11. Design and Testing of Summer, Integrator and Differentiator Circuits.
12. Design and Testing of Inverting and Non-Inverting Amplifiers.
13. Design and testing of astable and mono-stable multi vibrator using IC 741
14. Realisation of ADC and DAC.
15. Design and testing of astable and mono-stable multi vibrator using 555
16. Study of IC Power Amplifier LM 380
17. Study of IC Voltage Regulator 723.
18. PLL as free running oscillator and frequency multiplier.

Optional

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Any experiment relevant to **EE 010 405 and EE 010 505** may be added.

References

1. Digital Principles - Malvino & Leach.
2. Fundamentals of Digital Circuits - A.Anandakumar.
3. Op- Amps and Linear ICs - Ramakant Gayakwad
4. Linear IC - D.Roy Choudhury.

EE 010 601: Power Generation and Distribution

Teaching scheme **Credits:** 4
2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart introductory knowledge of power systems*
- *To develop understanding of power generation systems and power distribution systems.*

Module I (12 hours)
Steam power plants: Rankine cycle (ideal, actual and reheat) – layout – components – alternators – excitation system – governing system.
Hydroelectric power plants: selection of site – mass curve – flow duration curve – hydrograph – classification of hydro plants – layout – components – classification of hydro turbines.
Nuclear power plants: layout – components – pressurized water reactor – boiling water reactor – heavy water reactor – gas cooled reactor – fast breeder reactor.
Gas power plants: gas turbine cycle – layout – open cycle, closed cycle and combined cycle gas power plants.
Diesel power plants: Thermal cycle – diesel plant equipment

Module II (8 hours)
Economic Aspects: Load Curve – Load duration curve – Energy load curve - Maximum demand – demand factor – Diversity factor – coincidence factor – contribution factor – load factor – Plant capacity factor – Plant use factor – Utilisation factor – power factor and economics of power factor correction.
Tariffs: Flat rate tariff – Two part tariff – Block rate tariff – maximum demand tariff – power factor tariff

Module III (10 hours)
Distribution Feeders: Primary and secondary distribution – Feeder loading – voltage drop in feeder lines with different loadings – Ring and radial distribution – Transformer Application factor – Design considerations of distribution Feeder – Kelvin's law

Module IV (15 hours)
Voltage drop in DC 2 wire system, DC 3 wire system, AC single phase 2 wire system, AC three phase 3 wire and 4 wire systems – voltage drop computation based on load density – voltage drop with underground cable system – power loss estimation in distribution systems – power factor improvement using capacitors – sub harmonic oscillations and ferro resonance due to capacitor banks – optimum power factor for distribution systems

Module V (15 hours)
Energy Management & Auditing: The need for energy management. – Demand side energy management – auditing the use of energy – types of energy audit – electrical load management and maximum demand control – distribution and transformer losses – energy savings in motors and lighting systems

Text Books

1. D P Kothari and I J Nagrath , *Power System Engineering*:, Tata McGraw Hill
2. S N Singh, *Electric Power Generation, Transmission and Distribution,* PHI

Reference Books

1. V Kamaraju, *Electrical Power Distribution Systems,* Tata McGraw Hill
2. M V Deshpande, *Elements of Electrical Power Station Design*, PHI
3. A Chakrabarthi, M L Sony, P V Gupta, U S Bhatnagar, *A Text Book on Power System Engg.* , Dhanpat Rai & Co.
4. Lucas M. Faulkenberry, Walter Coffer, *Electrical power Distribution and Transmission,* Pearson Education
5. P.S. Pabla, *Electric Power Distribution*, Tata Mcgraw Hill
6. Course material for energy managers – Beaureau of energy efficiency, Government of India http://www.bee.gov.in

EE 010 602 Induction Machines

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *Construction, principle of operation and performance of induction machines and special electrical machines*

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Module1(16 Hours)

Three phase induction motor: Construction-squirrel cage and slip ring motors-principle of operation-slip and frequency of rotor current-mechanical power - developed torque- phasor diagram-torque-slip curve-pull out torque-losses and efficiency.

No load and locked rotor tests-equivalent circuit-performance calculation from equivalent circuit-circle diagram-operating characteristics from circle diagram-cogging and crawling and methods of elimination.

Module 2(14 Hours)

Starting of three phase squirrel cage induction motor-direct on line starting-auto transformer-star delta starting- starting of slip ring motors-design of rotor rheostat-variation of starting torque with rotor resistance.

Speed control-pole changing-rotor resistance control-frequency control-static frequency conversion-Deep bar and double cage induction motor –equivalent circuit -applications of induction machines-single phasing-analysis using symmetrical components.

Module3(10 Hours)

Induction Generator: Theory- phasor diagram-Equivalent circuit-Synchronous Induction motor-construction-rotor winding connections-pulling into step

Single phase Induction motor: Revolving field theory- equivalent circuit- torque-slip curve-starting methods-split phase, capacitor start-capacitor run and shaded pole motors.

Module 4(10 Hours)

Commutator motors-principle and theory-emf induced in a commutator winding- Single phase series motor :theory –phasor diagram-compensation and interpole winding-Universal motor-Repulsion motor: torque production –phasor diagram-compensated type of motors-repulsion start and repulsion run induction motor-applications-Reluctance motor-Hysterisis motor.

Module5(10 Hours)

Construction-principle of operation, operating characteristics of stepper motor, switched reluctance motor, BLDC motor, Permanent magnet synchronous motor, linear induction motor-principle-application-magnetic levitation

Text Books:

1. Alexander Langsdorf A S, *Theory of AC Machinery*, Tata McGraw-Hill
2. Dr. P S Bimbhra, *Electrical Machinery*, Khanna Publishers

Reference Books:

1. Say M G, *Performance and design of AC Machines*, ELBS
2. J B Gupta, *Electrical Machines* , S K Kataria and Son
3. Nagarath I J and Kothari D P, *Electrical Machines* ,4e, Tata McGraw- Hill Education, New Delhi, 2010
4. Vincent Deltoro, *Electrical Machines and Power System*, Prentice Hall
5. Venketaratnam, *Special Electrical Machines*, Universal Press

EE 010 603: Control Systems

Teaching scheme **Credits:** 4
2 hours lecture and 2 hours tutorial per week

Objectives

- *To provide knowledge in the frequency response analysis of linear time invariant systems*
- *To provide knowledge in the design of controllers and compensators.*
- *To provide knowledge in state variable analysis of systems.*

MODULE 1 (12 Hours)
Control system components – synchros, D.C servo motor, A.C servo motor, stepper motor, Tacho generator, Gyroscope.
Frequency domain analysis-. Bode plots, relative stability – gain margin and phase margin. correlation between time and frequency domain specifications. Static position error coefficient and static velocity error coefficient from bode plot. Gain adjustment in bode plot. Analysis of systems with transportation lag.

MODULE 2 (12 Hours)
Polar plots-phase margin and gain margin and stability from polar plot, Correlation between phase margin and damping ratio. Minimum phase and non-minimum phase systems. Log magnitude versus phase plots.
Nyquist plot – principle of argument , Nyquist stability criterion, conditionally stable systems

MODULE 3 (12 Hours)

Response of systems with P, PI and PID controllers.
Compensation Techniques – cascade compensation and feed back design, Lead, Lag and Lag-Lead design using Bode plots and root locus. Realisation of compensators using operational amplifiers.

Module 4 (12 Hours)
State variable formulation-concept of state variable and phase variable. State space representation of multivariable systems, Similarity transformation, invariance of eigen values under similarity transformation. Formation of Controllable canonical form, Observable canonical form. Diagnalisation, and Jordan canonical form from transfer function. Transfer function from state model.

Module 5 (12 Hours)
State model of discrete time systems. Solution of state equation – state transition matrix and state transition equation, computation of STM by canonical transformation, Laplace transform and cayley- Hamilton theorem. Discretization of continuous time system.

Text Books:

1. K.Ogatta, *Modern Control Engineering*- Pearson Education
2. I.J. Nagrath and M.Gopal, *Control Engineering*, TMH

Reference Books

1. D.Roy Choudhary, *Modern Control Engineering*, PHI
2. Richard C. Dorf and Robert H. Bishop, *Modern Control Systems*, Pearson Education
3. M.N. Bandyopadhay, *Control Engineering-Theory and Practice*, PHI,New Delhi,2009.
4 S. Hassan Saeed, *Automatic Control Systems* –Katson Books.
5. A. Anand Kumar, *Control Systems*, PHI
6. Franklin,Powell, *Feedback Control of Dynamic Systems*, Pearson.

EE 010 604 Digital Signal Processing

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

Objectives

- *To provide knowledge of transforms for the analysis of discrete time systems.*
- *To impart knowledge in digital filter design techniques and associated problems.*

Module 1 (14hrs)
Discrete time signals and systems: Basic principles of signal processing-Building blocks of digital signal processing. Review of sampling process and sampling theorem. Standard signals-delta, step, ramp. Even and odd functions. Properties of systems-linearity, causality, time variance, convolution and stability –difference equations-frequency domain representation – Discrete – time Fourier transform and its properties- Z transform and inverse Z transform-solution of difference equations.

Module 2 (14hrs)
Discrete fourier transform-inverse discrete fourier transform-properties of DFT-linear and circular convolution-overlap and add method-overlap and save method-FFT - radix 2 DIT FFT-Radix2 DIF FFT

Module 3 (12hrs)
Digital filter design: Design of IIR filters from analog filters - analog butter worth functions for various filters - analog to digital transformation-backward difference and forward difference approximations-impulse invariant transformation – bilinear transformation-frequency warping and pre warping-design examples- frequency transformations. Structures for realizing digital IIR filters-Direct form 1-direct form II-parallel and cascade structure-lattice structure.

Module 4 (12hrs)
Design of FIR filters-Properties of FIR filters-Design of FIR filters using fourier series method- Design of FIR filters without using windows- Design of FIR filters using windows-Design using frequency sampling-Design using frequency sampling method-Design using Kaiser's approach- realization of FIR filters .

Module 5 (8hrs)
Finite register length problems in digital filters-fixed point and floating point formats-errors due to quantization, truncation and round off. Introduction to DSP processors. Architecture of TMS 320C54 XX Digital Signal Processor. Principle of speech signal processing (Block Schematic only).

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing* ,PHI,New Delhi,1997V.
2. Mitra, *Digital Signal Processing* , 3e, Tata McGraw –Hill Education New Delhi,2007
3. P. Ramesh Babu- *Digital Signal Processing*-Scitech publication

Reference Books:

1. Alan V. Oppenheim, Ronald W. Schafer, *Discrete time Signal Processing* , PHI,New Delhi,1997.

2. Udayashankara , *Real Time Digital Signal Processing*, PHI, New Delhi, 2010.

3. Ganesh Rao, *Digital Signal Processing,* Sanguins

4. Haykin and Van Veen, *Signals and Systems,* John Wiley and sons Inc .,2010.

5. Li Tan, *Digital Signal Processing-Architecture Implementation and Applications*- Elsevier Publications

EE 010 605 Microcontrollers and Embedded Systems

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

Objectives

- *To impart knowledge about 8051 microcontroller programming and interfacing.*
- *To introduce students to advanced PIC 16F877 microcontroller and embedded systems*
- .

Module 1(14hrs)
Introduction to Embedded Systems (block diagram description)- Microcontrollers and Microprocessors - Comparison.
Intel 8051: Architecture–Block diagram-Oscillator and Clock-Internal Registers-Program Counter-PSW-Register Banks-Input and Output ports-Internal and External memory, Counters and Timers, Serial data I/O- Interrupts - SFRs.

Module 2 (14hrs)
Programming of 8051: Instruction syntax-Types of instructions–Moving data-Arithmetic Instructions-Jump and Call Instructions-Logical Instructions-Single Bit Instructions.
Arithmetic programs. Timing subroutines –Software time delay- Software polled timer-Addressing Modes – Application of Keil C in microcontroller programming.

Module 3 (10hrs)
I/O Programming: Timer/Counter Programming-Interrupts Programming- Timer and external Interrupts- Serial Communication- Different character transmission techniques using time delay, polling and interrupt driven-Receiving serial data – polling for received data, interrupt driven data reception-RS232 Serial Bus standard.

Module 4 (10hrs)
Microcontroller system design: External memory and Memory Address Decoding for EPROM and RAM. Interfacing keyboard. 7 segment display and LCD display. Interfacing of ADC (0808) and DAC (808) to 8051- frequency measurement – Interfacing of stepper motor.

Module 5 (12hrs)
Introduction to RISC Microcontrollers: Architecture of PIC 16F877 microcontroller- FSR – different Reset conditions – various oscillator connections- Internal RC, External RC, Crystal Oscillator and external clock. PIC memory organization – Program (Code) memory and memory map, Data memory and Data EEPROM.
Instruction set – Different addressing modes. Timers - Interrupt structure in PIC 16F877 microcontroller. Simple assembly language programs - square wave generation - reading/writing with internal data EEPROM.

Text books:

1. Muhammad Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems,* Pearson Education Asia.
2. Ajay V Deshmukh , *Microcontrollers- Theory and Applications* , Tata McGraw – Hill Education, New Delhi

Reference books

1. Kenneth J. Ayala, *The 8051 Microcontroller – Architecture, Programming and Applications*, Penram International Publishing (India), Second Ed.

2. K.V.Shibu, *Introduction to Embedded Systems*, 1e, Tata McGraw –Hill Education, New Delhi 2009

3. Dreamtech Software Team, *Programming of Embedded Systems* , Wiley Dreamtech

4. John B. Peatman, *Design with PIC Microcontrollers* , Pearson Education

5. Myke Predko, *Programming and Customizing the 8051 Microcontroller*, Tata McGraw Hill Education, New Delhi, 2009

6. Intel Data Book on MCS 51 family

EE 010 606 L01 High Voltage Engineering

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart the basic techniques of high voltage AC, DC and Impulse generation and measurement.*
- *To develop understanding about different high voltage testing techniques performed on electrical equipment.*

Module I (14 hours)

Fundamentals of electric breakdown in gases

Gas as insulating medium - Types of ionization by collision - types of collision. Condition for ionization by electron/ion collision - Collision cross section - Electric fields of low E/P (electric field/pressure in a gas medium).

Ionization process in gaseous media - Townsend mechanism and criterion of breakdown in gases - Paschen's law and its application- Streamer theory of breakdown- Corona discharges- Different theories of breakdown in solid dielectrics- pure and commercial liquids.

Module II (12 hours)

Generation of High DC, AC and Impulse voltages

HVDC : Cockcroft Walton double circuits – Multipliers- Vande Graaff generator

HVAC : Generation of High AC voltages- Cascade connection of transformers – resonant transformers - Tesla coil.

Impulse generation: Definition of impulse wave – B.I.S specification – single stage and multi stage impulse generator circuits. Tripping methods of impulse generator circuits - Impulse current generator.

Module III (12 hours)

Measurement of High DC and AC

Peak voltage- Sphere gap for measurement of DC,AC and impulse voltages. Measurement of HVDC by generating voltmeter – Potential dividers. Measurement of HVAC - Series impedance and Capacitor meters – Capacitance Potential Dividers – CVT

Module IV (10 hours)

Measurement of Impulse voltage and current

Measurement of impulse voltages and currents- Potential dividers - Measurement of impulse current- Hall generators - Magnetic potentio devices – Low current resistive shunts (Peak)

Module V (12 hours)

High voltage testing techniques

Measurement of dielectric constant and loss angle – High voltage Schering Bridge – Partial discharge measurements in high voltage equipment. Power frequency and impulse testing of high voltage apparatus – B.I.S specification – HV testing of insulators, bushing, cables and transformers.

Text Books

1. Naidu & Kamaraju ,*High voltage Engineering* ,Tata Mc Graw Hill Publications.
2. E. Kuffel & W.S Zaengel ,*High Voltage Engineering Fundamentals*, Oxford Pergamon Press

Reference Books

1. L.Lalston , *High voltage Technology* , Oxford university press.
2. Ravindra Arora ,*High voltage insulation engineering* , New Age International (P) Ltd.
3. High voltage experimental Techniques, Dieter Kind, Vieweg &Sohn Verlagsgesellschaft mbH, Braunschweig/ Wiesbaden, 1978

EE 010 606 L02 VLSI Systems

Teaching scheme
2 hours lecture and 2 hours tutorial per week **Credits:4**

Objective:

- *To cater the needs of students who want a comprehensive study of the principle and techniques of modern VLSI Design and Systems.*

Module I (10 hours)
Process steps in IC fabrication: Silicon wafer preparation- Czochralski process- Diffusion of impurities- physical mechanism- Ion implantation- Annealing process- Oxidation process- Lithography- Chemical Vapour Deposition (CVD)- epitaxial growth- reactors- metallization- patterning- wire bonding and packaging.

Module II (12 hours)
Monolithic components: Isolation of components- junction isolation and dielectric isolation. Monolithic diodes- schottky diodes and transistors- buried layer- FET structures- JFET- MOSFET- PMOS and NMOS, control of threshold voltage (Vth)- silicon gate technology- Monolithic resistors- resistors in diffused regions-
MOS resistors- monolithic capacitors- junction and MOS structures- IC crossovers and vias.

Module III (13 hours)
CMOS technology: CMOS structures- Latch up in CMOS. CMOS circuits: combinational logic circuits:- Inverter-NAND, NOR gates, complex logic circuits, Full adder circuit. CMOS Transmission Gates (TG)- realization of Boolean functions using TGs. Complementary Pass Transistor Logic (CPL)- CPL circuits: NAND, NOR gates, 4bit shifter.

Module IV (13 hours)
CMOS sequential logic circuits: SR flip-flop, JK flip-Flop, D latch circuits.
BiCMOS technology- Structure- BiCMOS circuits: Inverter, NAND gate, NOR gate.
CMOS Logic systems- Scaling of MOS structures- scaling factors- effects of miniaturization.

Module V (12 hours)
Gallium Arsenide Technology-:- Crystal structure- Doping process- Channeling effect- MESFET. Comparison between Silicon and GaAS technologies.
Introduction to Programmable Logic Arrays (PLA) and Field Programmable Gate Arrays (FPGA).

Text Books

1. N Weste and K Eshrangian, "*Principles of CMOS VLSI Design: A systems perspective"*, Pearson Education.
2. Jan M Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "*Digital Integrated Circuits – A Design Perspective,* Prentice Hall

Reference Books

1. S M Sze, *VLSI technology*, Me Graw Hill.
2. Douglas Pucknell, *Basic VLSI design*, PHI.
3. S.M.Kang & Y.Leblebici,*CMOS digital integrated circuits*, Mcgraw Hill.
4. K R Botkar, *Integrated Circuits* , Khanna Pub.

EE 010 606 L03 Artificial Neural Networks

Teaching scheme **Credits:** 4
2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart the basic concepts and application of neural networks*
- *To give an introduction to MATLAB based neural network programming*

Pre-requisites: *Fundamental Programming Concepts.*

Module I (15 hours)
Fundamentals of ANN – Biological prototype – Neural Network Concepts, Definitions - Activation. Functions – single layer and multilayer networks. Training ANNs – perceptrons – Exclusive OR problem – Linear seperability – storage efficiency – perceptron learning - perceptron training algorithms – Hebbian learning rule - Delta rule – Kohonen learning law – problem with the perceptron training algorithm
Introduction to MATLAB Neural network tool box. Basic MATLAB transfer functions like purlin, hardlim, hardlims ,tansig, logsig etc and basic programming

Module II (15 hours)
The back propagation Neural network – Architecture of the back propagation Network – Training algorithm – network configurations – Back propagation error surfaces – Back propagation learning laws – Network paralysis _ Local minima – temporal instability.
Introduction to nntool. Basic supervised programming with nn tool.

Module III (10 hours)
Counter propagation Networks – Architecture of the counter propagation network – Kohonen layer – Training the Kohonen layer – preprocessing the input vectors – initialising the weight vectors – Statisitical properties. Training the Grossberg layer- Feed forward counter propagation Neural Networks – Applications.

Module IV (10 hours)
Statistical methods – simulated annealing – Bloltzman Training – Cauchy training -artificial specific heat methods. Application to general non-linear optimization problems – back propagation and cauchy training

Module V (10 hours)
Hopfield net – stability – Associative memory – statistical Hopfield networks – Applications – ART NETWORKS –Bidirectional Associative memories- retreiving stored information. Encoding the association – continuous BAMS
Application of neural network for load forcasting, image enhancement, signal processing, pattern recognition etc.

Text Books

1. Philip D.Wasserman, *Neural Computing (Theory and Practice*)
2. J.Zuradha, *Introduction to Artificial Neural System* ,Jaico *Publishers*

Reference Books

1. S. Rajasekaran and G.A.V.Pai, *Neural Networks, Fuzzy Logic and Genetic algorithms*, PHI, 2003.
2. Hung T. Nguyen,Nadipuram.R Prasad ,*Fuzzy and Neural Control, CRC Press, 2002.*
3. Neural Network Toolbox, www.mathworks.com.
4. Kalyanmoyi Deb, Multi-Objective Optimization using Evolutionary Algorithms,Wiley,2001
5. Robert Hecht-Nilson, *Neuro Computing*
6. Simon Haykin, "*Neural Networks- A comprehensive foundation*", Pearson Education, 2001.

EE 010 606 L04 Object Oriented Programming

Teaching scheme

Credits: 4

2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart knowledge on concepts of object-oriented programming.*
- *To enable the students to master OOP using C++.*

Pre-requisites

- EE 010 406 Computer Programming

Module 1 (10 hours)
OOP concepts: Objects-classes-data abstraction-data encapsulation- inheritance- polymorphism-dynamic binding, comparison of OOP and Procedure oriented programming, object oriented languages.
OOP using C++: Classes and objects, class declaration-data members and member functions-private and public members-member function definition, inline functions, creating objects, accessing class members.

Module 2 (14 hours)
Arrays of objects, objects as function arguments-pass by value-reference variables/aliases-pass by reference, function returning objects, static class members.
Constructors and destructors -declaration, definition and use, default, parameterized and copy constructors, constructor overloading.

Module 3 (11 hours)
Polymorphism: function overloading-declaration and definition, calling overloaded functions. Friend classes, friend functions, operator overloading-overloading unary and binary operators-use of friend functions.

Module 4 (14 hours)
Inheritance: different forms of inheritance, base class, derived class, visibility modes , single Inheritance, characteristics of derived class, abstract class.
File handling in C++: file stream classes, file pointers and their manipulations, open (), close (), read (), write () functions, detecting end of file.

Module 5 (11 hours)
Dynamic memory allocation: pointer variables, pointers to objects, new and delete operators, accessing member functions using object pointers, 'this' pointer.
Run time polymorphism: pointers to base class, pointers to derived class, virtual functions-dynamic binding.

Text Book

1. Balagurusamy, *Object Oriented Programming with C++* , Tata McGraw Hill
2. D Ravichandran, *Programming with C++*, Tata Mc-Graw Hill

References

1. Robert Lafore, *Object Oriented Programming in Turbo C++*, Galgotia Publications
2. K R Venugopal, Rajkumar, T Ravishankar, *Mastering C++*, Tata Mc_Graw Hill
3. John R Hubbard, *Programming with C++*, Schaum's series, Mc_Graw Hill
4. Stanely B.Lippman, *C++ primer*, Pearson Education Asia
5. Bjame Stroustrup, *C++Programming Language,* Addison Wesley

EE 010 606 L05 Biomedical Engineering

Credits :4

Teaching Scheme
2 hours lecture+ 2 hours tutorial / Week

Objectives

- *To introduce the student to the various sensing and measurement devices of electrical origin.*
- *To provide the latest ideas on devices for the measurement of non-electrical parameters.*
- *To bring out the important and modern methods of imaging techniques.*
- *To provide latest knowledge of medical assistance / techniques and therapeutic equipments*

MODULE 1 (12 Hrs)
Cell and its structure – Action and resting potential - Propagation of action potential – Sodium pump –Nerve cell – Synapse –Different systems of human body- Cardio pulmonary system – Physiology of heart and lungs – Circulation and respiration – Man instrument system.Electrodes-Different types-Transducers – Different types – piezo-electric, ultrasonic, resistive, capacitive, inductive transducers
Safety instrumentation-Radiation safety instrumentation- Physiological effects due to 50 Hz current passage- Microshock and macroshock-Electrical accidents in hospitals-Devices to protect against electrical hazards-hospital architecture

MODULE 2 (12 Hrs)
Biopotential Recorders - Characteristics of recording system – Electrocardiography -Conducting system of heart - ECG lead configuration - Analysis of ECG signals - Heart sounds - Phonocardiography - Electroencephalography (EEG) - Placement of electrodes in EEG - Analysis of EEG – Electromyography - Electroretinography and Electrooculography

MODULE 3(12 Hrs)
Physiological Assist Devices- Pacemakers-Different modes of opreation- Pacemaker batteries-Artificial heart valves- Defibrillators –Different types- Heart Lung machine - Oxygenerators-Blood pumps- Kidney machine-Dialysis-Haemodialysis- Peritonial dialysis Blood pressure measurement (invasive and noninvasive)

MODULE 4 (12 Hrs)
Operation Theatre Equipment- Surgical Diathermy- Short wave diathermy-Microwave diathermy- Ultrasonic diathermy-Therapeutic effects of heat-Range and area of irritation of different diathermy techniques-Ventilators- Anesthesia machine- Blood flow meter-Pulmonary function analysers-Lung volumes and capacities- Gas analyser- Oxymeters-Elements of intensive care monitoring

MODULE 5 (12 Hrs)
Advances in Biomedical Instrumentation-X-ray tube-X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – Block diagram of CT machine- Applications of CT- Ultrasonic imaging-Modes of display-US imaging instrumentation-Applications of US-Magnetic Reasonance Imaging- MRI instrumentation- Thermography-Block diagram of the thermographic equipment- Medical applications of thermography-LASER in Medicine–LASER instrumentation-Photo thermal and photochemical applications of LASERS

Text Books

1. Dr. M. Arumugam ,*Biomedical Instrumentation*, Anuradha Publishers
2. Prof. S.K.Venkata Ram, *Biomedical Electronics and Instrumentation* ,Galgotia Publishers

Reference Books

1. Carr and Brown, *Introduction to Biomedical Equipment Technology* ,Prentice Hall
2. John G. Webster, *Medical Instrumentation Application and Design*, John Wiley & Sons Pvt. Ltd
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer,*Biomedical Instrumentation and Measurements* ,Pearson Education
4. Richard Aston ,*Principles of Biomedical Instrumentation and Measurement* , Maxwell Macmillan International Edition
5. R. S. Khandpur ,*Handbook of Biomedical Instrumentation*, TMH
6. Tompkins ,*Biomedical Digital Signal Processing*, PHI Learning Pvt. Ltd

EE010 606 L06 Renewable Energy Resources

Teaching scheme **Credits: 4**

2 hours lecture and 2 hours tutorial per week

Objective

- *To understand the importance, scope, potential, theory and applications of non conventional energy sources*

Module I (10 hours)

Energy scenario in India, Environmental aspects of Electrical Energy Generation , Energy for sustainable development, Renewable Energy sources-Advantages and limitations.
Renewable Hydro –Power Equation-Small, Mini and Micro hydro power-Types of turbines and generators

Module II (11 hours)

Solar energy – Introduction to solar energy: solar radiation, availability, measurement and estimation.
Solar Thermal systems- Solar collectors(fundamentals only)- Applications -Solar heating system, Air conditioning and Refrigeration system ,Pumping system, solar cooker, Solar Furnace, Solar Greenhouse -Design of solar water heater

Module III (11 hours)

Solar photovoltaic systems- Photovoltaic conversion- Solar Cell, module, Panel and Array Solar cell- materials-characteristics- efficiency-Battery back up-PV system classification-Design of stand-alone PV system.

Module IV (13 hours)

Wind energy –-Introduction – Basic principles of wind energy extraction – wind data and energy estimation – site selection – Basic components of wind energy conversion system – Modes of wind power generation.-Applications
Fuel cells –characteristics-types and applications

Module V (15 hours)

Biomass Energy - Resources - Biofuels- Biomass conversion process-applications Tidal power-Energy estimation-site selection-Types-Important components of a tidal power plants- Wave energy- characteristics-energy and power from the waves, wave energy conversion devices
Geothermal energy – resources - estimation of geothermal power - geo thermal energy conversion - Applications

Text Books

1. D.P.Kothari, K.C.Singal, Rakesh Ranjan, *Renewable Energy Sources and Emerging Technologies*, Prentice Hall of India, New Delhi, 2009
2. B.H. Khan, *Non-Conventional Energy Resources, 2nd* ,Tata McGraw Hill, New Delhi, 2010
3. Chetan Singh Solanki, *Renewable Energy Technologies,* Prentice Hall of India, New Delhi, 2009

Reference Books

1. Godfrey Boyle, *Renewable Energy*, Oxford
2. Tasneem Abbasi, S.A.Abbasi, *Renewable Energy Sources*, Prentice Hall of India, New Delhi, 2010
3. Siraj Ahmed, *Wind Energy- Theory and Practice*, Prentice Hall of India, New Delhi, 2010

EE010 607 Power Electronics Lab

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

Objectives

- *To provide experience on design and analysis of power electronic circuits used for power electronic applications.*

Experiments

1. Study of VI characteristics of SCR and TRIAC.
2. Study of BJT, IGBT, GTO & MOSFET.
3. R, RC and UJT firing circuit for control of SCRs.
4. Design and Implementation of Ramp-Comparator and digital firing scheme for simple SCR circuits.
5. Automatic lighting control with SCRs and optoelectronic components.
6. AC phase control using SCR and TRIAC.
7. Speed control of DC motor using choppers and converters.
8. Generation and study the PWM control signal for single phase dc to ac inverter.
9. Study and use of single phase half controlled and fully controlled AC to DC converter and effect of firing angle control on load voltage waveforms.
10. Study and use of back to back connected SCR/TRIAC controlled AC voltage controller and its waveforms with variations of firing angle.
11. Study and use of chopper circuit for the control of DC voltage using
    (i) Pulse width control
    (ii) Frequency control
12. Study of single phase inverter and its waveforms.
13. Study of 3 phase firing circuit with synchronization and testing with 3 phase AC to DC bridge converter. Testing waveforms of digital firing modules.
14. Study and testing of 3 phase bridge inverter with different types of loads.
15. Simulation of gating circuits and simple converter circuits.
16. Harmonic Analysis of Power Electronic devices.
17. Simulation of firing circuits using Pspice.
18. Microprocessor based 3 phase fully controlled converter.

References:

1. Joseph Vithayathil , *Power Electronics-Principles and applications*, TMH, 2010
2. M.H. Rashid , *Power Electronics – Circuits, Devices and Applications*, PHI/Pearson 2005

EE 010 608: Microprocessor and Microcontroller Lab

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

Objectives

- *To provide experience in the programming of 8085 microprocessor and 8051 microcontroller*
- *To familiarize with the interfacing applications of 8085 microprocessor and 8051 microcontroller.*

1. 8085 assembly language programming experiments

    a. 8-bit and 16 bit arithmetic operations
    b. Sorting
    c. BCD to binary and binary to BCD conversion
    d. Finding square root of a number
    e. Finding out square root of a number using look-up table
    f. Setting up time delay and square wave generation
    g. Interfacing of switch and LED
    h. Traffic control signals

2. 8051 programming

    a. Setting up time delay using timer and square wave generation
    b. Interfacing LEDs
    c. Interfacing Hex keyboard
    d. Interfacing LCD display
    e. Interfacing electromechanical and static relay
    f. Interfacing DC motor with MOSFET switches and opto-isolator

3. Mini Project
   The students are expected to do a mini project in the area of microprocessors /microcontrollers and should be evaluated separately and considered for internal assessment.

   Reference:
   Satish Shah, *8051 Microcontroller* , Oxford Higher Education

Note : Internal assessment mark for the laboratory work (Part 1 & Part2) is 60 % and for the mini project (Part 3) is 40 %.

EE 010 701: Electrical Power Transmission

Teaching scheme **Credits:** 4
2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart knowledge about electrical transmission systems*

Module I (10 hours)
Transmission Line Parameters: Inductance of single phase two wire line – inductance of composite conductor lines – inductance of three phase lines – double circuit three phase lines – bundled conductors – resistance – skin effect and proximity effect – magnetic field induction – capacitance of two wire line – capacitance of a three phase line with equilateral spacing and unsymmetrical spacing – transposition of lines – effect of earth on capacitance – method of GMD – electrostatic induction

Module II (11 hours)
Analysis of Transmission Lines: Short transmission line – generalised circuit constants – medium transmission lines by nominal pi and T methods – long transmission line rigorous solution – equivalent circuit of long lines – Ferranti effect – tuned power lines – power flow through a transmission line – Effects of transformer on the performance of a transmission line – reactive power in a line – power transfer capability of transmission lines – compensation of transmission lines – power flow in a long transmission line

Module III (12 hours)
Insulators for overhead transmission lines: Ratings – types of insulators – potential distribution over a string of suspension insulators – string efficiency – methods to improve string efficiency – methods of equalising potential – insulation failure – testing of insulators.
Mechanical design of Transmission Lines: Sag and Tension – Spans of unequal length – equivalent span – effect of ice and wind loading – stringing chart – vibration and vibration dampers.
Underground cables: types of cables – capacitance of single core cables – grading of cables – power factor and heating of cables – capacitance of three core belted cable – DC cables – location of faults in underground cables (Murray and Varley tests)

Module IV (12 hours)
Substations: Types of substations – Bus bar arrangements – substation bus schemes – substation equipments
Grounding Systems: resistance of grounding systems – neutral grounding – resonant grounding – solid grounding or effective grounding – resistance grounding – reactance grounding – earthing transformer
Corona: Critical disruptive voltage – conditions affecting corona – corona loss – factors affecting corona loss – radio interference – interference between power and communication lines.

Module V (15 hours)
HVDC Transmission: Advantages and disadvantages of HVDC transmission – Types of HVDC links – Interconnection of HVDC into AC systems
FACTS Technology: Objectives of Flexible AC Transmission – FACTS devices – simple model of STATCOM, static VAR compensator(SVC), thyristor controlled reactor(TCR), thyristor switched reactor(TSR), thyristor switched capacitor(TSC), interline power flow controller(IPFC), thyristor controlled series capacitor(TCSC), thyristor controlled series reactor(TCSR) and unified power flow controller(UPFC)

Text Books

1. Power System Engineering: D P Kothari and I J Nagrath, Tata McGraw Hill
2. Electric Power Generation, Transmission and Distribution: S N Singh, PHI

Reference Books

1. Power System Analysis: William D Stevenson Jr, John J Grainger, Tata McGraw Hill
2. Electrical machines, Drives and Power Systems: Thoedore Wildi, Pearson Ed.
3. Electrical power Distribution and Transmission: Luces M. Faulkenberry, Walter Coffer, Pearson Education
4. Power System Analysis: Hadi Saadat, Tata McGraw Hill

EE 010 702: Synchronous Machines

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

Objectives

To impart knowledge on

- *Construction and performance of salient and non – salient type synchronous generators.*
- *Principle of operation and performance of synchronous motors*.

Module 1 (12 hours)

Synchronous Machines: Types – selection of alternators – constructional features of cylindrical and salient pole machines.
Armature windings: different types – phase grouping – single and double layer, integral and fractional slot winding – emf equation – distribution factor – coil span factor – tooth harmonic ripples – skewed slots – harmonics, elimination of harmonics – revolving magnetic field.

Module 2 (14 hours)

Armature Reaction – Synchronous reactance – circuit model of synchronous machine.
Regulation – predetermination – emf, mmf and potier methods, saturated synchronous reactance – Phasor diagrams – short circuit ratio – two-reaction theory – Phasor diagram – slip test – measurement of Xd, Xq, losses and efficiency of synchronous machines.

Module 3 (14 hours)

Parallel operation of alternators – load sharing – synchronizing power and torque – governor characteristics – method of synchronizing – synchroscope.
Synchronous Motor: Principles of operation – torque and power relationships – Phasor diagram – hunting in synchronous machines – damper winding – starting of synchronous motors.

Module 4 (12 hours)

Synchronous machines connected to infinite bus – power angle characteristics of cylindrical rotor and salient pole machines – reluctance power – steady state stability limit – V-curves – inverted V-curves – O-curves – synchronous condenser
Symmetrical short circuit of unloaded alternators – steady state, transient and sub-transient reactance – current variation during short circuit.

Module 5 (8 hours)

Excitation systems: different types – comparison – exciter ceiling voltage – excitation limits – exciter response – methods of increasing the response of an exciter.

Brushless Alternators: Principle of operation - constructional features – excitation methods – voltage regulation.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

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

Text Book

1. Electrical Machines: P.S Bhimbra, Khanna Publishers, New Delhi

References

1. The performance and Design of AC Machines: M.G. Say, Cbs Publishers
2. Theory of Alternating Current Machinery: Alexander Langsdorf, Tata Mgraw Hill
3. A course in Electrical Engg. Vol.2: C.L Dawes, McGraw- Hill Book Company inc.
4. Power System Stability – Vol. 3: Edward.W Kimbark, Ieee Computer Society Press
5. Electric Machines: D. P.Kothari & I.J.Nagrath, Tata McGraw Hill
6. Chapman S J, Electrical Machine Fundamentals, Mc Graw Hill
7. Theory and performance of Electrical Machines: J.B Gupta, S. K. Kataria & Sons

EE 010 703: Drives and Control

Teaching scheme **Credits:** 3
2 hours lecture and 2 hour tutorial per week

Objectives

- *To understand the characteristics of important types of electrical machines used in industry and the loads they drive, the speed control using solid state drives for energy efficient operation and the power electronics converters and control schemes required for realizing the drive systems.*

Module I (15 hours)
Concept of Electric Drives –parts of electrical drives – dynamics of electric drive – torque equation –Four quadrant operation of electric drives– loads with rotational and translational motion – Steady state stability- components of load torques – nature and classification of load torques – load equalization.
DC motor drive systems: Methods of speed control – single phase half wave controlled drive, half and fully controlled bridge rectifier drives-continuous and discontinuous conduction – speed torque characteristics-motoring and inverter modes of operation- commutation failure-source side power factor

Module II (10 hours)
3 Phase fully controlled and half controlled bridge rectifier drives-motoring and inverter modes of operation. Dual converter fed DC motor drives. Chopper fed drives –single, two and four quadrant operation- motoring and regenerative breaking.

Module III (10 hours)
Speed Control of three phase Induction motors**:** Stator voltage control – principle –controller configurations –speed reversal- operation and applications-VSI based induction motor drives – V/f control- Constant torque and constant power operation.

Module IV (12 hours)
Slip speed control: Slip power recovery scheme – principle – Static Kramer's drive – Static Scherbius' drive. CSI fed induction motor drives– operation under fixed frequency – operation under variable frequency – Dynamic and Regenerative Braking of CSI and VSI fed Drives. Basic principle of Vector control.

Module V (13 hours)
Speed control of synchronous motors : Adjustable frequency operation of synchronous motors – principles of synchronous motor control – Voltage Source Inverter Drive with open loop control – self controlled synchronous motor drive using load commutated thyristor inverter.
Electric Traction: Important features of traction drives-Conventional DC and AC traction drives – DC & AC traction using PWM VSI SCIM drives

Text Books

1. G.K Dubey, *Power Semiconductor controlled Drives*, Prentice hall, 1989
2. Mohammad A and E.L Sharkawi, *Fundamentals of Electric Drives*, Thomson Learning-2005

Reference Books

1. G.K. Dubey, *Fundamentals of Electrical Drives*, Narosa Publishing House, New Delhi, 2005.
2. R.Krishnan, *Electric Motor Drives – Modeling, Analysis and Control*, Prentice-Hall of India 2003.
3. W. Leonhard, *Control of Electrical drives*, Springer-Verlag, 2005
4. P.C. Sen, *Thyristor DC Drives*, Wiley-Interscience Publication 1984
5. Joseph Vithayathil, *Power Electronics-Principles and applications*, TMH, 2010
6. B. K. Bose, *Modern Power Electronics and A.C. Drives*, PHI, 2002.

EE 010 704: Modern Control Theory

Teaching Schedule: 2hours Lecture and 1hour Tutorial Credits -3

Objective: *To provide sound knowledge of advanced control systems*

Module 1 (9 Hrs**)**

Design of modern control systems- Concept of Controllability and Observability, Kalman's and Gilbert's tests for controllability and observability. Pole placement design using state variable feed back. Observers- design of full order observer.

Module 2. (9Hrs)

Non-linear systems – Characteristics – Phase plane analysis – linearization and stability of equilibrium points – Iscoline method – limit cycles of phase plane – stability of limit cycles.

Module 3.(9Hrs)

Describing function method– Harmonic linearization, describing function of nonlinear systems(On-Off, saturation and dead-zone only)-Analysis of nonlinear systems using describing function. Limit cycles' amplitude and frequency – Stability of non-linear systems – Lyapunov's method for non-linear system – Popov's criterion.

Module 4. (9Hrs)

Discrete time systems – Sampling theorem – sample and hold circuits and data reconstruction – Z-transforms – inverse Z transforms – pulse transfer function – state variables – description of discrete time systems – time domain analysis – stability using Jury's tests and Schurcohn method.

Module 5. (9Hrs)

Computer control of industrial processes(Basic Concepts only) – Control hierarchies for plant level automation – Microprocessor/microcontroller/DSP-based control.

Programmable logic controllers –Principle of operation- Architecture. Introduction to PLC programming –symbols used in ladder diagrams-AND,OR,NOR,XOR,Latch operations, Illustrative example of a motor control using PLC.

PC-based control – Direct Digital control (Basic concept only). Distributed Digital control (Basic Concept only) .

Text Books:

1. K.P. Mohandas, *Modern Control Engineering*, Sanguine Technical Publishers.

2 S.Hassan Saeed, *Automatic Control Systems*. Katson Books

3 M.N. Bandyopadhay, *Control Engineering-Theory and Practice,* PHI.

Reference:

1 Alberto Isidori – Non-linear control systems
2. S. Wiggins – Introduction to applied non-linear dynamical systems and chaos
3. Gene. F. Franklin and David Powel – Digital control of dynamic systems,Pearson.
4. Benjamin .C. Kuo – Digital control systems
5. Digital Control Engineering-Analysis and Design, M.Sami Sadali, Elsevier
6. M. Gopal – Digital control and state variable methods,TMH
7. Stefani,Shahian,Savant and Hostetter, Design of feedback Control Systems, Oxford University Press.
8. Krishna Kant , Computer Based Industrial Control ,PHI(Module 5)
9. S.K. Singh, Process Control, Concepts, Dynamics and Applications, PHI.(Module 5)
10. W.Bolton – Instrumentation and control systems, Elsevier(Module 5)

EE 010 05 : Communication Engineering

Teaching Scheme **Credits: 3**

2 hours lecture and 1 hour tutorial per week.

Objectives

- To develop student's basic concepts in communication engineering.
- To expose the students to modern communication systems.

Module 1 (6 Hours)

Review of AM and FM.

AM receiver- Superheterodyne AM receiver- RF amplifier, mixer, detector and AGC circuits.

FM Transmitter-Reactance modulator (BJT, FET)-Block schematic of Armstrong FM Modulator.

FM receiver-Block Schematic of Superheterodyne FM receiver-FM detector-Ratio detector.

Module 2 (9 Hours)

Television: Composite video signal – synchronizing pulse – blanking pulse-equalizing pulse, Video BW, Positive and negative modulation, Vestigial side band transmission, Television standards.

Colour Television: Compatibility, characteristics of colour transmission and reception, luminance, hue & saturation, colour difference signal, I & Q signals, frequency interleaving, colour sub carrier-block schematic of NTSC,SECAM and PAL transmitters and receivers-comparison.

Module 3 (6 Hours)

Radar: Basic radar system, radar range equation – performance factors, Pulsed radar, Continuous wave radar – advantages-limitations-applications, CW radar, MTI radar system. Radio navigational aids – ILS – GCA-war & peace application.

Module 4 (14 Hours)

Satellite Communication: Satellite frequency band- orbits & inclination-Geostationary orbits-effects of solar eclipse-orbital height-Apogee and Perigee calculation-Satellite subsystem-Altitude & orbit control-Tracking ,Telemetry & command-Power System-Transponder-functions-up link/down link converters. HPA-Antenna subsystem-Satellite link Analysis-Path losses-Link budget calculation-C/N & G/T-up link down link modeling-Multiple access techniques-TDMA-FDMA-CDMA-DA FDMA-DA TDMA-SPADE-Earth Station Block Schematic.

Module 5 (10 Hours)

Digital Communication: Digital Coding of Analog Waves: PCM, Differential PCM, Delta Modulation, PAM, Adaptive Digital Coding.

Modulation Techniques- Basic principles of Binary and M-Ary modulation. Basic Principles of Binary Amplitude Shift Keying-Binary Phase Shift Keying-Binary Frequency Shift Keying-M-Ary Amplitude Shift Keying- M-Ary Frequency Shift Keying- M-Ary Phase Shift Keying.

Text Books

1. Electronic Communication Systems: Wayne Tomasi, Pearson Education, LPE
2. Radio Engineering: M.L.Gupta, Dhanpat Rai Publishing Co (P) Ltd;

References

1 Electronic Communication Systems: George Kennedy, TMH
2. Monochrome and Colour Television: R.R Gulati, Wiley Eastern
3. Satellite Communications: K.N. Raja Rao, PHI
4. Satellite Communication: Manoj Mitra, Khanna Publishers
5. Radio Engineering :Mithal,Khanna Publishers
6. Digital Communications: V.K.Khanna S Chand Publishers.
7. Digital and Analog Communication System: K Sam Shanmugam

EE 010 706 L01: HVDC Transmission

Teaching scheme **Credits:** 4
2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart the basic concepts of HVDC Transmission systems and components*

Pre-requisites: *Fundamentals of Power Electronics*

Module I (13 hours)
Introduction: Comparison of AC, DC transmission – Description of DC transmission systems – Planning for HVDC transmission – Thyristor device characteristics and protection – Pulse number of converters – choice of converter configuration – Review of Graetz circuit – Valve rating – Transformer rating – Simplified analysis of Graetz circuit(without overlap and with overlap) – Converter bridge characteristics.

Module II (10 hours)
HVDC System Control: principles of DC link control – converter control characteristics – system control hierarchy – firing angle control – Current and extinction angle control – Higher level controllers – starting and stopping of DC link – power control

Module III (10 hours)
Converter faults and protection: types of faults – commutation failure – arc through, misfire and current extinction – protection against over currents – over voltages – surge arresters – protection against over voltages – smoothing reactors – DC line – transient over voltages in DC line – Protection of DC line – DC breakers

Module IV (12 hours)
Reactive power control: Steady state reactive power requirements – sources of reactive power – static VAR systems – Thyristor Controlled Reactor – Thyristor switched capacitor – Reactive power control during transients

Harmonics and filters: Generation of harmonics in HVDC systems – criteria of design for AC filters – types of AC filters – DC filters – Carrier frequency and radio interference noise

Module V (15 hours)
Multi-terminal DC systems: applications of MTDC systems – types – comparison – Control and protection

Modeling: Converter model – modelling of DC and AC networks

Text Books
1. HVDC Power Transmission Systems-Technology and System Interactions: K.R Padiyar, New Age Int'l.

Reference Books
1. Direct Current Transmission Vol 1: E.W Kimbark, Wiley
2. HVDC and FACTS controllers – Vijay K Sood – Kluwer Academic Publishers

EE 010 706 L02: Industrial Instrumentation

Teaching Scheme **Credits: 4**

Lecture 2 Hours Tutorial 2 Hours / Week

Objectives

- To describe the construction and operation of measurement and calibration instruments for pressure, level and temperature.
- To select a suitable measurement instrument for a given process measurement.
- To describe the installation procedure for a selected measurement instrument in a particular industrial situation, and correctly interpret measurements obtained.
- To provide latest knowledge of Industrial Instrumentation systems.

MODULE 1 [12Hours]

Displacement, Torque and speed measurement
Transducers-Classification- Measurement of displacement- Resistance potentiometer-Resistance Strain gauge-LVDT- Capacitive transducer-Piezoelectric transducer Measurement of force- Hydraulic force meter- Pneumatic force meter-Electric force transducer-Pressductor load cells- Measurement of torque- Inline rotating Torque sensor-Inline stationary Torque sensor- Proximity Torque sensor- Measurement of speed-Revolution counter-Resonance Tachometer-Eddy current tachometer- Tachometer Generators-D.C. Tachometer- Contactless Tachometer

MODULE 2 [12Hours]

Density, Viscosity and pH Measurement
Density Measurement- Types-Solid-Liquid-Gas- Magnetic methods-Vibrational methods-Weigh methods-Hydrometers-Radiation Densitometer- Refractometric Densitometer-Viscosity Measurement- Types-Capillary-Efflux cup-Rotational-Industrial-Applications of Viscometers- pH Measurement- Working Principle-Construction of electrodes-Glass electrode pH Measurement.

MODULE 3 [12Hours]

Level Measurement
Direct Methods-Hook type Level Indicator-Sight Glass- Float type- Displacer type Level Indicator- Indirect Methods-Hydrostatic pressure type- Pressure gauge Method- Air Bellows- Air purge system- Liquid purge system- Electrical Methods- Capacitance Level Indicator- Radiation Level Detectors- Laser level sensors-- Microwave Level switches-Optical Level Detectors- Ultrasonic Level Detectors- Eddy current Level Measurement sensors- Servicing of Level Measuring Instruments- Selection of Level sensors

MODULE 4 [12Hours]

Pressure Measurement

Different types of Pressure- Methods of Pressure Measurement-Manometers-Elastic Pressure Transducers- Measurement of vacuum- Force balance Pressure gauges- Electrical Pressure Transducers- Pressure switches- Calibration of Pressure Measuring Instruments- Maintenance and repair of Pressure Measuring Instruments-Troubleshooting

MODULE 5 [12Hours]

Temperature measurement

Thermocouple-RTD-Thermistor-LDR-Optical transducers Temperature scales-Methods of Temperature measurement- Expansion Thermometer **–** Filled system Thermometer- Electrical Temperature Instruments-Pyrometers-Fiber optic Temperature measurement systems- Ultrasonic Thermometer – Calibration of Thermometers- Temperature measurement considerations-

TEXT BOOKS

1. S K Singh , Industrial instrumentation and control, Tata McGraw Hill Publishing Ltd., New Delhi.
2. Arun K.Ghosh , Introduction to Measurements and Instrumentation , PHI Learning Private Limited , New Delhi.

REFERENCE BOOKS

1. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi.
2. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation – Dhanpat Raj and Sons, New Delhi
3. P.Holman, Experimental Methods for Engineers International Student Edition, McGraw Hill Book Company
4. B.C.Nakra and K.K.Chaudary, Instrumentation Measurement and Analysis, Tata McGraw Hill Publishing Company Ltd., New Delhi

EE 010 706 L03: Power Quality

Teaching scheme

Credits: 4

Lecture 2 hours and Tutorial 2 hours per week

Objectives

- *To impart the basic concepts of Power quality the various measures to improve power quality*

Module-1 (12 Hours)

Definition of **power quality**- power quality progression-power quality terminology –power issues- susceptibility criteria-cause and effects – treatment criteria-PQ weak links-interdependence – Stress-strain criteria –PQ Vs equipment immunity- classification of PQ issues-PQ measures and standards .

Module-2 (12 Hours)

Power frequency disturbances.

Introduction –Common power frequency disturbances- voltage sags-voltage swells

Cures for low frequency disturbances:- Isolation transformers- voltage regulators-static uninterruptible power source systems-Rotary uninterruptible power source units-voltage tolerance criteria. Conclusions

Module-3 (12 Hours)

Electrical Transients:-

Impulsive transients-oscillatory transients-transient system model.

Sources of transient over voltages:- Capacitor switching-magnification of capacitor-switching transients-Lightening –Ferro resonance- other switching transients-principles of over voltage protection- Devices for over voltage protection:- surge arresters and transient voltage surge suppressers- low pass filters- low impedance power conditioners- utility surge arresters. Switching transient problems with loads:- transients from load switching-transformer energizing :– Computer tool for transients analysis

Module-4 (12 Hours)

Harmonics:- Definition –harmonic distortion –voltage vs. current distortion- harmonics vs. transients .

Power system quantities under non sinusoidal conditions:- Active, reactive and apparent power- power factor- displacement and true harmonic phase sequences- triplen harmonics .Effects of harmonics on power system devices- THD,TIF ,DIN .

Module-5 (12 Hours)

Power Quality monitoring (basic ideas only needed)-Power quality measurements equipment:- Wiring & grounding testers-multimeters- Oscilloscope-disturbance analyzer-spectrum analyzer and harmonic analyzer-combination disturbance & harmonic analyzer-flicker meter-smart power quality monitors- transducer requirements.

TEXT BOOKS:

1. Surya Santoso, H Wayne Beaty, Roger C Dugan, Mark F McGranaghan, Electrical Power System Quality, McGraw Hill, 2002
2. C. Sankaran , Power Quality, CRC Press

REFERENCES

1 Fuchs,Power Quality in Power systems and Electrical Machines; Elsevier Publications, 2009

2.G T Heydt, Electric Power Quality, West Lafayette, Stars in a circle Publications,1991

3 Jose Arillaga and Newille R Watson, Power System Harmonics, John Wiely,2003

4. J Arrilaga Power System Quality Assessment, John Wiley,2000

5. Math H Bollen, Understanding Power Quality Problems, IEEE Press Standard Publishers, Delhi,2001

EE 010 706 L04 PLC Based systems

Teaching scheme **Credits: 4**

Lecture 2 hours and Tutorial 2 hours per week

Objectives

- *To impart the basic concepts of handling analog and discrete signal, by PLC for industrial automation using Ladder programming.*

Module I (12 Hours)

Configuration of PLC-Basic block diagram-Types of PLC- Open frame and Shoe box PLCs-Discrete and analog I/O voltage levels-scan time, and scan rate and Scan cycle. Central processing Unit, memory of PLC. Power supply to PLC – Interfacing I/O modules (module layout)
Electromechanical relay-NO and NC contacts-time delay relays- Delay On timer relay-Delay off timer relay. Realization of logic gates with relay contacts. AC motor control (ON/OFF) using contactors.

Module II (14 Hours)

PLC programming-Programming formats. Ladder diagram basics - rail, rung, sub rung, timer, contacts. Relation of digital gate logic to contact/coil logic. Process Scan-scan rate. Internal relays - Oscillators in PLC- simple examples. Process Scan-scan rate. Discrete I/O to PLC – Opto isolated inputs and outputs- Isolated inputs and non -isolated inputs. Output wiring- Relay outputs - solid state output with sinking and sourcing
Mnemonic based programming of PLC- simple examples.

Module III (12 Hours)

Registers – General characteristics- input, output and holding registers. PLC arithmetic functions- addition, subtraction, multiplication, division, square root, trigonometric and logarithmic functions. PLC timer functions- process timing applications. PLC counter functions. Shift register applications and sequencers in PLC.
Skip and Jump functions in PLC, Data move and FIFO functions. Bit operations- changing a register bit status.

Module IV (10 Hours)

Sensors – output classification-Connecting discrete sensors to PLC. Sensors of physical quantities- proximity sensors – Temperature sensors – Liquid level sensors – Force sensors – Pressure sensors – Flow sensors – Acceleration sensors – Rotating speed sensors - linear displacement sensors.

Module V (12 Hours)

Analog PLC operation – analog modules - voltage and current levels. PID control in PLC – Importance of Proportional , Derivative and Integral components - Tuning methods – Adjust and observe method , Ziegler-Nichols method , Auto tuning.
Networking of PLC – Distributed Control System(DCS) with PLCs. Speed control of DC and AC motors using PLC.

Text Books

1. Programmable Logic Controllers : John R. Hackworth, Pearson Education.
2. Programmable Logic Controllers – Principles and Applications : John W. Webb and Ronald A. Reis , PHI learning (Fifth edition)

Reference Books

1. Programmable Logic Controllers : Petruzella , Mc Graw Hill Publication (Third edition)
2. Programmable Logic Controllers – Principles and Applications : NIIT , PHI learning

3 .Programmable Logic Controllers- Bolton, Elsevier Publications,Fifth edition

EE 010 706 L05: MEMS Technology

Teaching scheme **Credits: 4**

Lecture 2 hours and Tutorial 2 hours per week

Objectives:

- Makes students conversant with unfamiliar concepts and practices that are needed to solve MEMS problems.
- Presents exciting new opportunities for students to become involved in specific application domain such as bio engineering, nanotechnology, optical engineering, power & energy, wireless communication, etc…

Module I (12 Hours)
Micro Electro Mechanical Systems (MEMS) : History of MEMS development – characteristics of MEMS.
Microfabrication – introduction – micro electro fabrication process – silicon based MEMS process – new materials and fabrication process.

Module II (12 Hours)
Electrostatic sensors and actuators – introduction – parallel plate capacitors – applications of parallel plate capacitors – interdigitated finger capacitors.
Thermal sensors and actuators – introduction - sensors and actuators based on thermal expansion – thermal couples – thermal resistors – applications.

Module III (12 Hours)
Piezoresistive sensors – origin and expression of piezoresistivity - piezoresistive sensor materials – applications of piezoresistive sensors.
Piezoelectric sensors and actuators – introduction – properties of piezoelectric materials – applications.
Magnetic actuation – introduction – essential concepts and principles – fabrication of micromagnetic components.

Module IV (12 Hours)
Micromachining and silicon anisotropic etching – introduction – anisotropic wet etching - dry etching of silicon – plasma etching – Deep reactive ion etching (DRIE) – isotropic wet etching.
Surface micromachining – basic surface micromachining process – structural and sacrificial materials – acceleration of sacrificial etch.

Module V (12 Hours)
Instruments for scanning probe microscopy – introduction – general fabrication methods for Tips – cantilevers with integrated Tips – SPM probes with sensors and actuators.
Optical MEMS – introduction – passive MEMS – optical components – actuators for active optical MEMS.

Text Book

1. Foundations of MEMS – Chang Liu (University of Illinois at urbana – chapaign)

Reference

1 .MEMS and MOEMS Technology and applications – P. Rai-Choudhury (PHI Learning Private Limited, New Delhi)

EE 010 706 L06: Special Electrical Machines

Teaching scheme **Credits: 4**

Lecture 2 hours and Tutorial 2 hours per week

Objective: *To introduce special types of electric machines and their applications.*

Module I (12 Hours)
Stepping Motors
Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control

Module II (12 Hours)
Switched Reluctance Motors
Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control.

Module III (12 Hours)
Synchronous Reluctance Motors
Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – Phasor diagram, motor characteristics.

Module IV (12 Hours)
Permanent Magnet Brushless DC Motors
Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers

Module V (12 Hours)
Permanent Magnet Synchronous Motors
Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics

REFERENCES

1. Kenjo T, Sugawara A, *Stepping Motors and Their Microprocessor Control*, Clarendon Press, Oxford, 1994.
2. Miller T J E, *Switched Reluctance Motor and Their Control*, Clarendon Press, Oxford, 1993.
3. Miller T J E, *Brushless Permanent Magnet and Reluctance Motor Drives*, Clarendon, Press, Oxford, 1989.
4. B K Bose, *Modern Power Electronics & AC drives*, Pearson, 2002.

EE 010 707: Electrical CAD

Teaching scheme **Credits:** 2

3 hours practical per week

Objective:

To develop skills in computer aided drafting of electrical machines and lay-out of various electrical installations.

Familiarization of CAD Environment- Creating files/folders- Naming of files/folders-Basic features of CAD software like AutoCAD, ProE, CATIA etc. Drafting and modelling- Setting the work space/work bench- 2D drafting/sketching- Status bar/tool bar settings.

Simple drawing commands: line, ray, arc, circle, spline, ellipse, polygon etc., text, text editing

Edit commands – cut, copy, paste…, **View commands**- zoom, pan, redraw, regen …,

Modify commands- erase, copy, mirror, offset, move, rotate, trim, extend, arrays….,
Object selection – Window, crossing, last, previous…

Preparation of 2D drawings -Dimensioning- Layer and block control, Block Editor, Dimension styles, Scaling, Editing Preparation of 2D drawings-X-ref- commands, Printing/ Plotting of drawings

Electrical CAD- Symbol libraries, Electrical User interface, icon menus, PCB drawing, Help system, Basic work flow, Project manager- opening, activating and closing projects

Drawing Examples- DC simplex Lap and Wave windings- Schematic wiring, Wires, Ladders, Wire numbering, Signal arrows…etc, Three phase ac double layer Lap winding and single layer Mush winding

Circuits- Multiple phase circuits, Electrical Schematic drawing of an 11kV indoor Sub-station, HT/LT panels with Circuit Breakers-Electrical Schematic drawings of MSB with supplies from a Transformer and Standby DG set, relays, indication lamps, metering etc.

Editing- Editing tools, Schematic symbols, Updating of blocks, Rail assembly.

Electrical Machine (2D) dimensioned drawings- Half sectional elevation and end view of Induction motor, Synchronous machine and DC machine.

Introduction to 3D (demonstration only)

References

1. Auto CAD reference manual (Release 2008 or later)
2. A text book computer aided machine drawing: S. Trymbaka Murthy
3. CAD/ CAM principle, practice and manufacturing management: Chris McMahon, Jimmie Browne

EE 010 708: Control And Simulation Laboratory

Teaching Scheme **Credits: 2**

3 hours lab per week

Objectives

1. *To impart knowledge in various aspects of control systems through experiments*
2. *To impart knowledge in the simulation of different systems*

PART A

1. Transfer function of armature controlled D.C. motor b) Field controlled D.C. motor.
2. Transfer function and characteristics of amplidyne.
3. Load characteristics of amplidyne under different levels of compensation.
4. Closed loop voltage regulation of separately excited D.C generator using amplidyne.
5. Characteristics of synchro pair and its transfer function
6. Closed loop feedback control system for D.C. servo motor with velocity feedback.
7. Level process control/ Temperature process control using PI, PD and PID control.
8. Transfer function and characteristics of A.C. servomotor.
9. Closed loop performance of inverted pendulum.
10. Open loop control of stepper motor using microprocessor.

PART B

1. Step response and computation of time-domain specifications of typical second order systems using MATLAB.
2. Frequency response and computation of frequency -domain specifications of typical second order systems using MATLAB.
3. Design of lag compensator using MATLAB. Verification of the frequency response characteristics of the designed compensator using passive elements.
4. Design of lead compensator using MATLAB. Verification of the frequency response characteristics of the designed compensator using passive elements.
5. Design of PD,PI and PID controllers for conceptual systems using MATLAB/LabView.
6. State variable analysis of inverted pendulum using MATLAB.
7. Simulation of models(Transfer function and state –space) of conceptual systems using SIMULINK/Lab View.
8. Simulation and analysis of non-linear and discrete time systems using SIMULINK.

9. Analysis of D.C and A.C circuits using PSpice(for independent sources and dependent sources).
10. Analysis BJT/MOSFET circuits using PSice.

References:

1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems,Eleventh Edition, Pearson Educatio,n2009.
2. Katsuhiko Ogatta, Modern Contro Engineering,Fourth Edition, Pearson Education,2002.
3. Muhammad H. Rashid, Introduction to PSpice Using Orcad for Circuits and Electronics, Third Edition,PHI2009.
4. R.K. Bansal,A.K. Goel,M.K Sharma,MATLAB and Its Application in Engimneering, Second edition, Pearson,2010.

EE 010 709 Seminar

Teaching scheme **credits: 2**

2 hours practical per week

The seminar power point presentation shall be fundamentals oriented and advanced topics in the appropriate branch of engineering with references of minimum seven latest international journal papers having high impact factor.

Each presentation is to be planned for duration of 25 minutes including a question answer session of five to ten minutes.

The student's internal marks for seminar will be out of 50. The marks will be awarded based on the presentation of the seminar by the students before an evaluation committee consists of a minimum of 4 faculty members. Apportioning of the marks towards various aspects of seminar (extent of literature survey, presentation skill, communication skill, etc.) may be decided by the seminar evaluation committee.

A bona fide report on seminar shall be submitted at the end of the semester. This report shall include, in addition to the presentation materials, all relevant supplementary materials along with detailed answers to all the questions asked/clarifications sought during presentation. All references must be given toward the end of the report. The seminar report should also be submitted for the viva-voce examination at the end of eighth semester.

For Seminar, the minimum for a pass shall be 50% of the total marks assigned to the seminar.

EE 010 710 Project Work

Teaching scheme **credits: 1**

1 hour practical per week

Project work, in general, means design and development of a system with clearly specified objectives. The project is intended to be a challenge to intellectual and innovative abilities and to give students the opportunity to synthesize and apply the knowledge and analytical skills learned in the different disciplines.

The project shall be a prototype; backed by analysis and simulation etc. No project can be deemed to be complete without having an assessment of the extent to which the objectives are met. This is to be done through proper test and evaluation, in the case of developmental work, or through proper reviews in the case of experimental investigations.

- The project work has to be started in the seventh semester and to be continued on to eighth semester.
- Project work is to be done by student groups. Maximum of four students only are permitted in any one group.
- Projects are expected to be proposed by the students. They may also be proposed by faculty member (Guide) or jointly by student and faculty member.
- Students are expected to finalise project themes/titles with the assistance of an identified faculty member as project guide during the first week of the seventh semester.

The progress from concept to final implementation and testing, through problem definition and the selection of alternative solutions is monitored. Students build self confidence, demonstrate independence, and develop professionalism by successfully completing the project.

Each student shall maintain a project work book. At the beginning of the project, students are required to submit a project plan in the project book. The plan should not exceed 600 words but should cover the following matters.

- ❖ Relevance of the project proposed
- ❖ Literature survey
- ❖ Objectives
- ❖ Statement of how the objectives are to be tackled

- Time schedule
- Cost estimate

These proposals are to be screened by the evaluation committee (EC- minimum of 3 faculty members including the guide) constituted by the head of department, which will include a Chairman and the EC will evaluates the suitability and feasibility of the project proposal. The EC can accept, accept with modification, request a resubmission, or reject a project proposal.

Every activity done as part of project work is to be recorded in the project book, as and when it is done. Project guide shall go through these records periodically, and give suggestions/comments in writing in the same book.

The students have to submit an interim report, along with project work book showing details of the work carried out by him/her and a power point presentation at the end of the 7^{th} semester to EC. The EC can accept, accept with modification, request a resubmission, or extension of the project.

The student's internal marks for project will be out of 50, in which 30 marks will be based on day to day performance assessed by the guide. Balance 20 marks will be awarded based on the presentation of the project by the students before an evaluation committee consists of a minimum of 3 faculty members including the guide.

For Project, the minimum for a pass shall be 50% of the total marks assigned to the Project work.

EE 010 801: Power System Analysis

Teaching scheme **Credits: 4**
2 hours lecture and 2 hour tutorial per week

Objectives

- *To develop understanding about the techniques for analysing power systems*

Module I (15 Hours)

Power System Representation: Single phase solution of balanced three phase networks – single line diagram – impedance diagram – per unit system – transformer model – synchronous machine representation – representation of loads
Load flow studies: Network model formulation – formation of Y Bus by singular transformation – Load flow problem – Gauss Siedel Method – Newton Raphson method – Decoupled load flow methods – control of voltage profile by generators and transformers

Module II (11 Hours)

Economic Load Dispatch: System constraints – Economic dispatch neglecting losses – optimal load dispatch including transmission losses – physical interpretation of co ordination equations – exact transmission loss formulae – modified co ordination equation – automatic load dispatching – unit commitment.

Module III (10 Hours)

Automatic generation and voltage control: Single area Load frequency control – model of speed governing system – turbine model – generator model – load model – block diagram of load frequency control – steady state analysis – dynamic response – proportional plus integral control – two area load frequency control – area control error – automatic voltage control – load frequency control with generation rate constraints – speed governor dead band and its effect on automatic generation control.

Module IV (12 Hours)

Short circuit analysis: Transient on a transmission line – short circuit of a synchronous machines without and with load – selection of circuit breakers – algorithm for short circuit studies – Z Bus formulation – symmetrical components – phase shift in star delta transformers – sequence impedances of transmission lines, transformers and synchronous machines – sequence networks of a power system
Unsymmetrical faults – analysis of single line to ground, line to line and double line to ground faults in power system – analysis of unsymmetrical fault using Z bus.

Module V (12 Hours)

Stability: Dynamics of synchronous machine – power angle equation – node elimination technique – steady state stability – transient stability – equal area criterion – numerical solution of swing equation – multi machines stability – factors affecting transient stability

Text Books

1. Modern Power system Analysis: D P Kothari and I J Nagrath, Tata McGraw Hill
2. Electrical Power Systems: C. L. Wadhwa, New Age Int'l

Reference Books

1. Advanced Power System Analysis and Dynamics – L P Singh – New Age Intl.
2. Computer Techniques in Power System Analysis – M A Pai – Tata McGraw Hill
3. Power System Operation and Control: S Sivanagaraju, G Sreenivasan, Pearson Ed.
4. Power System Analysis: Bergen, Pearson Ed.
5. Power System Analysis: William D Stevenson Jr, John J Grainger, Tata McGraw Hill
6. Power System Analysis: Hadi Saadat, Tata McGraw Hill

EE 010 802: Switchgear and Protection

Teaching scheme **Credits: 4**

2 hours lecture and 2 hours Tutorial per week

Objectives

- *To develop the understanding of protection in power systems.*

Module I (12 hours)

Switch Gear: Definition And Terminology, Protective Gear and Control Gear, Basics of Switch Gear-Contactors, Isolators, Fuses, Earthling switches and Circuit Breakers

Circuit Breakers: Insulating fluid ,Properties of insulating and arc quenching medium ,initiation of arc in circuit breakers, arc interruption , current chopping and resistance switching, capacitive current breaking, restriking and recovery voltage, main parts of a circuit breaker, Rating of alternating current circuit breakers, DC circuit breakers. Bulk oil circuit breakers – Minimum Oil circuit breakers -Vacuum circuit breakers- SF6 Gas circuit breakers constructional details, principle of operation advantages and disadvantages

Module II (12 hours)

Structure of a power system, protective zone, primary and back up protection, basic requirements, protective schemes. Classification of protective relays –Induction relays – operating principle- constructional details and characteristics, thermal relays, transducer relays, electronic relays, classification based on function.

Protective schemes-over current relaying, instantaneous over current relays, time delayed relays ,definite time over current relays ,inverse time over current relays, IDMT relays and relay coordination .Differential relays circulating current differential relays and voltage balance differential relays, Biased percentage differential relays. Directional over current and directional power relays. Distance relays –Impedance relays –reactance relays and mho type relays- theory and applications.

Module III (12 hours)

Static relays –static relay components-static over current relays -static distance relays,-static differential relays – static earth fault relays-static polyphase relays

Microprocessor based relays- over current, earth fault, impedance, reactance and Mho relay-Application of microprocessor based relays. Relay testing

Module IV (12 hours)

Generator protection – faults in generators –stator protection –rotor protection –miscellaneous protections .Conventional protection of generators. Motor Protection –stator protection- rotor protection – overload protection –unbalance and single phasing protection-under voltage and reverse phase protection-protection for loss of synchronism

Transformer protection-Faults in transformers-differential protection –over current and earth fault protection –Bucholz relay. Protection of feeders - Radial feeders-parallel feeders - ring mains-differential pilot protection –Merz price protection –Translay system. Protection of transmission lines-definite time and time –distance protection-phase and earth fault protection-carrier current protection

Module V (12 hours)

Over voltages in power systems –Power frequency over voltages-Switching over voltages causes of over voltages

Protection against over voltages- surge arrestors .Wave propagation in Transmission lines and cables- transmitted and reflected waves-surge impedance. Insulation coordination

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Switch Gear and Power system Protection :Ravindra P Singh, Tata Mc Graw Hill
2. Switch Gear and Power System Protection : Badri Ram D N Viswakarma, Tata Mc Graw Hill

Reference Books

1. Power System Protection and Switchgear: Ravindranath and Chander, New Age Int'l
2. Electrical Power Systems: C. L. Wadhwa, New Age Int'l
3. A Course in Electrical Power Systems: Sony, Gupta, Bhatnagar
4. Elements of Power System Analysis: William D. Stevenson, Tata Mc Graw Hill
5. Traveling Waves on Transmission Systems: Bewsley L. V.
6. Power System Protection: M. A Date, B. Oza and N.C Nair, Bharati Prakashan New Age International

EE 010 803: Electrical System Design

Teaching scheme **Credits: 4**

3 hours Lecture and 2 hours Tutorial per week

Objectives

- *Design of Electrical machines and transformers for the given specifications*
- *To impart sound knowledge in the design and estimation of electrical installations.*

Module I (18 Hours)

Design of D.C Machines:

Magnetic system- Carter's coefficient – real and apparent flux density. Design specifications – output equation – output Coefficient – specific loadings – choice of speed and number of poles – calculation of D and L – Armature design – choice of type of winding – number of slots –number of conductors per slot – current density – cross sectional area – slot insulation – length of air gap – field winding design – field ampere turns – excitation voltage per coil – conductor cross section – height of pole.

Module II (16 Hours)

Transformers: Design – single phase and three phase – output equation – specific magnetic loading – core design – single, stepped core - windings – number of turns – current density – area of cross section of conductors – types of coils – insulation – window area – window space factor – overall dimensions-heating, cooling and temperature rise calculation – continuous, short time and intermittent rating– design of cooling tank with tubes – design of small transformers like 230V/6-0-6V.

Module III (11 Hours)

Design of Synchronous Machines: Specific loading – output equation – output coefficient – main dimensions – types of winding – design of field system – turbo alternator – main dimensions – stator design – rotor design – damper winding design – comparison of water wheel and turbo alternators.

Design of three phase Induction motors: output equation – output coefficient –main dimensions – rotor bar currents.

Module IV (15 Hours)

General awareness on standards of Bureau of Indian Standards (BIS) with special reference to (1) Code of Practice for Medium Voltage Installations I.S .732, (2) Code of Practice for Earthing I.S.3043, National Electrical Code, Bureau of Energy Efficiency (BEE) and its labelling. Electrical wiring layout of a small residential building and preparation of schedule of quantity of materials, Preparation of basic electrical schemes and layout drawings of a high-rise building , Commercial building with rising main distribution to upper floors, Basic design and layout of cinema theatres, Basic illumination design of a small seminar hall with fluorescent lamps

Module V (15 Hours)

Selection of transformer and standby generator for High Tension consumers having one large capacity motor and many small motors. Basic design and preparation of single line diagram and layout drawings of an HT industrial consumer with a) outdoor and b) indoor 11kV substation. Layout and estimation of over head and under ground power distribution system. Design of earthing system for an HT consumer, Dimensions and drawings of typical earth electrodes (1)Pipe Earthing, (2)Plate Earthing. Touch, Step and Transfer potentials at EHT Sub-Stations, Earth-mat, installations of special equipment like X-Ray, Neon-Sign.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Electrical Machine Design- A. K. Sawhney & A. Chakrabarthi.Dhanapat Rai &Sons
2. Electrical Design Estimating and costing.- Raina & Bhatacharya, Wiley Eastern Limited, New Delhi,
3. Electrical system Design: M K Giridharan ,I K International Publishing House Pvt.Ltd, Bangalore.

Reference Books

1.Design &Testing of electrical machines: Deshpande, Wheeler Publishing
2.Design of Electrical Machines: V N Mittle

Note: Relevant codes/ Data Sheets may be permitted for examinations

EE 010 804 L01 : ADVANCED POWER SYSTEM

Teaching Scheme **Credits:4**

2 hours lecture & 2 hours tutorial per week

Objectives

* To introduce a number of engineering and economic matters involved in planning, operating and controlling power generation and transmission systems in electric utilities.
* To introduce students to the important "terminal" characteristics for thermal and hydro electric power generation systems.

Module 1 (12 Hours)

Load frequency control-Necessity of maintaining frequency constant- Basic Generator control Loops-Load Frequency Control (Single Area Case)-Turbine Speed Governing System-Model of Speed Governing System-Turbine Model-Generator-Load Model-Block Diagram model of LFC-Steady State Analysis-Dynamic Response-Control Area Concept-Proportional Plus Integral Control-Two area Load Frequency Control-ACE

Module 2 (10 Hours)

Unit Commitment- Constraints in Unit Commitment- Spinning Reserve-Thermal Unit Constraints- Other Constraints- Unit Commitment Solution Methods-Priority List Methods-Dynamic Programming Solution.

Module 3 (14 Hours)

Hydrothermal Coordination-Long Range and Short Range Hydro-Scheduling-Hydro-Electric Plant Models-Scheduling Problems-Scheduling Energy-The short-term Hydro-thermal Scheduling Problem-Short Term Hydro-Scheduling: A Gradient Approach-Hydro –units in series-Pumped Storage Hydro plants- Pumped Storage Hydro-Scheduling by λ-γ iteration and gradient method-Dynamic Programming solution to the Hydrothermal scheduling Problem-Dynamic –Programming solution to Multiple Hydroplant problem.

Module 4 (12 Hours)

Interchange of Power and Energy-Advantages of interconnected system-Economy interchange between interconnected utilities-Inter utility-Economy Energy Evaluation-Interchange Evaluation with Unit Commitment-Multiple-Utility Interchange Transactions-Wheeling-Other Types of Interchange-Power Pools-The Energy –Broker System-Centralized Economic Dispatch of a Power Pool-Allocating Pool savings

Module 5 (12 Hours)

Power system Security-Functions of System Security-SCADA-Factors affecting Power System Security-Contingency Analysis: Detection of Network Problems-An overview of Security

Analysis-Linear Sensitivity Factors-Calculation of Network Sensitivity Factors-AC Power Flow Methods-Contingency Solution-Concentric Relaxation-Bounding

Text Books

1. Power Generation Operation and Control –Allen J Wood & Bruce F Wollenberg

2. Power System Engineering –I.J.Nagrath &D.P.Kothari

Reference Books

1. Power System Analysis –Arthur R Bergen &Vijay Vittal

2. Elements of Power System Analysis- William D Stevenson

3. Power System Operation and Control- S.Sivanagaraju & G.Sreenivasan

EE 010 804 L02: COMPUTER NETWORKS

Teaching Scheme

2 hours lecture and 2 hours tutorial per week **Credits-4**

Objectives:

- *To provide knowledge in the specific area of computer networking and the Internet.*
- *To expose students to technological advances in computer communications.*

Module 1 (12 Hours)

Introduction: Goals and applications of networks - Network Topologies: Broadcast - Point to point - bus, star, ring, tree - Types of network : LAN, MAN, WAN -OSI reference model - TCP/IP reference model - Client server computing. **Physical layer** - Transmission media: Guided media – wireless. Packet switching – telephone and cable network in data transfer(basic concepts) : dial-up connection – DSL- cable TV data transfer.

Module 2 (12 Hours)

Data link layer: Services - Data framing - Error handling – Detection and correction codes: Parity check, Hamming code, CRC, Checksum -Data link protocols: Stop and wait protocol, Sliding window protocol(basic concepts only) - data link layer in the Internet- SL1P/PPP.

Module 3 (12 Hours)

Medium access sub layer: Channel allocation - static vs dynamic channel allocation - CSMA protocol - collision detection - wireless LANs – collision avoidance- IEEE 802 standards - Ethernet - Token bus -Token ring – wireless

Module 4 (14 Hours)

Network layer: services - Routing - congestion control - internetworking - Principles - Gateways - Host - backbone network - Network layer in the Internet - IP protocol - IP address - Internet control protocols.
Transport layer: Services - Internet Transport protocols - TCP and UDP.

Module 5 (10 Hours)

Application layer: Services - Network security - Cryptography - DNS - Name servers -. Internet services: E-mail - FTP -TELNET - WWW - Network Management concepts.

Text Books:

1. Computer Networks - Tanenbaum, Pearson Education Asia
2. Data communication and networking – Forouzan, Tata McGraw Hill

References:

1. Data and computer communications - William Stalling, Pearson Education Asia
2. Data Communication, Computer networks - F. Halsall, Addison Wesley and open systems
3. Computer Networks, A system approach - Peterson & Davie, Harcourt Asia
4. The Internet Book- Douglas E. Comer, Pearson Education Asia
5. Internet Complete Reference - Harley Harn Osborne

EE 010 804 L03: Generalized Machine Theory

Teaching Scheme
2 hours lecture & 2 hours tutorial per week **Credits:4**

Objective

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

Module I (12 Hours)
Introduction
Unified approach to the analysis of Electrical Machines-Basic two pole model of rotating machines-Kron's primitive machine-voltage, power and torque equation-Linear transformation from 3-phase to 2-phase and from rotating axes to stationary axes-invariance of power

Module II (10 Hours)
DC Machines
Application of generalized theory to separately excited, shunt, series and compound machines-steady state and transient analysis-sudden short circuit of separately excited generator

Module III (14 Hours)
Poly-phase Synchronous Machines
Generalized machine equations-steady state analysis of salient pole and non-salient pole machines-phasor diagrams-power angle characteristics-reactive power-short circuit ratio transient analysis -sudden three phase short circuit at generator terminals-reactance-time constants-transient power angle characteristics damping and synchronizing torques in small oscillation stability analysis - application of small oscillation models in power system dynamics.

Module IV (14 Hours)
Induction Machines
Representation of Induction machine using
Generalized machine theory - Formation of general equations - three phase induction motor - equivalent two phase machine by m.m.f equivalence-voltage equation-steady state analysis-equivalent circuits-torque slip characteristics-effect of voltage and frequency variations-electric transients in induction machines-speed control of induction motor-introduction to vector control-applications in speed control of induction machine

Module V (10 Hours)
Representation of single phase Induction motor using Generalized machine theory - Formation of general equations,-voltage and torque equation-steady state analysis

Text Book

Generalised Machine Theory: P S Bimbhra

EE 010 804 L04: FEM Applications in Electrical Engineering

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of numerical methods applied for analysis of electromagnetic fields*
- *To develop understanding about Finite element analysisand its applications for electrical machine analysis.*

Pre-requisites

- EE 010 404 Electromagnetic Filed Theory
- EE 010 702 Synchronous Machines

Module 1 (12 Hours)

Electromagnetic fields-General Overview-Maxwell's equation-constitutive relationships and continuity equations-Laplace, Poisson and Helmholtz equation-Overview of computational methods in electrostatics

Module 2 (12 Hours)

Basic principles of Finite element method- Introduction-Classical Methods for field problem solutions-The classical residual method (Galerkin's method)-The classical Rayleigh-Ritz's method– The finite element method-Partition of the domain-Choice of the interpolating function-formulation of the system-solution of the problem.

Module 3 (10 Hours)

Analysis of 2D fields using FE method-.Reduction of field problem to a 2D problem-Boundary conditions-Dirichlet's ,Neumann's and periodic conditions-Discretization-Assembly.

Module 4 (12 Hours)

FE Analysis of Electromagnetic devices: Equivalent electric circuit of single phase transformer-computation of no load inductance –computation of magnetic flux density-main flux-flux linkage-magnetic energy-self and mutual inductance-Estimation of iron losses.

Module 5 (14 Hours)

FE analysis of rotating electrical machines: synchronous generator-computation of no load characteristics –computation of Ld, Lq -saturation effect-computation of machine characteristics 3phase induction motors: Equivalent circuit-no load and blocked rotor test of motor -motor analysis using FEA under load-Non linearity of magnetic materials-computation of torque.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

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

Text Book:

1. Electrical Machine Analysis using finite elements-Nicolas Bianchi-CRC Press.
2. Numerical Methods in Electromagnetism:M.V.T .Chari, S.J.Salon-Academic Press

References:

1. The performance and Design of AC Machines: M.G. Say, Cbs Publishers
2. Theory of Alternating Current Machinery: Alexander Langsdorf, Tata Mgraw Hill
3. A course in Electrical Engg. Vol.2: C.L Dawes, McGraw- Hill Book Company inc.
4. Electromagnetics- John D Krauss McGrow Hill International
5. Finite elements analysis of Electrical Machines-Sheppard J.Salon - Khuwer International Series
6. Introduction to FE method-Erik G Thomson-Wiley India(P) Ltd
7. Finite element analysis-George R Buchanan-Schaum's Series- McGrow Hill Companies

EE 010 804 L05: Digital Signal Processors

Teaching Schedule:
2 hour Lecturer and 2hour Tutorial / week **Credits-4**

***Objectives* :**
To introduce the students to various techniques of digital signal processing and the basic architecture of digital signal processors

Module I (12 Hours)
Fundamentals of Programmable DSPs
Multiplier and Multiplier accumulator, Modified Bus Structures and Memory access in P-DSPs, Multiple access memory, Multi-ported memory, VLIW architecture, Pipelining, Special addressing modes in P-DSPs, On-chip Peripherals, Computational accuracy in DSP processor

Module II (12 Hours)
ADSP Processors

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors

Module III (12 Hours)
TMS320C5X Processor
Architecture, Assembly language syntax, Addressing modes, Assembly language instructions, Pipeline structure, Operation Block Diagram of DSP starter kit, Application Programs for processing real time signals.

Module IV (12 Hours)
Programmable Digital Signal Processors

Data Addressing modes of TMS320C54XX DSPs, Data Addressing Modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, On-chip peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors.

Module V (12 Hours)
Advanced Processors
Code Composer studio, Architecture of TMS320C6X, Architecture of Motorola DSP563XX, Comparison of the features of DSP family processors.

Text Book

1. Digital Signal Processors, Architecture, Programming (*B. Venkata Ramani and M. Bhaskar*) TMH 2004.

Reference Books

1. DSP Implementation using DSP microprocessor with Examples from TMS32C54XX (*Avtar Singh, S. Srinivasan*) Thamson2004
2. Digital signal Processing A Practical approach (*E.C. Ifeachor and B. W. Jervis*) Pearson Publication
3. Digital signal Processing (*Salivahanan Ganapriya*) TMH, second Edition
4. DSP Processor Fundamentals. Architecture and Features (*Lapsleyetal*) S. Chand & co. 2000.
5. Digital signal Processing (*Jonathen Stein*) John Wiley 2005
6. Digital signal Processing (*S. K. Mitra*) Tata McGraw-Hill Publication, 2001.

Mahatma Gandhi University

EE 010 804 L06: Optoelectronics

Teaching Schedule:
2 hour Lecturer and 2hour Tutorial **Credits-4**

Course Objectives :

Optical fibres have become an enabling technology in the information system.
This course gives basic ideas of design, operation & capabilities of fibre system.
Also new technological advances in fibre optic communication are discussed.

Module I (12 Hours)
Optical fibre wave guides-Review of ray theory-Electromagnetic mode theory-Phase and group velocity-Modes-guided, radiative and leaky modes-'V' number-cut off wave length-Step index and graded index fibres-Parameters of optical fibre-problems.
Signal degradation in fibres-Attenuation-Absorption loss-Linear and nonlinear scattering loss-Fibre bend loss-Dispersion mechanisms-Intramodal and intermodal dispersion-Expressions-modal noise-overall dispersion in single mode/multimode fibres-problems-mode coupling.

Module II (14 Hours)
Optical sources-Light emitting diodes- P N junction characteristics- Direct and Indirect band gap materials- Spontaneous emission- Carrier concentration variation in n+p junction- carrier life time-Diffusion coefficient- Diffusion length- Injection efficiency- internal Quantum efficiency-Power internally generated- Overall efficiency of LED- problems- Heterojunction LEDs – Advantages- LED modulation- Electrical and Optical Bandwidth- LED structures-ELEDs and SLEDs-LED characteristics-Effect of temperature- LED Drive Circuits.

LASER diodes- Spontaneous Vs Stimulated emission-Einstein's relation-population inversion-cavity resonance and threshold gain-Laser modes-stimulated emission in PN junction-Rate equation-condition for lasing-Laser diode characteristics-Modulation-frequency chirp-Heterojunction LASER-LASER structures-LED Vs LASER diodes.

Module III (12 Hours)
Optical Detectors and Fibre optic link- Requirements for Detectors-Intrinsic and extrinsic absorption responsivity-cut off wave length-Quantum efficiency- classification of detectors-Photodiodes-PN junction photo diode-PIN photodiode- response and noise- APDs –Advantages of APD- APD Bandwidth and noise-Phototransistor-parameters of phototransistor-problems-Detector performance parameters-noises-NEP

Power launching and coupling- source to fibre coupling-joints- fibre to detector coupling- losses-fibre splicers, connectors and couplers-types-Fibre optic link-System considerations-link power budget-rise time budget-Link Design

Module IV (10 Hours)
Fibre optic receivers-Block schematic- Data patterns-noice in receivers-Speckle noise-Reflection noise-Receiver Circuit –pre amplifier-high impedance and transimpedance amplifier-equalization and sensitivity.

Regeneration- inter symbol interference- Filter characteristics- Eye diagram- Effect of amplifier and thermal noise- noise penalty in a practical system.

Module V (12 Hours)

Advanced system technology-Optical amplifiers-Raman and Erbium doped optical amplifiers-noises-Wave length Division Multiplexing(WDM) and components-Optical network-wave length routed networks.

Fibre optic sensors-classification-Fibre bragg gratings for strain and temperature sensors-displacement sensor-optical computing concepts-optical logic gates.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Optical communication Systems-John Gower-PHI
2. Optical fibre Communication Systems-Principles and practice-John M. senior-Pearson
3. Optoelectronics devices and system-Dr. S. C. Gupta-PHI

Reference Books

1. Optical fibre Communication-Keiser Gerd, Mc Graw Hill
2. Fibre optic communication system-Agarwal G. P., John Wiley & Sons
3. Fibre optic communications-Harold Kolimbiris-Pearson
4. Fibre optic communications-Joseph C. Palais-Pearson
5. Fibre optic communication – M. Nagabushaan, L. Satishkumar-Denett & Co.

EE 010 805 G01: Soft Computing Techniques
(Global Elective)

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

Objectives

- *To introduce the ideas of neural network, fuzzy logic,genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations.*
- *To introduce the techniques of soft computing systems which differ from conventional AI and computing in terms of its tolerance to imprecision and uncertainty.*

Module I (12 Hours)
Fundamentals of ANN – Biological prototype – Neural Network Concepts, Definitions - Activation. Functions – single layer and multilayer networks. Training ANNs – Supervised and unsupervised network.
Perceptrons – Exclusive OR problem – Linear seperability – perceptron learning - perceptron training algorithms.The back propagation Neural network – Architecture of the back propagation Network – Training algorithm –Network paralysis _ Local minima – temporal instability.

Module II (12 Hours)
Unsupervised learning-Competitive Network-Winner take all policy .Network initialization and weight adjustment.Geometric interpretation. Associative memory -ART NETWORKS – Bidirectional Associative memories- retreiving stored information.
Neuro Control System-Classical controls-neuro control –Basic identification scheme using nn-Forward modelling: Series -parallel identification.Non linear system identification-Direct inverse neuro control scheme with ANNI and ANNC.Adaptive neuro control.

Module III (12 Hours)
Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

Module IV (12 Hours)
Introduction to Genetic Algorithm. Simple Genetic Algorithm and its major operators: Reproduction, Crossover, Mutation etc. Mathematical Construction of Genetic Operators. Tunning of membership function using genetic algorithm.

Module V (12 Hours)
Application of neural network for load forcasting, image enhancement, signal processing, pattern recognition.
Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.
Application of GA to neural network Tuning of controllers, Electric drives and Power System.
Introduction to MATLAB Neural network tool box, Fuzzy tool box and Genetic programming (Basic Treatment Only)

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) , One assignment must be based on MATLAB Programming for any application of neural network, Fuzzy and GA tool.(Only Basic Treatment expected)
20% - Regularity in the class

Text Books

1. Philip D.Wasserman, *Neural Computing(Theory and Practice*)
2. J.Zuradha,Introduction to Artificial Neural System
3. S. Rajasekaran and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic algorithms, PHI, 2003.
4. *Kalyanmoyi Deb,Multi-Objective Optimization using Evolutionary Algorithms,Wiley,2001*

Reference Books

1. Timothy J. Ross, " Fuzzy Logic With Engineering Applications", McGraw-Hill Inc. 1997
2. Linus Fe, *Neural Network in Computer Intelligence* , McGrawHill
3. J.S.R.Jang, C.T.Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 2007.
4. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2001.
5. T.Mitchel, Machine Learning,McGrawHill, 1997.
6. **Reeves**, Colin R., **Rowe**, Jonathan E.Genetic Algorithms - Principles and Perspectives,Springer,2002

EE 010 805 G02: Intellectual Property Rights

(Global Elective)

Teaching scheme **Credits:4**

2 hour lecture and 2 hour tutorial

Objectives

1. *To appreciate the concept of Intellectual Property and recognize different kinds of Intellectual Property*
2. *To appreciate the rationale behind IP and underlying premises*
3. *To know the position of IP under the constitution of India*

Module 1(12 Hours)

Concept of intellectual property – different types of IP-Rationale behind Intellectual property-Balancing the rights of the owner of the IP and the society – Enforcement of IPRs – IP and constitution of India.

Module 2 (12 Hours)

World intellectual Property Organization (WIPO) – WTO/TRIPS Agreement – India and the TRIPS Agreement – Patent law in India –Interpretation and implementations – Transitional period.

Module 3 (12 Hours)

Patent system – Patentable Invention – Procedure for obtaining patent – Rights of a patentee – Limitations on Particular's Rights – Revocation of patent for Non – working Transfer of patent – Infringement of patent.

Module 4 (12 Hours)

Indian Designs Law – Meaning of Design Registration and Prohibitions – Copyright in Designs – Piraiy of Design and Penalities – Steps for foling an Application – Copyright law in India –Owner of the copyright – Rights of Broad Casters and Performers – Registration of Copyright – Assignment, Licensing and Transmission – Infringement – International Copyright and Copyright Societies

Module 5 (12 Hours)

Trade Mark Law in India – Functions of a Trade Mark – Registration of Trade Mark Exploiting Trade Mark – Infringement –Offenses and Penalties – Indian Trade Mark Act 1999; salient features. Geographical Indications – Registration of Geographical Indication – Term and Implication of Registration – Reciprocity and Prohibition on Registration.

Text books

1. Jayasree Watal **-Intellectual Property Rights:** In the WTO and Developing Countries -Oxford University Press
2. V.Sarkar-Intellectual Property Rights and Copyright- ESS publications

References

1. R..Anita Rao and Bhanoji Rao - Intellectual Property Rights –Eastern Book Company

2. Arthur R Miller and Michael H Davis – Intellectual Property in a Nutshell: marks patents, Trade and Copy Right

3. Richard Stim - Intellectual Property marks patents, Trade and Copy Right – Cangage Learning
4. Christopher May and Susan K Sell - Intellectual Property Rights –A critical History - Viva Books

Mahatma Gandhi University

EE 010 805 G03 Advanced Mathematics

(Global Elective)

Teaching Schedule: **Credits: 4**

2 hour Lecturer and 2 hour Tutorial/week

Module 1 (12 Hours)
Green's Function
Heavisides, unit step function – Derivative of unit step function – Dirac delta function – properties of delta function – Derivatives of delta function – testing functions – symbolic function – symbolic derivatives – inverse of differential operator – Green's function – initial value problems – boundary value problems – simple cases only

Module 2 (12 Hours)
Integral Equations
Definition of Volterra and Fredholm Integral equations – conversion of a linear differential equation into an integral equation – conversion of boundary value problem into an integral equation using Green's function – solution of Fredhlom integral equation with separable Kernels – Integral equations of convolution type – Neumann series solution.

Module 3 (12 Hours)
Gamma, Beta functions
Gamma function, Beta function – Relation between them – their transformations – use of them in the evaluation certain integrals – Dirichlet's integral – Liouville's extension of Dirichlet's theorem – Elliptic integral – Error function.

Module 4 (12 Hours)
Power Series solution of differential equation
The power series method – Legendre's Equation – Legendre's polynomial – Rodrigues formula – generating function – Bessel's equation – Bessel's function of the first kind – Orthogonality of Legendre's Polynomials and Bessel's functions.

Module 5 (12 Hours)
Numerical solution of partial differential equations
Classification of second order equations- Finite difference approximations to partial derivatives – solution of Laplace and Poisson's equations by finite difference method – solution of one dimensional heat equation by Crank – Nicolson method – solution one dimensional wave equation.

Text Book.

S.S Sasthri, "Introductory methods of Numerical Analysis",Prentice Hall of India.

References

1. Ram P.Kanwal, Linear Integral Equation, Academic Press, New York.
2. Allen C.Pipkin, Springer, A Course on Integral Equations, Verlag.
3. H.K.Dass, Advanced Engg. Mathematics, S.Chand.

4. Michael D.Greenberge, Advanced Engg. Mathematics, Pearson Edn. Asia.
5. B.S.Grewal, Numrical methods in Engg.&science, Khanna Publishers.
6. R.F. Hoskins, Generalized functions, John Wiley and Sons.
7. Bernard Friedman, Principles and Techniques of Applied Mathematics, John Wiley and sons
8. James P.Keener, Principles of Applied Mathematics, Addison Wesley.
9. P.Kandasamy, K.Thilagavathy, K.Gunavathy Numerical methods, S.Chand & c

EE 010 805 G04 Virtual Instrumentation
(Global Elective)

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

Objectives

- *To impart the basic concepts of Graphical coding using LabVIEW*
- *To develop understanding about graphical programing and dynamic system control using tool boxes of LabVIEW.*

Pre-requisites: *Knowledge required to study this subject (especially any subject previously studied)*

Module I (12 Hours)
Basic concept of Virtual instrumentation - Hardware and Software in Virtual Instrumentation. Virtual instrumentation model.
Introduction to LabVIEW software – Conventional and Graphical Programming- Advantages - Tool boxes- Front panel, Block diagram and Icon – Functions Palette - Controls and Indicators – Data flow programming- G code.

Module II (12 Hours)
LabVIEW programming – Front panel and Block diagram -VIs and Sub Vis – Express VI - Different data types . Structures in LabVIEW- For loop, While loop, Shift registers, tunnels and feedback nodes. Timing inside loops- Communication between loops - local and Global variables.
Arrays – Two dimensional and three dimensional arrays – Auto indexing- Matrix operations with arrays- Polymorphism. Clusters – Order of cluster elements- Assembling and disassembling of clusters. Conversion between clusters and arrays - error handling. Formula nodes and Mathscript

Module III (14 Hours)
MAX software - Data Acquisition using LabVIEW – Specifications of DAQ system- Classification of signals- Signal conditioning- SCXI- Grounded and floating signal sources. Measuring systems- Differential Measurement system – Referenced single ended (RSE) system – Non referenced single ended (NRSE) system – sampling of signals.
NI-DAQmx - Scales- Tasks. Reading and writing of Digital / Analog signals. Multi channel acquisition – counting frequency and events. Examples for AC/DC voltage, current, Power measurement.

Module IV (12 Hours)
Instrument control using LabVIEW - VISA – VISA functions. State machines - Property nodes of Control / indicators – Event structures. RS 232C / RS 485 interfacing- Parallel port interfacing.
String controls and indicators- string functions – converting string value to numbers- Writing to / reading from spreadsheet files.

Module V (10 Hours)
Advanced features of LabVIEW – Notifiers- Semaphore – Queue – Rendezvous- occurance. Data sockets – Shared Variables-Report generation.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

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

Text Books

1) LabVIEW for every one – Jeffrey Travis, Jim Kring, Pearson Education
2) Virtual Instrumentation using LabVIEW – Jovitha Jerome, PHI Learning
3) Virtual Instrumentation using LabVIEW – Sanjay Gupta & Joseph John, Mc Graw Hill Publication

EE 010 805 G05: Digital Image Processing

(Global Elective)

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objectives

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

Module I (14 hours)

Digital image representation : Elements of digital image processing systems - Image digitizers & scanners - Elements of visual perception - Brightness & contrast - colour perception & processing - pixel based transformation – geometric transformation – image file formats

Image sampling & Quantization - Two dimensional Sampling theorem - Reconstruction of image from its samples – Aliasing

Module II (14 hours)

Image Transforms : Two dimensional DFT & its properties - Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar, Slant, and Karhunen – Loeve transforms

Module III (10 hours)

Image Enhancement : Point processing - Histogram processing - Spatial Filtering – image subtraction - image averaging - Enhancement in the frequency domain - colour Image processing.

Module IV (12 hours)

Image Restoration : Degradation model – Diagonalization of circulant matrices - Inverse filtering - Wiener filter methods – Constrained least mean square filtering

Image Coding & Compression- basic principles Image compression: Run length coding , predictive coding ,Basics of Image compression standards:

Module V (10 hours)

Image analysis : Segmentation – Thresholding – point, line and edge detection – Boundary detection - Region Based segmentation - image reconstruction – radon transform – projection theorem – convolution filter back projection - Fourier reconstruction method – applications of image processing.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. Rafael C. Gonzalez - Richard E. Woods, *Digital Image Processing*, Pearson Education
2. Dutta Majumdar - *Digital Image Processing and Applications,* PHI

Reference Books

1. Madhuri A. Joshi – Digital Image Processing,PHI, New Delhi,2010
2. Anil K. Jain - Fundamentals of Digital Image processing," Prentice Hall India, 1989.
3. William K. Pratt - Digital Image Processing, John Wiley and sons, New delhi, 2010.
4. S.Jayaraman, S. Esakkiarajan. T. Veerakumar- Digital Image Processing,TMH,New Delhi, 2010.
5. Rosenfield and A. C. Kak - Digital Picture Processing, 2nd edition, Vols. 1 & 2, Academic Press, New York, 1982.
6. R. J. Schalkoff - Digital Image Processing and Computer Vision, John Wiley & Sons,

EE 010 805 G06: Distributed Power Systems

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart introductory knowledge of distributed power systems*
- *To develop understanding of power generation systems using renewable energy*
- *To develop understanding of integrating the renewable energy systems to the grid.*

MODULE I (12 Hours)

Photo-voltaic and Fuel cells: Basic characteristics of sunlight – solar energy resource – photovoltaic cell – cell efficiency – characteristics – equivalent circuit – photo voltaic for battery charging – charge regulators – PV modules – battery backup – limitations – equipments and systems – types of fuel cells – losses in fuel cells.

MODULE II (12 Hours)

Wind Turbines and Embedded generation: Wind Source – wind statistics – energy in the wind – aerodynamics – rotor types – forces developed by blades – aerodynamic models – braking systems – tower – control and monitoring system – power performance – Wind driven induction generators – power circle diagram – steady state performance – modeling – integration issues – impact on central generation – transmission and distribution systems – wind farm electrical design.

MODULE III (12 Hours)

Isolated generation: Wind – diesel systems – fuel savings – permanent magnet alternators – modeling – steady state equivalent circuit – self excited induction generators – integrated wind – solar systems.

MODULE IV (12 Hours)

Other Renewable Sources and Bio fuels: Micro- hydel electric systems – power potential – scheme layout – generation efficiency and turbine part flow isolated and parallel operation of generators – geothermal – tidal and OTEC systems – classification of bio fuels – Conversion process – applications.

MODULE V (12 Hours)

Power Quality Issues: sustained interruptions – voltage regulation – harmonics – voltage sag
Operating conflicts: Fault clearing requirements – reclosing – interference with relaying – voltage regulation issues – islanding – ferroresonance.
Distributed generators on low voltage networks: Network operation – interconnection issues – integrating techniques

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
20% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

Text Books

1. John F.Walker & Jenkins ,N., ` Wind Energy Technology', John Wiley and sons, Chichester, U.K.,1997.
2. Sukhatme,S.P.,`Solar Energy- Principles of Thermal Collection and Storage' Tata Mc-Graw-Hill, New Delhi.
3. S.L.Soo, 'Direct Energy Conversion', Prentice Hall Publication.
4. Roger.C.Dugan, Mark F McGranaghan, Surya Santoso, H.Wayne Beaty Electrical Power Systems Quality, Tata McGraw Hill

Reference Books

1. Freries L.L., 'Wind Energy Conversion Systems', Prentice Hall U .K., 1990.
2. Kreith,F., and Kreider,J.F., 'Principles of Solar engineering', Mc-Graw-Hill, Book Co.
3. Imamura M. S.et.al., 'Photo voltaic System Technology, European Hand Book',H S., Stephen and Associate, 1992.
4. James Larminie, Andrew Dicks,Fuel Cell Systems', John Wiley and Sons Ltd .

EE 010 806: Electrical Machines Lab II

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

Objectives

- *To conduct various tests on synchronous and induction machines and to study their performance.*

1. Alternator regulation by direct loading.
2. Alternator regulation by emf/mmf methods.
3. Alternator regulation by potier method.
4. Regulation of salient pole alternator – slip test.
5. Alternator V curves for constant input/output.
6. Synchronization of alternator to mains.
7. Study of induction motor starters and brake test on three phase induction motor.
8. Variation of starting torque with rotor resistance in slip ring induction motor.
9. Predetermination of performance characteristics of induction motor – circle diagram and equivalent circuit.
10. Performance characteristics of pole changing induction motor.
11. Hysteresis loss calculation of induction machine.
12. Single-phasing of three phase induction motor - torque slip characteristics.
13. Induction generator characteristics
14. Performance characteristics of single phase induction motor.
15. Speed control of three phase induction motor using power electronic converters - V/f control.

References

1. The performance and Design of AC Machines: M.G. Say, CBS Publishers
2. Theory and performance of Electrical Machines: J.B Gupta, S. K. Kataria & Sons
3. Theory of Alternating Current Machinery: Alexander Langsdorf, Tata Mgraw Hill

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

Note: Minimum of 12 experiments should be conducted.

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
30% - Viva voce

EE010 807 Project Work

Teaching scheme **credits: 4**

6 hours practical per week

The progress in the project work is to be presented by the middle of eighth semester before the evaluation committee. By this time, the students will be in a position to publish a paper in international/ national journals/conferences. The EC can accept, accept with modification, and request a resubmission.

The progress of project work is found unsatisfactory by the EC during the middle of the eighth semester presentation, such students has to present again to the EC at the end of the semester and if it is also found unsatisfactory an extension of the project work can be given to the students.

Project report: To be prepared in proper format decided by the concerned department. The report shall record all aspects of the work, highlighting all the problems faced and the approach/method employed to solve such problems. Members of a project group shall prepare and submit **separate** reports. Report of each member shall give details of the work carried out by him/her, and only summarise other members' work.

The student's sessional marks for project will be out of 100, in which 60 marks will be based on day to day performance assessed by the guide. Balance 40 marks will be awarded based on the presentation of the project by the students before an evaluation committee.

For Project, the minimum for a pass shall be 50% of the total marks assigned to the Project work.

EE010 808 Viva -Voce

Teaching scheme **credits: 2**

A comprehensive oral Viva-voce examination will be conducted to assess the student's intellectual achievement, depth of understanding in the specified field of engineering and papers published / accepted for publication etc. At the time of viva-voce, certified bound reports of seminar and project work are to be presented for evaluation. The certified bound report(s) of educational tour/industrial training/ industrial visit shall also be brought during the final Viva-Voce.

An internal and external examiner is appointed by the University for the Conduct of viva voce University examination.

For Viva-voce, the minimum for a pass shall be 50% of the total marks assigned to the Viva-voce.

Note: If a candidate has passed all examinations of B.Tech. course (at the time of publication of results of eighth semester) except Viva-Voce in the eighth semester, a re-examination for the Viva-Voce should be conducted within one month after the publication of results. Each candidate should apply for this 'Save a Semester examination' within one week after the publication of eighth semester results.