West Bengal University of Technology  
BF-142, Salt Lake City, Kolkata-700064

Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

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THIRD SEMESTER

A. THEORY:

<table>
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<tr>
<td>MS(EE)-301</td>
<td>Electrical Engineering Materials</td>
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<td>EE-302</td>
<td>Electrical and Electronics measurement</td>
<td>3 1 0 4 4</td>
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<td>EE-301</td>
<td>Circuit Theory &amp; Networks</td>
<td>3 1 0 4 4</td>
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<tr>
<td>CS302</td>
<td>Data Structure &amp; Algorithms</td>
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<td>M302</td>
<td>Mathematics</td>
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<td>Numerical Methods &amp; Programming Lab</td>
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TOTAL OF SEMESTER | 34 30
FOURTH SEMESTER

A. THEORY:

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<td>Electrical Machines-I</td>
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<td>Analog Electronic Circuits</td>
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<tr>
<td>EC(EE) 402</td>
<td>Digital Electronics &amp; Integrated Circuits</td>
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<td>Electromagnetic Field Theory</td>
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<td>ME(EE) 411</td>
<td>Thermal Power Engineering</td>
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**TOTAL OF THEORY** 18 18

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**TOTAL OF PRACTICAL** 12 8

C. SESSIONAL:

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<th>Technical Report writing &amp; Language Practice Lab</th>
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**TOTAL OF SESSIONAL** 3 2

**TOTAL :** 33 28
Revised & Final Syllabus of B.Tech in EE up to 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

FIFTH SEMESTER

A. THEORY:

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<td>ELECTRICAL MACHINES – II</td>
<td>3 1 0</td>
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<tr>
<td>EE 502</td>
<td>POWER SYSTEM – I</td>
<td>3 0 0</td>
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<tr>
<td>EE 503</td>
<td>CONTROL SYSTEMS-I</td>
<td>3 1 0</td>
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<td>EE 504</td>
<td>POWER ELECTRONICS</td>
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<td>CS513</td>
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TOTAL OF THEORY: 17 17

B. PRACTICAL:

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<tr>
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<td>EE 592</td>
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<td>EE 593</td>
<td>CONTROL SYSTEMS LAB</td>
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TOTAL OF PRACTICAL: 12 8

C. SESSIONAL:

TOTAL: 29 25
### SIXTH SEMESTER

#### A. THEORY

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<td>4</td>
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<td>MICR OPROCESSOR &amp; MICROCONTROLLERS</td>
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<td>5</td>
<td>EC 611</td>
<td>DIGITAL SIGNAL PROCESSING</td>
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**TOTAL OF THEORY**

|       |       |                             |                       | 20    | 20      |

#### B. PRACTICAL

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**TOTAL OF PRACTICAL**

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#### C. SESSIONALS

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**TOTAL OF SESSIONALS**

|       |       |                             |                       | 3     | 2       |

6-week Industrial Training during summer vacation
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

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**SEVENTH SEMESTER**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code</th>
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<tr>
<td>1.</td>
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<td>Electric Drives</td>
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<td>HU-701</td>
<td>Financial Management &amp; Accounts</td>
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<td>3.</td>
<td>EE-702</td>
<td>Power System-III</td>
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<td>EE-703</td>
<td>Utilization of Electric Power</td>
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<td>Elective-I</td>
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<tbody>
<tr>
<td>1.</td>
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<td>EE-792</td>
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**SESSIONAL**

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<td>EE-782</td>
<td>Seminar on Assigned / Selected Topics</td>
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<td>3.</td>
<td>EE-794</td>
<td>Assigned Project</td>
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**TOTAL OF SEMESTER**

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Elective-I(EE704A/B/C/D/E)

a. High Voltage Engineering
b. Embedded System
c. Power Generation Economics
d. Power Plant instrumentation and Control
e. Non conventional energy sources
EIGHTH SEMESTER

Proposed Curriculum

<table>
<thead>
<tr>
<th>Sl. No</th>
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<td>Values and Ethics in Profession</td>
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<td>Industrial Management</td>
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<td>Elective-II</td>
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PRACTICAL

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SESSIONAL

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<td>Personality Development</td>
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<td>EE-882</td>
<td>Comprehensive Viva-Voce</td>
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</table>

**TOTAL OF SEMESTER**

|        |        | 27 | 26 |

Elective-II(EE801A/B/C/D)

A. Advanced High Voltage Engineering:
B. Power system dynamics & Control:
C. Energy Management & Audit.
D. Non linear Control systems:

Elective-III(EE802A/B/C/D)

A. Communication Engineering:Old Code: EC802 (a)
B. Sensors & Transducers:
C. AI and Soft computing:Old Code: -CS-802 (d)
D. Project Management & Operation Research: Old Code: M-802(f)
THIRD SEMESTER SYLLABUS

ELECTRICAL ENGINEERING MATERIALS
MS (EE) 301
Contacts: 3L
Credits: 3

Conductive materials: General properties and specifications of conductor materials; free electron theory of Metals, Relaxation time, collision time and mean free path, joule’s law, factors affecting resistivity. Thermal conductivity of metals-Wiedemann Franz law, Properties of high conductive materials (Copper, Brass, Bronzes, and Aluminum), Conductor-bimetals: solders, Materials of high resistivity; alloys for use in electrical resistance, precision electrical measuring instruments, arc lamps and electric furnaces. Different types of fuses, fusing current and fuse ratings, materials used for highly loaded metal contacts. Electrical carbon materials: characteristics of different carbon brushes and graphite brushes, Superconductivity. 08


Magnetic Materials: Magnetic parameters (Permeability, magnetic susceptibility, Magnetic moment, Magnetization, ). Classification of magnetic materials, Ferromagnetic behavior below critical Temperature, Spontaneous Magnetism and Weiss Theory of Ferromagnetism, Ferromagnetic Materials at high temperature, Spontaneous magnetization, cyclic magnetization, magnetic anisotropy and magnetostriction. Antiferromagnetism, Ferromagnetic material, Magnetic materials for electrical devices, Soft magnetic materials, Hard magnetic material. 10

Dielectrics: Different types of dielectric materials and their classification, dielectric as an electric field medium. Dielectric properties of insulators in static fields: Dielectric parameters, mechanism of polarization, ionic polarization, orientational polarization, internal field in solids and liquids, the Clausius Mosotti equation, Ferroelectric material and their application, classification of ferroelectric material, antiferroelectricity, piezoelectricity. Dielectric properties of insulators in alternating fields: Complex permittivity, Electronic polarizability, frequency dependence of ionic polarization, complex dielectric constant of non polar solids, Dielectric losses, Equivalent circuits. 10

Materials for direct Energy conversion devices: Solar cells, MHD generations, Fuel cells, thermoelectric generator, Thermo ionic converters. 05

Text books:
2. Electrical Engineering Materials, A.J. Dekker, PHI.

Reference:
1. Materials Science for Electrical & Electronics Engineers, Ian P. Jones, Oxford
3. Introduction to material science for engineers, J.K. Shackelford & M.K. Muralidhara, Pearson Education.
West Bengal University of Technology  
BF-142, Salt Lake City, Kolkata-700064

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------------------------------------------------------------------------------------------------------------

Electrical and Electronics measurement  
Code: EE302  
Contact: 3L + 1T  
Credit: 4  
Measurements: Methods of measurement, Measurement system, Classification of instruments, Definition of accuracy, precision, resolution. Speed of response. Errors in measurement, classification of errors. Loading effect due to shunt and series connected instruments.  


Potentiometers: Principle of operation and application of Crompton’s DC potentiometer, Polar and co-ordinate type of AC potentiometers.  

AC bridges: Measurement of inductances, capacitance and frequency by A.C bridges.  


Measurement of energy: Construction, theory and operation of AC energy meter, testing of Energy meters.  

Cathode Ray Oscilloscope: Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope. Double beam CRO.  


Sensors & Transducers: Introduction to sensors & transducers, strain gauge, LVDT, temperature transducers, Flow measurement using magnetic flow measurement.  

Text Books:  
2. Electrical Measurements and Measuring Instruments; E.W Golding & F.C. Wides, Wheeler Publishing  
3. Electronic Instrumentation; H.S.Kalsi, Tata McGraw hill, 2nd edition
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

Reference Books:
1. Sensors and Transducers; D. Patranabis, PHI, 2nd edition

Electrical and Electronics measurement Lab
EE-392
Credits: 2
Contacts: 3P
Syllabus:
Experiments related to the topics in EE-302

Circuit Theory & Networks
Code: EE 301
Contact: 3L+ 1T
Credit: 4

Different types of systems & networks: Continuous & Discrete, Fixed and Time varying, Linear and nonlinear, lumped and distributed, passive & Active networks and systems.


Fourier series and Fourier Transform (in continuous domain only)

Network theorems: Thevenin’s, Norton’s, Superposition, Maximum power transfer and Millman’s theorem and their applications in 3 phase unbalanced circuit analysis, formulation of network equations, Source transformation, Loop variable analysis and node variable analysis.

Graph of Network: Concept of tree branch, tree link, Incidence matrix, Tie-set matrix and Loop currents, Cut set matrix and node pair potentials.

Two port networks: Open circuit Impedance and Short circuit Admittance parameters, Transmission parameters, Hybrid parameters and their inter relations.

Passive and Active filter: Analysis and synthesis of the following filters using operational amplifier, Low pass, High pass, band pass, band reject, all pass (first and second order only).

Text Books:
2. Network Analysis & synthesis, C.L. Wadhwa, New Age International Publisher.
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Reference Books:

1. Circuit Theory & Networks (TMH WBUT Series), S.P. Ghosh & A. Chakraborty, TMH
3. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand

Circuit & Network Lab:
Code: EE 391
Contact: 3P
Credit: 2

1. Transient response of R-L and R-C Network: Simulation using PSPICE / hardware
2. Transient response of R-L-C series and parallel circuits: Simulation with PSPICE / hardware.
3. Determination of Impedance (Z) and Admittance (Y) parameters of two port network: Simulation / hardware.
5. Frequency response of BP and BR filters: simulation / hardware.
6. Generation of Periodic, Exponential, Sinusoidal, Damped sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form.
7. Determination of Laplace transform and Inverse Laplace transform using MATLAB.
8. Amplitude and Phase spectrum analysis of different signals using MATLAB.
9. Verification of Network theorems using SPICE

Reference book: 1 Introduction to PSpice Using Orcad for circuits and Electronics, Muhammad H. Rashid, Pearson Education.

DATA STRUCTURES AND ALGORITHMS
Code: CS 302
Contact: 3L + IT
Credit: 4

Overview of C language
Time and Space analysis of Algorithms - Order Notations.

Linear Data Structures - Sequential representations - Arrays and Lists, Stacks, Queues and Dequeues, strings, Application.

Linear Data Structures, Link Representation - Linear linked lists, Circularly linked lists. Doubly linked lists, application.

Recursion - Design of recursive algorithms, Tail Recursion, When not to use recursion, Removal of recursion.

Hashing - Hashing Functions, collision Resolution Techniques.

Sorting and Searching Algorithms, Bubble sort, Selection Sort, Insertion Sort, Quicksort, Merge Sort, Heapsort and Radix Sort.

File Structures - Sequential and Direct Access. Relative Files, Indexed Files - B+ tree as index. Multi-indexed Files, Inverted Files, Hashed Files.

Text books:
1. Data Structures and Algorithms – O.G. Kakde and U.A. Deshpande, ISTE/EXCEL BOOKS
3. Drozdek A – Data Structures and Algorithms
5. Ajay Agarwal- Data Structure Through C, Cyber Tech

References:
2. Data Structures Using C – M.Radakrishnan and V.Srinivasan, ISTE/EXCEL BOOKS
5. Tanenbaum A. S. , “Data Structures using ‘C’ ”

MATHEMATICS

Code: M 302
Contacts: 3L + 1T
Credits: 4

Fourier Series:
Introduction: Euler’s formula; Problems on general Fourier Series; Conditions for Fourier Expansion; Fourier Expansions of Discontinuous Functions; Even and Odd functions; Change of interval; Half range series; Typical Waveforms (Square, Saw-toothed, Triangular, Half Wave rectifier, Full Wave rectifier); Parseval’s Identity (statement only); Fourier Transform (FT) and its properties; Inverse Fourier Transform (statement only); Fourier transform of derivative (statement only); Convolution (statement only); Application of Fourier Transform in solving partial differential equations — Laplace’s Equation (2D only), Heat Conduction Equation (1D only) and Wave Equation (1D only).

Calculus of Complex Variable:
Functions; Limits and Continuity; Analytic Functions; Cauchy Riemann Conditions; Analytic Continuation; Complex Integration and Cauchy's Theorem; Cauchy's Integral Formula; Taylor's and Laurent Series; Zeros of an Analytic Function; Poles; Essential Singularities; Residue Theorem (statement only) and it's application to evaluation of integral; Introduction to Conformal Mapping; Simple problems.
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

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**Probability and Statistics:**
Mean, Median, Mode and Standard Deviation; Samples Space; Definition of Probability; Conditional Probability; General Multiplication Theorem; Independent Events; Bayes' Theorem; Random Variable; Discrete and Continuous Probability Distributions - Probability mass function; Probability density function; Distribution Function; Expectation; Variance; Probability Distribution—Binomial, Poisson and Normal. Correlation and Regression; Method of Least Squares; Linear Curve Fitting.

**Graph Theory:**
Graphs; Digraphs; Isomorphism; Walk; Path; Circuit; Shortest Path: Dijkstra's Algorithm; Tree; Properties of Tree; Binary Tree; Fundamental Circuit; Minimal Spanning Tree: Kruskal's Algorithm; Prim’s Algorithm. Cut Set; Fundamental Cut Set and Cut Vertices; Matrix Representation of Graphs (Adjacency and Incidence Matrices); Network; Flow Augmenting Path; Ford-Fulkerson Algorithm for Maximum Flow; Max Flow – Min Cut Theorem (statement only).

**Text Books:**
1. Rathor, Choudhari: Discrete Structure And Graph Theory.
10. West D.B.: Introduction to Graph Theory - Prentice Hall
11. Deo N: Graph Theory with Applications to Engineering and Computer Science - Prentice Hall.
14. Jana- Undergraduate Mathematics
15. Lakshminarayan- Engineering Math 1.2.3
16. Gupta- Mathematical Physics (Vikas)
17. Singh- Modern Algebra
18. Rao B: Differential Equations with Applications & Programs, Universities Press
19. Murray: Introductory Courses in Differential Equations, Universities Press
22. Chowdhury: Elements of Complex Analysis, New Age International
23. Bhat: Modern Probability Theory, New Age International
26. Dhani: Differential Calculus, New Age International

**Total 48L**
NUMERICAL METHODS AND PROGRAMMING

Code : CS 312
Contacts : 3L
Credits :3

Approximation in numerical computation, Truncation and rounding errors;
Interpolation: Lagrange’s Interpolation, Newton forward & backward differences Interpolation, Newton divided difference;
Numerical Integration: Trapezoidal, Rule, Simson’s 1/3 Rule, Weddle’ Rule;
Numerical Solution of a system of linear equation
Gauss elimination method, Matrix Inversion, LU Factorization method, Gauss Jacobi method, Gauss Seidel method;
Algebraic Equation: Bisection method, Secant method, Regular-Falsi method, Newton-Raphson method;
Numerical solution of ordinary differential equation: Taylor’s series method, Euler’s method, Runge-kutta method, and Predictor-Corrector method;
C Language Overview: Loop, recursion, function, array, pointers, structures, various types of file access methods: Sequential, Indexed Sequential, Random;
Various types of files in C and various types file handling statements in C
Implementation above Numerical & Statistical Problems in C Language;

Text Books:

2. Numerical Mathematical Analysis by J.B.Scarborough
3. C Language and Numerical Methods by C.Xavier
4. Introductory Numerical Analysis by Dutta & Jana
5. Balagurusamy: Numerical Methods
7. Numerical Methods (Problems and Solution) by Jain, Iyengar , & Jain
12. Numerical Methods for Engineers – Gupta, New Age International
18. Applied Discrete Structures – Joshi, New Age International

DATA STRUCTURE LAB

Code: CS 392
Contact: 3P
Credit: 2

Experiments should include but not limited to :
Implementation of array operations
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

Stacks and Queues: adding, deleting elements
Circular Queue: Adding & deleting elements
Merging Problem: Evaluation of expressions operations on Multiple stacks & queues:
Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues using linked lists:
Polynomial addition, Polynomial multiplication
Sparse Matrices: Multiplication, addition.
Recursive and Non-recursive traversal of Trees
Threaded binary tree traversal. AVL tree implementation.
Application of Trees, Application of sorting and searching algorithms
Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

NUMERICAL METHODS & PROGRAMMING LAB
Code: CS 382
Contact: 3P
Credit: 2

1. Assignments on Interpolation: Newton forward & backward, Lagrange
2. Assignments on Numerical Integration: Trapezoidal Rule, Simson’s 1/3 Rule, Weddle’s Rule
3. Assignments on Numerical solution of a system of linear equation: Gauss elimination, Gauss Jacobi, Matrix Inversion, Gauss Seidal
4. Assignments on Algebraic Equation: Bisection, Secant, Regular-falsi, Newton Raphson
5. Assignments on Ordinary Differential Equation: Taylor Series, Euler’s method, Runga-Kutta

Assignments on Statistical Problem: Mean, Median, Mode, Standard deviation (for simple & frequency type data), Correlation & Regression

FOURTH SEMESTER SYLLABUS

Electrical Machines-I
EE 401
Contacts: 3L + 1 T
Credits: 4

Direct Current machines:
Review of construction, types of armature winding, physical concepts of winding pitches, derivation of EMF equation & types of excitation.
Compensating winding, Commutation and function of commutators. Improvement of commutation: Brush shift and interpoles.

Direct Current motors:
Review of types of DC motors. Torque equation, speed torque characteristics: shunt, series and compound motors.
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

3 phase Transformers: Determination of polarity and connections; (Star/star, star/delta, delta/star, star/zigzag, delta/zigzag, open delta), phasor groups. Effects of unbalanced loading, production of harmonic in transformers and their suppression. 3-phase to 2-phase transformation, Scott connection, 3-phase to six phase connections: double star & double delta. 3-winding transformers: parameter estimation. Applications. Parallel operation of transformers, autotransformers. Introduction to tap changers and their functions. 12


Text books:
2. Electric Machines, I.J. Nagrath & D.P. Kothari, 3/e, TMH

Reference books:
2. Electric Machinery & Transformers, Bhag S.Guru & H. R. Hiziroglu, Oxford
3. Electrical Machines: Theory & Practice, M.N. Bandoyopadhyay, PHI
4. Electric Machinery & Transformer, Irving L Koskow, 2/e, PHI

ANALOG ELECTRONIC CIRCUITS
Code: EC(EE) 401
Contacts: 3L
Credits: 3

Small Signal models of -Junction Transistors. Single stage amplifiers, CE, CC Voltage follower. R-C coupled amplifiers
Field Effect Devices: JFET/HFET, MIS structures and MOSFET operation; JFET characteristics and small signal models; MOS capacitor CV and concept of accumulation, depletion and inversion; MOSFET characteristics and small signal models. Discrete FET amplifiers: Common source amplifiers; source followers.
Power amplifiers – Class A, B, AB, C, Tuned amplifier.
Instrumentation Amplifier, Logarithmic amplifiers, analog multiplier, Precision Rectifier
Linear voltage regulator: series and shunt, Switch mode regulators
Multivibrator – Monostable, Bistable, Astable.
Timer. Monostable and astable operation using 555 timers.
Function generator, wave shapers.
V-I, I-V, V-F & F-V converters. VCO, PLL lock-in amplifier.

Text Book:
1. Malvino—Electronic Principles, 6/e, TMH
2. Nagrath, Electronics: Analog and Digital, PHI, 2004
3. Mottershed, Electronics Devices & Circuits, Wiley Eastern
5. Gayakwad R.A  -- OpAmps and Linear IC’s, 4/e, Pearson-PHI
6. Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e,TMH

Reference:

3. Maheshwari and Anand , Analog Electronics, PHI
5. Millman & Halkias: Basic Electronic Principles; TMH.

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS
Code : EC(EE) 402
Contacts : 3L + 1T
Credits :4
Concept of digital data , Binary representation of integers, Octal, Hexadecimal and BCD Codes and their conversions. Unit distance code, Gray code, Shaft position encoder. ASCII code 
Serial transmission of binary data (1-byte), Ideal digital signals, practical digital signals: voltage levels, rise time, duty cycle.
Boolean algebra, Venn diagram, Truth Table, De-Morgans Theorem and applications.
Elementary logic gates (NOT, AND, OR, XOR, NOR and NAND) . Realization of binary expressions using gates., universality of NOR and NAND gates.
Normal forms, minterms, maxterms. Minimization of logic expressions by algebraic method, K-map method and Quine Mc Clauskey method. Don't care conditions.
Elementary concepts of hardware description languages (HDL)
Combinational circuits- 1-bit half adder and full adder, encoder, decoder and code-converters (BCD-Hex,BCD-7segment, Hex-7segment), comparator, multiplexer, de-multiplexer, parity generator .
Clocks and timing circuits: Waveform, Semitt trigger, monostable multi-vibrator.
Ripple and Synchronous counters. Ring Counters
Registers and Shift registers, parallel load and serial load.
Memory Systems: RAM, ROM, EPROM, EEROM.
General Sequential systems. State table and state transition diagram, Moore and Mealy machines.
Sequential circuit design (Synchronous), using ROM, Algorithmic Sequential Machine, Simple application examples like vending machines.
Design of combinational and sequential circuits using Programmable logic devices and gate arrays.
Digital Integrated Circuits, Different Logic families- TTL, ECL, MOS and CMOS, their operation and specifications.

Signed binary number representation with 1’s and 2’s complement methods, Binary arithmetic: addition, subtraction, multiplication. Sign-Magnitude Binary representation.
Digital to analog conversion using resistive ladder..A/nalog to Digital conversion: counter /staircase method, Successive approximation; Accuracy and precision of converters.

Textbooks:

1. Leach , Malvino, Saha—Digital Principles & Application, 6/e, TMH
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

2. Mano, Digital Logic Design, 3/e, PHI/Pearson,
3. Jain—Modern Digital Electronics, 3/e, TMH,

Reference:
1. Nair, Digital Electronics and Logic Design, PHI, 2004

Electromagnetic Field Theory
EE-402
Contact: 3L
Credit: 3


Electrostatic field: Coulomb’s law, field intensity, Gauss’s law- Maxwell’s equation, Electric potential and potential gradient, Relationship between E and V-Maxwell’s equation An electric Dipole & flux lines, Energy density in electrostatic fields. Boundary conditions: Dielectric-dielectric, Conductor-dielectric, Conductor-free space, Poisson’s and Laplace’s equations, General procedure for solving Poisson’s and Laplace’s equation.

Magnetic fields: Biot-Savart Law, Ampere’s Circuit law-Maxwell’s equation, Magnetic Flux density-Maxwell’s equation, Maxwell’s Equation for static fields, Magnetic static and vector potential, forces due Magnetic fields, Magnetic torque and moments, Magnetisation in material, Magnetic boundary condition, inductor and inductances, Magnetic energy, Force on magnetic materials.

Electromagnetic field: Farady’s law, Transformer and motional EMF, Displacement current, Maxwell’s equations, Time varying potentials, Time harmonic fields.

Electromagnetic wave propagation: Wave propagation in lossy dielectrics, plane waves in lossless dielectric, plane wave in free space, plane wave in good conductor, skin effect, skin depth, power and the poyneting vector, reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence. Transmission lines, Transmission line parameters, Transmission line equation.

Text Books:
1. Elements of Electromagnetics, Mathew N.O. Sadsiku, 3/e, Oxford University press,
2. Engineering Electromanetics, 7/e, Hyat, TMH
3. Theory & Problems in Electromagnetic, 2/e, Edminister, TMH
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e., for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

Reference:
1. Electromagnetics with applications, 5/e, Krause, TMH
2. Elements of Engineering Electromagnetics, 6/e, N.N. Rao, Pearson Education.

THERMAL POWER ENGINEERING
Code : ME(EE) 411
Contacts : 3L + 1T
Credits : 4


Rotary Thermodynamic devices — Steam turbines & their classifications — Impulse & Reaction type Turbines, Thermodynamics of compressible fluid-flow, equation and continuity — Isentropic flow through nozzles, velocity diagram, Blade efficiency, optimum velocity ratio, multi-staging, velocity & pressure compounding, losses in turbines, erosion of turbine blades, turbine governing, performance analysis of turbine, Condensing system.


Text:
1. P.K. Nag- Engineering Thermodynamics — TMH, 2/e
2. P K Nag- Power Plant Engg. - TMH Pub
3. P.S. Ballaney- Thermal Engineering — Khanna Pub

Reference:
1. Cengel --- Thermodynamics , 3/e, TMH
2. Et-Wakil — Power Plant Engineering, MH

ELECTRICAL MACHINES LAB
Code: EE 491
Contacts: 3 P
Credits: 2

1. Study of the characteristics of a separately excited D.C generator.
2. Studies of the characteristics of a D.C shunt motor.
3. Speed control of a D.C motor.
4. Study of the characteristics of a compound D.C generator (short shunt)
7. Polarity test on single phase transforms and study of the different connections of three-phase transformer.

ANALOG ELECTRONIC CIRCUITS LAB
Code: EC(EE)491
Contacts: 3 P
Credits: 2
1. Introduction: Study of characteristics curves of B.J.T & F.E.T.
2. Construction of a two-stage R-C coupled amplifier & study of it’s gain & Bandwidth.
3. Study of class A & class B power amplifiers.
5. Realization of current mirror & level shifter circuit using Operational Amplifiers.
9. Construction of a simple function generator using IC.
11. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).
12. Study of D.A.C & A.D.C.

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS LAB
Code: EC(EE) 492
Contacts: 3 P
Credits: 2
1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 & vice-versa.
3. 4-bit parity generator & comparator circuits.
5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
13. Design of Sequential Counter with irregular sequences.
15. Construction of adder circuit using Shift Register & full Adder.
THERMAL POWER ENGG. LAB
Code: ME(EE) 481
Contacts: 3P
Credits: 2

1. Study of Cut Models – Boilers IC Engines
   - Lanchashire Boiler
   - Bahcock & Willcox Boiler
   - Cochran Boiler
   - Vertical Tubular Boiler
   - Locomotive Boiler
   - 4S Diesel Engine
   - 4S Petrol Engine
   - 2S Petrol Engine

2. Load Test on 4 Stroke Petrol Engine & Diesel Engine by Electrical Load Box.

3. Load Test on 4 Stroke Diesel Engine by Rope Brake Dynamometer.


6. To find the Calorific Value of Diesel Fuel & Coal by Bomb Calorimeter.

7. To find the Flash Point & Fire Point of Petrol & Diesel Fuel.

8. To find the Cloud Point & Pour Point of Petrol & Diesel Fuel.

9. To find Carbon Particle Percentage in Diesel Engine Exhaust Smoke by Smokemeter and trace the BHP Vs. % Carbon Curve.


11. To find out the Boiler performance – Boiler efficiency & Steam evaporation rate.

12. To visit a Thermal Power Station & study of the followings :
    a) Boiler           b) Steam pipe           c) Furnace
    d) Economizer       e) Preheater            f) Steam turbines
    g) Alternator       h) Water treatment plant i) E. S. P.
TECHNICAL REPORT WRITING & LANGUAGE PRACTICE LABORATORY
Code: HU(EE) 481
Contacts: 3
Credits: 2

Topics to be covered and number of hours required for it:

1. Introductory lecture is to be given to the students so that they get a clear idea of the syllabus and understand the need for having such a practice lab in the first place (3 hours)
2. Conversion practice is done on given situation topics. The students are also made to listen to pre-recorded cassettes produced by British Council and also by the Universities of Oxford and Cambridge (6 hours)
3. Group Discussions:- The students are made to understand the difference between the language of conversion and group discussion. Strategies of such discussions are to teach to them. It is also helpful to use videocassettes produced by the U.G.C. on topics like group-discussion. After wards the class is divided into groups and the students have to discuss on given topics on current socio-economic-political-educational importance (12 hours)
4. Interview sessions-students are taught the do’s and don’ts of facing a successful interview. They then have to face rigorous practices of mock-interviews. There simulations of real life interview sessions where students have to face an interview panel (12 hours)
5. Presentations: The secrets of an effective presentation are taught to the students. Then each and every student has to make lab presentations with the help of the Overhead projector/ using power point presentation and other audio-visual aids in the laboratory. They also have to face the question answer sessions at the end of their presentation (12 hours)
6. Classes are also allotted to prepare the students for competitive examinations like the T.O.E.F.L. by making the students listen to specially produced C.D. cassettes of such examinations (3 hours)

The overall aim of this course is to inculcate a sense of confidence in the students and help them to become good communicators in their social as well as professional lives.

Text:
1. Sharma—Business Correspondence & Report Writing, TMH
2. Prasad—Group Discussion & Interview (With Audio Cassette), TMH

Reference:
1. Sashi Kumar—Spoken English (with Cassette), TMH
5th SEMESTER SYLLABUS

ELECTRICAL MACHINES – II

<table>
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<th>EE – 501</th>
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<td>Contact: 3L + 1T</td>
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**Single phase Induction motor:**
Construction, Double revolving field theory, Cross field theory, Starting methods, Speed — Torque characteristics, Phasor diagram, Condition of maximum torque, Determination of equivalent circuit parameters, Applications.
Single Phase AC series motor, Compensated & uncompensated motors.

**Synchronous machines:**
Construction, Types, Excitation systems, Generator & Motor modes, Armature reaction, Theory for salient pole machine. Two reaction theory, Voltage regulation (EMF, MMF, ZPF)

**Special Electromechanical Devices:**
Principle and construction of Switched reluctance motor, Permanent magnet machines, Brushless D.C machines, Stepper motor, Tacho generators, Synchros & resolvers, & AC servo motors. Principle, Construction and operational characteristics of Induction Generators

**TEXT BOOKS □**
1. Electrical Machinery — P.S. Bimbhra, *Khanna Publishers*
3. Electrical Machines — Nagrath & Kothary, *TMH*
4. Electrical Machines — M.N. Bandyopadhyay, *Pearsons*

**REF. BOOKS □**
3. Fitzgerald : Electrical Machinery, *TMH*

ELECTRICAL MACHINES LABORATORY

EE 591
Contact: 3P
Credit: 2

List of Experiments:
1. Different method of starting of 3 phase squirrel cage Induction motor & their comparison [ D.O.L, Auto transformer & Star-Delta]
2. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [ voltage control & frequency control]
3. Speed control of three phase slip ring Induction motor by rotor resistance control.
7. Load test on single phase Induction motor to obtain the performance characteristics.
8. To determine the direct axis reactance \([X_d]\) & quadrature axis reactance \([X_q]\) of three phase synchronous machine by slip test.
9. Load test on wound rotor Induction motor to obtain the performance characteristics.
10. To make connection diagram of full pitch & fractional slot winding of 18 slot squirrel cage Induction motor for 6 pole & 4 pole operation.

**POWER SYSTEM – I**

<table>
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<tr>
<th>EE – 502</th>
<th>Contact : 3L + 1T + 3P</th>
<th>Credit : 4</th>
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**Overhead Transmission line**: Choice of Voltage, Types of conductors, Inductance and Capacitance of single phase and three phase symmetrical and unsymmetrical configurations, Bundle conductors, Transposition, Concept of GMD and GMR. **10**

**Overhead line construction**: Line supports, Towers, Poles, Sag, Tension and Clearance, Effect of Wind and Ice on Sag, Dampers. **6**

**Insulators**: Types, string Insulator efficiency & methods of its improvement. **3**

**Corona**: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona, methods of reduction of Corona. **3**

**Underground Cables**: Types of cables, capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle. **5**

**Performance of lines**: Short, medium (nominal \(\Pi\), T) and long lines and their representation. A, B, C, D constants, voltage regulation, Ferranti Effect, Power Equations and line compensation, Power Circle Diagrams. **8**

**Tariff**: Guiding Principle of Tariff, different types of tariff. **1**

**Indian Electricity Rules-2003**: General Introduction. **1**

**Distribution System**: Feeders and Distributors, radial and loop systems. **3**

**Distribution substation**: Types of substations, Location of Substation, Substation — equipment and accessories, Earthing of Substation. **3**

**TEXT BOOKS**

1. Electrical Power System — Subir Roy, *Prentice Hall*
2. Power System Engineering — Nagrah & Kothary, *TMH*
3. Electrical Power System — C.L.Wodhwa, *New Age International*

**REF. BOOKS**

Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e., for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

POWER SYSTEMS LAB
Code: EE 592
Contacts: 3 P
Credit: 2

List of experiments

1) Determination of the generalized constants A, B, C, D of a long transmission line.
2) Simulation of DC distribution by network analyzer.
3) Measurement of earth resistance by earth tester.
4) Dielectric strength test of insulating oil.
5) Determination of breakdown strength of solid insulating material.
6) Different parameter calculation by power circle diagram.
7) Study of different types of insulators.
8) Active & reactive power control of an alternator.
9) Study and analysis of an electrical transmission line circuit with the help of PSPICE.
10) Dielectric constant, tan delta, resistivity test of transformer oil.

CONTROL SYSTEMS-I
EE 503
Contacts: 3L + 1T
Credits: 4

Introduction to control system:
Concept of feedback and Automatic Control, Effects of feedback, Objectives of control systems. Definition of linear and nonlinear systems. Elementary concepts of sensitivity and robustness. Types of control systems: Servomechanisms and regulators, examples of feedback control systems.

Mathematical modeling of dynamic systems.

Control system component
Potentiometer, synchros, resolvers, position encoders, D.C. and A.C. tacho-generators, actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an alternator.

Time domain analysis:

Error analysis:
Steady state errors in control systems due to step, ramp and parabolic inputs. Concept of system types and error constants.

Stability analysis:
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

Root locus techniques, Construction of Root Loci for simple systems. Effects of gain on the movement of poles and zeros. 

Frequency domain analysis of linear systems:

Control system performance measures:
Improvement of system performance through compensation, Lead, lag and lead-lag compensation, PI, PD and PID control.

Text Books:
1. Ogata, K: Modern Control Engineering, 4e, Pearson Education.
3. Roy Choudhury, D., Control system Engineering, PHI
4. Kuo, B.C. Automatic Control System, PHI

Reference Books:
1. Control Systems (TMH WBUT Series), Purkait, Satpati, Mondal & Mallik, TMH
2. Bandyopadhyaya, Control Engineering Theory and Practice, PHI
4. Dorf R C & Bishop R.H., Modern Control System, 11e : Pearson Education
5. Graham C Goodwin, Stefan F. Graebe, Mario E. Salgado, Control System Design, PHI

CONTROL SYSTEM LAB (PSPICE & MATLAB)

Code: EE 593
Contacts: 3 P
Credit: 2

List Of Experiments

1) Familiarisation with MATLAB control system tool box, MATLAB –Lab- simulink tool box & PSPICE.
2) Determination of Step Response for First Order & Second Order System with Unity Feedback on CRO & Calculations of Control System Specifications like Time Constant, % Peak Overshoot, Settling Time Etc., From the Response.
3) Simulation of Step Response & Impulse Response for Type-0, Type-1 & Type-2 System with Unity Feedback Using MATLAB & PSPICE.
4) Determination of Root Locus, Bode- Plot, Nyquist Plot Using MATLAB- Control System Toolbox for 2nd Order System & Determination of Different Control System Specifications From the Plot.
6) Determination of Approximate Transfer Function Experimentally From Bode Plot.
7) Evaluation of Steady State Error, Setting Time, Percentage Peak Overshoot, Gain Margin, Phase Margin with Addition of Lead.
POWER ELECTRONICS
EE504
Contact: 3L + 1 T
Credit: 4

Introduction:
Concept of power electronics, application of power electronics, uncontrolled converters, advantages and
disadvantages of power electronics converters, power electronics systems, Power diodes, Power transistors,
Power MOSFETS, IGBT.     (4)

PNPN devices:
Thyristor, brief description of members of Thyristor family with symbol, V-I characteristics and
applications. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate
characteristics, ratings, SCR protection, series and parallel operation, gate triggering circuits. Different
commutation techniques of SCR.      (5)

Phase controlled converters:
Principle of operation of single phase and three phase half wave, half controlled, full controlled converters
with R, R-L and RLE loads, effect of free wheeling diodes and source inductance on the performance of
converters. External performance parameters of the converters, techniques of power factor improvement,
Single phase and three phase dual converters, Resonant converters.             (8)

DC-DC converters:
Principle of operation, control strategies, step up choppers, types of choppers circuits based on quadrant of
operation, performance parameters, multiphase choppers and switching mode regulators.           (5)

Inverters:
Definition, classification of inverters based on nature of input source, methods of commutation and
connections. Principle of operation with R and R-L loads, three phase full bridge inverters, performance
parameters of inverters, methods of voltage control and harmonic reduction of inverters.        (8)

AC controllers:
Principle of on-off and phase control, single phase and three phase controllers with R and R-L loads.
Principle of operation of Cycloconverters, circulating and non circulating mode of operation, single phase
to single phase step up and step down Cycloconverters, three phase to single phase Cycloconverters, three
phase to three phase Cycloconverters.                                             (6)

Applications:
Speed control of AC and DC motors, HVDC transmission, static circuit breaker, UPS, static VAR
controller.    (4)

Text Books:
2.  Power Electronics, V.R. Moorthi, Oxford, 2005
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

Reference books:
5. Analysis of Thyristor power conditioned motor, S.K. Pillai, University press.

POWER ELECTRONICS LABORATORY
EE 59
Contact: 3 P
Credit: 2
List of Experiments:

1. Study of the characteristics of an SCR.
2. Study of the characteristics of a Triac.
3. Study of different triggering circuits of SCR.
4. Study of firing circuits suitable for triggering SCR in a single phase fully controlled bridge converter.
5. Study of the operation of single phase fully controlled bridge converter.
6. Study of single phase half controlled symmetrical and asymmetrical bridge converters.
7. Study of step down Chopper.
8. Simulation of single phase controlled converter with & without the source inductance.
9. Simulation of step up and step down chopper with MOSFET and GTO.
10. Simulation of single phase half controlled symmetrical and asymmetrical bridge converters.
11. Simulation of PWM bridge inverter using MOSFET with R-L load.
12. Simulation of three phase AC regulator

SYSTEM PROGRAMMING & OPERATING SYSTEM
CS 513
Contacts: 3L
Credits - 3

Assemblers [12L]
One pass and Two Pass, Macro Processors, Linkers, Loaders: absolute and relocating loaders, editors and Debuggers, Introduction to Compilers

System Calls [3L]
Programming using system calls (in DOS or Unix)

Operating System [3L]
Introduction to Operating system, O.S. services and Kernel, Multiprogramming and Time Sharing

Processor Scheduling [3L]
Preemptive and non-preemptive, algorithms (FCFS, SJF, RR, priority)

Process Synchronization [6L]
Critical section problem, critical region, semaphores, monitors

Memory management [3L]
Swapping, paging, Demand paging and virtual memory
I/O and device management [4L]
I/O hardware, interrupts, DMA, Block and Character Devices, blocking and non-blocking I/O, spooling and device reservation

Disk and File Management [4L]
Disk structure, disk scheduling (FCFS, SSTF, SCAN), boot block

Deadlocks, Concurrent processes, protection and security [4L]

Introduction to multiprocessors and Distributed O.S. [6L]

Text Books / References:
2. D. Dhandhere “System Programming” TMH
3. A Silberschaz & Galvin “ Operating System Concepts” Addision Wesley/Pearson Education
4. Tanenbaum “Modern Operating System” Prentice Hall of India/Pearson Education
5. Sumitava Das “ Unix Systems V.4 Concept and Application” TMH
6. Maurice J Bach “ The Design of Unix Operating System” PHI/Pearson Education

SIXTH SEMESTER SYLLABUS

ELECTRICAL MACHINE DESIGN
Code: EE 601
Contacts : 3L+1T
Credits : 4

Fundamental Aspects of Electrical Machine Design:
Design factors, limitation in design, modern trends in design of electric machines, modern machine manufacturing techniques. Temperature rise, cooling and thermal grading (classification) of insulations. (2)

Design of Resistances:
Material of resistance elements, design of loading rheostat, design of heating element. (2)

Principles of Magnetic circuit design:
Magnetic leakage, calculation of total mmf in a magnetic circuit, determination of iron losses, pulsation losses, magnetic leakage calculations, specific permeance, leakage reactance, armature leakage, slot leakage, calculation of magnetizing current. (5)

Design of Electromagnets:
Design of Electromagnet core, selection of materials, electromagnet coils. (2)

Design of Power Inductors:
Inductor design calculations choke (small inductors), design procedure. (2)
Design of Transformer:
Core, core cross section, yoke cross section, clamping of core, core earthing, transformer winding, cooling of transformers, transformer insulation, bushings, design details of single phase transformer. Introduction of 3 phase transformer with special emphasis on core design. (10)

Design of three phases Induction motor (Squirrel Cage and Slip Ring):
Stator frames, rotor, rotor windings, slip rings, shaft and bearings, design details. (10)

Design of Capacitors and Inductors for Power system. (2 + 2)

Books:

POWER SYSTEMS-II
Code : EE 602
Contacts : 3L + 1T
Credits :4

General layout of a typical coal fired power station, hydro electric power station, nuclear power station, their components and working principles. Comparison of different methods of power generation. Introduction to solar and wind energy systems. (6)

Nature of Faults in Electrical systems:
Symmetrical fault: Short circuit of a synchronous machine with no load and load, Symmetrical components transformation. Sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. Representation of sequence network of power system. Unsymmetrical faults: Single line to ground, line to line, double line to ground fault. (8)

Power system dynamics:
Steady state stability, transient stability, equal area criterion, swing equation, multimachine stability concept. (4)

Load flow studies:
Network model formation, formation of Y bus, load flow problems, Gauss-Siedel, Newton-Raphson, Fast decoupled methods and their comparison. (6)

Power System Protection:
Protective zones, Relaying elements and quantities. Protective relays: Basic requirements and type of protection, phase and amplitude comparator. Grading (time & current), Classification of electromagnetic (attracted armature & induction type) relays, Directional relay, Distance relay, Differential relay, Basic aspects of static and digital relays. Relay protection scheme for transformers, feeder, generators and AC motors. (10)
Circuit breakers: circuit breaking transients, transient recovery voltage, current chopping and resistance switching, circuit breaker rating, Arc and Arc extinction. Circuit breaker types, oil circuit breaker, Vacuum circuit breaker, Air blast circuit breaker, SF6 circuit breaker and operating mechanism, Advantages and disadvantages of different types. (8)
CONTROL SYSTEMS-II
Code : EE 603
Contacts : 3L + 1T
Credits :4

State variable model of continuous dynamic systems:
Converting higher order linear differential equations into state variable form. Obtaining SV model from transfer functions. Obtaining characteristic equation and transfer functions from SV model. Obtaining SV equations directly for R-L-C and spring-mass-dashpot systems.
Controllability and observability. Linear State variable feedback controller, the pole allocation problems. Linear system design by state variable feedback. (15)

Analysis of discrete time (sampled data) systems using Z-transform:

Introduction to non-linear systems:

Text Books
1. Gopal M : Digital Control and State Variable Methods, 2e, – TMH
2. Roy Choudhuri, D., Control System Engineering, PHI
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

Reference Books:
1. Goodwin, Control System Design, Pearson Education
2. Bandyopadhyaya, Control Engg. Theory and Practice, PHI
7. Umez-Eronini, Eronini., System Dynamics and Control, Thomson
9. Ramakalyan, Control Engineering, Vikas
11. Lyshevski, Control System Theory with Engineering Applications, Jaico

MICROPROCESSORS & MICROCONTROLLERS
Code : EI(EE) 611
Contacts : 3L +1T
Credits : 4

Introduction to computer architecture and organization; Architecture of a typical microprocessor; Bus configuration; The CPU module; ROM and RAM families; Introduction to assembly language and machine language programming; Instruction set of a typical microprocessor (e.g. 8085) ; Subroutines and stacks; Timing diagrams; Memory interfacing; interfacing input-output ports; Interrupts and interrupt handling; Serial and parallel data transfer schemes; Programmed and interrupt driven data transfer; Direct memory access; Programmable peripheral devices; Programmable interval timer; Analog input-out using AD and DA converters. (25)

Assembly language programming of a typical microprocessor; Use of compiler, assembler, linker and debugger. (5)

Basic 16 bit microprocessors (e.g. 8086): Architecture and Min – Max mode. (4)

Introduction to microcontrollers- architecture and instruction set of a typical microcontroller (e.g. PIC16F84 device). Features of popular controller (Processor 8031/8051) and its programming and interfacing. (8)

Text:
4. Microprocessor and Programmed Logic, Short, Pearson Education.

References:
DIGITAL SIGNAL PROCESSING:
Code: EC 611
Contacts: 3L + 1T
Credits: 4

Introduction: Discrete and continuous time signals and systems. Data acquisition and conversion including multi-channel data converter and monitors. Stability, linearity and causality of linear shift in variant signal transmission and processing. Review of Z-transformation.

DFS: Its properties, Fourier representation of finite duration sequences.

DFT: Representation of periodic sequence computational algorithms.


Computer control of processes – supervisory and direct digital control. Simple filter design using MATLAB.

Introduction to DSP hardwares: Architectural features, Fixed point processors, floating point processors. Control and Instrumentation application – Telemetry and metering.

BOOKS:
1. Mitra S: Digital Signal Processing - A computer based approach; TMH
3. Chen, Digital Signal Processing, OUP
4. Johnson, Digital Signal Processing, PHI
5. Babu Ramesh, Digital Signal Processing, Scitech
6. Ingle, Digital Signal Processing Using MATLAB, Vikas
7. Ifeachor, Digital Signal Processing, Pearson Education
11. Rabiner L R & Gold B: Theory & Applications of Digital Signal Processing, PHI

ELECTRICAL MACHINE DESIGN LAB
Code: EE 691
Contacts: 3P
Credits: 2

1. Familiarization of synchronous machine, single phase & three phase induction machine, DC machine, single phase & three phase transformers with the help of cut section models.
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e., for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

2. Familiarization with the construction of single phase fan. (Students should be able to understand windings, rotor and starting of the fan).

3. Design & Fabrication of air and iron core inductor.

4. Design & fabrication of small single phase transformer, 100 VA, 220/12 V.

5. Design & fabrication of 10 W wire wound resistor.

6. Introduction to computer aided machine design.

POWER SYSTEM LAB
Code: EE 692
Contacts: 3P
Credits: 2

1. Study on (i) on load Time Delay Relay (ii) off load Time Delay Relay

2. Polarity, Ratio and Magnatisation Characteristics Test of CT & PT

3. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay

4. Study on D C Load Flow


7. Study on Economic Load Dispatch

8. Study of Transformer Protection by Simulation

9. Study of Generator Protection by Simulation

10. Study of Motor Protection by Micon Relay

11. Study of Different Characteristics of Over Current Relay

CONTROL SYSTEM LAB-II
Code: EE 693
Contacts: 3P
Credits: 2

1. STUDY OF A PRACTICAL POSITION CONTROL SYSTEM. Obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components in SIMULINK. Determination of un-damped natural frequency and damping ratio from the experimental data.
2. TUNING OF P, PI, AND PID CONTROLLER FOR FIRST ORDER PLANT WITH DEAD TIME USING Z-N METHOD. Process parameters (time constant and delay/lag) will be provided, the students would compute controller gains by using Z-N method. Steady state and transient performance of the closed loop plant with and without steady disturbances will have to be noted. Theoretical phase and gain margins will have to be manually computed for each gain settings.

3. DESIGN OF LEAD AND LAG COMPENSATION USING CACSD TOOLS (Plant transfer function will be provided. Step response is to be obtained. (PSPICE, MATLAB, SciLab may be used).

4. STATE VARIABLE ANALYSIS USING CACSD COMMAND TOOL. Familiarization and use of CACSD command for state variable analysis. Obtaining transfer function from SV model and vice versa. Obtaining step response for a SISO system given in SV form. (PSPICE, MATLAB, SciLab may be used).

5. STATE VARIABLE ANALYSIS USING CACSD BLOCK DIAGRAM TOOL. Familiarization and use of CACSD BLOCK DIAGRAM TOOL for state variable analysis. Obtaining step response and initial condition response for a single input, two output system given in SV form. (PSPICE, MATLAB, SciLab may be used).

6. PERFORMANCE ANALYSIS OF A DISCRETE TIME SYSTEM USING CACSD TOOL. Familiarization and use of CACSD block diagram tool for Digital Control System. Study of closed response of a continuous system with a digital controller with sample and hold. (PSPICE, MATLAB, SciLab may be used).

7. STUDYING THE EFFECTS OF NONLINEARITY IN A FEEDBACK CONTROLLED SYSTEM USING TIME RESPONSE. Determination of step response with a limiter nonlinearity introduced into the forward path of 2nd order unity feedback control systems. The open loop plant will have one pole at the origin and the other pole will be in LHP or RHP. To verify that (i) with open loop stable pole, the response is slowed down for larger amplitude input and (ii) for unstable plant, the closed loop system may become oscillatory with large input amplitude. (PSPICE, MATLAB, SciLab may be used).

8. STUDYING THE EFFECTS OF NONLINEARITY IN A FEEDBACK CONTROLLED SYSTEM USING PHASE PLANE PLOTS. Determination of phase plane trajectory and possibility of limit cycle of common nonlinearities. CACSD block diagram tool will be used. (PSPICE, MATLAB, SciLab may be used).

Reference Books;
1. Pressiter, Programming in MATLAB, Vikas
2. Ogata K : Modern Control Engg. 4e, Pearson PHI

MICROPROCESSOR AND APPLICATIONS LAB
Code : EI(EE) 691
Contacts : 3P
Credits : 2

1. Familiarization with 8085 register level architecture and trainer kit components, including the memory map. Familiarization with the process of storing and viewing the contents of memory as well as registers.
2. a) Study of prewritten programs on trainer kit using the basic instruction set (date transfer, load/store, Arithmetic, Logical)

   b) Assignments based on above.

3. a) Familiarization with 8085 simulator on PC.

   b) Study of prewritten programs using basic instruction set (data transfer, load/Store, Arithmetic, Logical) on the simulator.

   c) Assignments based on above.

4. Programming using kit/simulator for
   i) table look up
   ii) copying a block of memory
   iii) shifting a block of memory
   iv) packing and unpacking of BCD numbers
   v) addition of BCD numbers
   vi) Binary to ASCII conversion
   vii) string matching

5. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit eg. subroutine for delay, reading switch state and glowing LEDs accordingly, finding out the frequency of a pulse train etc.

6. Interfacing any 8-bit latch (eg 74LS373) with trainer kit as a peripheral mapped output port with absolute address decoding.

7. Interfacing with I/O modules:
   a) ADC
   b) Speed control of mini DC motor using DAC
   c) Keyboard
   d) Multi-digit Display with multiplexing
   e) Stepper motor

8. Study of 8031/8051 Micro Controller kit and writing programs for the following tasks using the kit.

   a) Table look up
   b) Basic arithmetic and logical operations
   c) Interfacing of keyboard and stepper motor
SEVENTH SEMESTER SYLLABUS

ELECTRICAL DRIVES
Code: EE-701
Contacts: 3L
Credits: 4

Electrical drive: Concept, classification, parts and advantages of electrical drives.  

(2)


(4)

Motor power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods for fluctuating and intermittent loads.

(4)

Stating of Electric Drives: Effect of starting on Power supply, motor and load, Methods of stating of electric motors, Acceleration time Energy relation during stating, methods to reduce the Energy loss during starting.

(3)


(4)


(4)

Induction motor drives: Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.

(8)

Synchronous motor drive: Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector control.

(4)

Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive

(3)


(4)

Text Books:
2. Electric Drives, Vedam Subrahmanyam, TMH

Reference Books:
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from
the academic session, July 2007, i.e. for the students who were admitted in Academic
Session 2006-2007). The syllabi of other semesters will be published soon.

1. Electric motor Drives, R. Krishnan, Pearson Education.
Modern power Electronics and AC drives, Bimal K Bose, PHI

**ELECTRICAL DRIVES - LIST OF EXPERIMENTS**

**Code: EE-791**

**Credits: 2**

1. Study of thyristor controlled DC Drive.
2. Study of Chopper fed DC Drive.
3. Study of AC Single phase motor-speed control using TRIAC.
4. PWM Inverter fed 3 phase Induction Motor control using PSPICE / MATLAB / PSIM Software.
5. VSI / CSI fed Induction motor Drive analysis using MATLAB/DSPIE/PSIM Software.
7. Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software.
PC/PLC based AC/DC motor control operation.

**FINANCIAL MANAGEMENT AND ACCOUNTS**

**Code: HU 701**

**Contacts: 3L**

**Credits: 3**

**Allotted Hrs: 45L**

**Introduction [3L]**

**Capital Budgeting [7L]**

**Management of Working Capital [7L]**
Various concepts, Elements, Classification, Financing and importance of working capital, Investment analysis, Cash flow determination, cost of capital, capital budgeting methods.

**Budgeting Control Technique [5L]**
Concepts of Budget, budgeting and budgetary control, Objectives, Functions, Uses, Advantages, Limitations; Master Budget and Report.

**Cost - Volume - Profit Analysis [8L]**
Classification of costs, Allocation, apportionment and absorption, Cost centers, different costing systems, Cost analysis for managerial decisions, Meaning of Linear CVP analysis, Objectives, Assumptions, Break-Even analysis, determining the Break-Even point profit, Volume graph profit, Volume ratios margin of Safety.

**Introduction to Accounting [8L]**
Basic accounting concepts, important definitions, uses, limitations, advantages; types of Accounting, Financial statements, introduction to Journal Accounting; different types of Vouchers, double entry bookkeeping, different types of transactions related to Financial Accounting.

Financial Control [7L]
Posting of Ledgers and preparation of Trial Balance; preparation of Balance Sheet and Profit and Loss Accounts; Controlling other departments by Financial Accounting (A practical Approach).

Books:
3. Advanced Management Accounting - Kaplan & Atkinson, PHI.
5. Financial Mgmt Accounting, Gupta, Pearson
6. Financial Mgmt, I.M. Pandey, Vikas
7. Financial Mgmt., Khan & Jain, TMH
8. Financial Mgmt , Mcmenamin, OUP
10. Financial Mgmt,Kulkarni & Satyaprasad, Himalaya

POWER SYSTEM –III
Code: EE 702
Contacts: 3L
Credits: 3
Allotted Hrs: 45L

Introduction: Objective of the course, Power systems in restructured environment, Distributed and Dispersed generation, Environmental aspect of Electric Generation. (2)

Economic Operation of Energy Generations systems: Introduction, Economic operation of Thermal system, Plant Scheduling, Transmission loss and Penalty factor, Hydro thermal scheduling, Scheduling of pumped storage plants, Unit Commitment. (8)

Automatic Generation Control: Introduction, Load frequency control (Single area case), Load frequency control of two area systems, response of load frequency controller, Optimal control of AGC. (8)

Compensation in power systems: Reactive power sensitivity and voltage control, Exciter and VAR control, Load compensation, Line compensation, Passive shunt and series compensation, introduction to FACTs controller (SVC, STATCOM). (8)

Power system transients: Introduction, Types of System Transients, Traveling Waves or Propagation of Surges, Generation of over Voltages on transmission lines, Protection against Lighting, Protection of Power system Apparatus against surges. (8)
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

Text Books
2. Power system analysis, operation and control, Chakrabarti and Halder, PHI

Reference Books:
3. Power system Analysis, Nagsarkar & Sukhija, Pearson

POWER SYSTEM LABORATORY
Code: EE-792
Contacts: 3P
Credits: 2
1. Computation of scheduling of thermal power plants without network losses.
2. Computation of P-V and Q-V profiles in simple power systems.
3. Application of SVC at load bus of a simple power system.
5. Simulation of LFC for two area power system
6. Economic load dispatch considering network losses
7. Simulation of Reactive power by STATCOM

UTILISATION OF ELECTRIC POWER
Code: EE 703
Contacts: 3L
Credits: 3
Allotted Hrs: 45L

Traction: System of Traction Electrification, Train movement & energy consumption (Speed-time curves, Crest speed, Average speed & Schedule speed), Tractive effort, Factors affecting energy consumption (Dead weight, Acceleration weight & Adhesion weight), Protective devices. (10)

Electric Traction motor & their control: Starting, braking with special emphasis on power electronic controllers, Current collector, Interference with telecommunication circuit. A brief outline of linear Induction motor principle in Traction. (10)

Illumination: Laws of illumination, Polar cuvees, Photometry, Integrating sphere, Types of Lamps: Conventional and Energy Efficient, Basic principle of Light control, Different lighting scheme & their design methods, Flood and Street lighting. (10)

Heating: Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating. (6)
West Bengal University of Technology  
BF-142, Salt Lake City, Kolkata-700064

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**Welding:** Resistance welding, Arc welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Requirement for good welding, Power supplies for different welding schemes.

(6)

Text:
1. Wadha C L: Generation, Distribution and Utilization of electrical energy - New Age International Ltd.

**Electives-I**

**High Voltage Engineering**  
**Code:** EE-704A  
**Contacts:** 3L  
**Credits:** 3

**Breakdown Phenomena**


Lightning Phenomena: Electrification of cloud, Development of Lightning Stroke, lightning induced over voltage, direct stroke, indirect stroke.

Protection of Electrical Apparatus against over voltage:

Lightning Arrestors, Valve Type, Metal Oxide arresters, Expulsion type. Effect of location of lightning arresters on protection of transformer. Protection of substation, Earthwire.

**Insulation Co ordination:**

Basic Insulation level. Basic Impulse level, Switching Impulse level. Volt time characteristics of protective devices, Determination of Basic Impulse level of substation equipment.

**Generation of High Voltage**


**Measurement of High Voltage:**

Sphere gap voltmeter: a.c, d.c and impulse, high voltage measurement as per Indian Standard Specifications. Resistance and Capacitance: Potential dividers, Peak voltmeters for measurement of high a.c. voltage in conjunction with capacitance dividers. Capacitance Voltage Transformer, Rotating Voltmeter for the measurement of d.c high voltage, Electrostatic Voltmeter.

**High Voltage testing:** Testing as per Indian Standard Specifications.

(3) Power frequency withstand, induced over voltage and impulse test on transformers, Power frequency wet withstand test and impulse test on insulators.
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

References:

**Embedded System**
**Code:** EE-704B
**Contacts:** 3L
**Credits:** 3

**INTRODUCTION TO EMBEDDED SYSTEMS**

**PIC MICROCONTROLLERS**
PIC Microcontrollers: 16F877 Architecture and Instruction Set, External Interrupts, Timers, watch-dog timer, I/O port Expansion, analog-to-digital converter, UART, I2C and SPI Bus for Peripheral Chips, Accessories and special features. (8)

**SOFTWARE ARCHITECTURE AND RTOS**
Software Architecture: Round Robin- Round Robin with interrupts -Function Queue, Scheduling Architecture RTOS: Architecture -Tasks and Task States -Tasks and Data -Semaphores and Shared Data -Message Queues -Mail Boxes and pipes -Timer Functions -Events -Memory Management Interrupt Routines. (8)

**BASIC DESIGN USING A REAL TIME OPERATING SYSTEM:**
Overview. General principles. Design of an embedded system (Underground tank monitoring System). (6)

**SOFTWARE DEVELOPMENT TOOLS AND DEBUGGING TECHNIQUES**

**TEXT BOOKS:**
Power Generation Economics  
**Code:** EE-704C  
**Contacts:** 3L  
**Credits:** 3

Cost of power generation- Thermal, Hydro and Nuclear- Types of Consumers in a distribution system- Domestic, Commercial, Industrial etc. Concept of load factor, diversity factor, demand factor.  
(6)

Electricity Tariff- Block rate, flat rate, two part, and three part tariffs. Subsidization and Cross subsidization. Availability tariff of generation companies. Pool tariff of transmission companies. Availability based tariff (ABT).  
(8)

Economics of Power Generation- Unit commitment solution, Spinning reverse.  
(4)

(10)

State estimation and load forecasting- Introduction, state estimation methods, concept of load for casting and application in power system.  
(8)

**Text Books:**

Power Plant instrumentation and Control  
**Code:** EE-704D  
**Contacts:** 3L  
**Credits:** 3

Block Diagram of different parts of a Power Plant and scope of Instrumentation - Measurements on Boiler Plant, Turbo-generator Plant and Nuclear Reactors.

**Measurement:**

Fuel Measurement and various types of weighing systems.

Pressure Measurement - capsules; bellows; diaphragm gauges; bourdon tube pressure gauges; pressure transducers - capacitive type, piezo resistive type; Smart pressure transmitters.

Temperature Measurement - resistance temperature detectors; thermocouples; radiation pyrometers.

Flow Measurement - head type-orifice, venturi; area type-rotameter; mass flow meter.

Level Measurement - capacitive sensors; ultrasonic; DP transmitters.

**Analytical:**
Gas Analysis - Oxygen - zirconium sensor, paramagnetic; SO\textsubscript{x}; NO\textsubscript{x}; CO, CO\textsubscript{2}  
Liquid Analysis - pH; conductivity; dissolved oxygen  
Coal Analysis - moisture, carbon, ash

Control:
Boiler Control - Steam pressure control, combustion control, Furnace Draft control, Steam temperature control, Feed water control  
Data logger and computer control, supervisory control and monitoring system.

Books:  
1. Deobelin E O: Measurement System - Application and Design; TMH.  
3. Johnson C: Process Control Instrumentation Technology; PHI/Pearson Education  
5. Watt Boyes (Editor): Instrumentation Reference Book, 3\textsuperscript{rd} ed.; Butterworth Heineman  
7. Modern Power Station Practice (Control & Instrumentation), Vol-F; Pergamon Press.

Non conventional energy sources  
Code: EE-704E  
Contacts: 3L  
Credits: 3

Classification of Energy Sources (2)  
Advantages of Non Conventional Energy Sources over Conventional Sources Economics, Impact on Environment  
Electricity Generation from Non Conventional Energy Sources:  
Solar Energy: Solar radiation and its Characteristics, Solar Collector: flat Plate, focusing, Solar Energy use for water heating, Solar thermal power generation, Hybrid solar power  
Principle of energy conversion in solar cells, Photovoltaics, Different types of PV Cells, Mono-poly crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems.  
Wind Energy: Wind as energy source, Design of Wind turbine, Selection of site of Wind farm, characteristics of different types of wind generators used with wind turbines  
Hydel Energy: Electricity generation from micro hydel plants, location, auxiliaries and associated problems.  
Bio Energy: Resources and conversion process: bio gas conversion, bio gas plant, bio mass gasifier. co generation Bio diesel;  
Sources, usability and advantages over mineral product,  
Tidal Energy: Principle, selection of site, Economics and future prospect  
Wave Energy: Principle , selection of site and future prospect  
Geo thermal Energy: Principle , location , economics and prospect  
Fuel Cells: Principle of fuel cells, Different types of fuel cells, advantages and limitations  
Magneto hydrodynamics energy conversion:  
Principle, Economics and environmental aspect of MHD generation
EIGHTH SEMESTER SYLLABUS

VALUES & ETHICS IN PROFESSION
HU-801
Contracts:3L
Credits- 3

Science, Technology and Engineering as knowledge and as Social and Professional Activities

Effects of Technological Growth:
Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development
Energy Crisis: Renewable Energy Resources
Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics
Appropriate Technology Movement of Schumacher; later developments
Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.

Ethics of Profession:
Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Profession and Human Values:
Values Crisis in contemporary society
Nature of values: Value Spectrum of a good life
Psychological values: Integrated personality; mental health
Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.
Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity
Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

Books:
Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session, July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

INDUSTRIAL MANAGEMENT
Code: HU-802
Contacts: 3L
Credit: 3

Basic concepts of management, objectives, classification and hierarchy, different schools of management thought, principal functions of management, Management as an organizing and directing force, Structure of the management decision making process, Organization structure, authority and responsibility, Organisation dynamics, Managerial leadership, communication systems, Managing human factors in business and industry, Industrial relation, Union activities, trade union acts, collective bargaining, disciplinary procedure.

Organizational objectives and long range forecasting, planning, organizing, programming and controlling process, managerial control strategies; quantity and quality control, cost benefit analysis, present work and breakeven analysis, budgetary control, use of management science for the efficient administration of economic units, production, financial and marketing management.

Adoption of statistical and computer methods and techniques to managerial research and managerial decision making and general management.

Books:
2. Industrial Management, Vol.1 L.C. Jhamb, EPH,
3. Industrial Engineering & Production Management - Martand Telsang, S. Chand
4. Industrial & Business Management - Martand T. Telsang, S. Chand
6. Production & Operations Management – Adam, Pearson Education / PHI
7. Industrial Relations, Trade Unions & Labour Legislation - Sinha, Pearson Education Asia

Elective-II

Advanced High Voltage Engineering [New]
EE801A
Contacts: 3L
Credit: 3

Module 1

Electric Stress and its estimation
Field sketching: Effect of asymmetry, Effect of multi dielectric
Field Computation Techniques: Electrolytic tank method, Numerical Methods
Electric Stress control techniques.
Mechanism of Spark Breakdown in gases:
Charge generation in gases and from solids, Review of Townsend’s Theory and Streamer Theory. Time lags: Formitive time lag, Atatisical time lag.
Breakdown in Vacuum, Breakdown of Electronegative gases
Module 2

Partial Discharge: Breakdown of gaseous medium in non uniform field. Effect of polarity on corona inception and breakdown process.
Partial discharge development in solid dielectric under d.c and a.c voltage applications. Measurement of Partial Discharges, different techniques, Electrical method: apparent charge, straight method, balanced method.

Module 3

Multistage Impulse Generator, Representation of multistage impulse generator by single stage generator, analysis of single stage impulse generator circuit, triggering of impulse generator, triggering techniques.
Impulse current generator
Generation of switching surge
D.C High Voltage Generation:
Multistage Cockcroft Walton Voltage doubler Circuit, Determination of optimum stage, Regulation
Measurement of Impulse voltage and impulse current.

Module 4

Voltage distribution in a transformer under impulse voltage. Tests on a transformer. Impulse voltage test. Interpretation of test result. Short circuit tests, Testing of Lightning Arrestors, Circuit Breakers

Reference Books

3. An Introduction to High Voltage Engineering- Subir Ray (PHI Learning)
4. High Voltage Engineering- M.S Naidu & V.Kamaraju (Tata Mcgraw Hills)

Power system dynamics & Control[New]

EE801B
Contacts: 3L
Credit: 3

Module-1

Modeling of Power System Components: Modeling of a synchronous generator along with its components(exciter and turbine), Modeling of a regulating transformer, three phase modeling, modeling of three phase single circuit transmission line, modeling of a pair of three phase mutually coupled transmission line, modeling of shunt capacitor and inductor, modeling of a series capacitor, modeling of an induction motor, modeling of a series capacitor, modeling of a SVC, power network modeling, modeling of a load. [8]
Module-2

**Reactive Power Flow and Voltage Control Problems:** Reactive power-voltage coupling concept, reactive power and voltage regulation, load bus reactive power sensitivity, effect of series reactive loss, reactive power requirement for control of voltage in long lines, concept of voltage stability and system voltage expression, stability margins, fundamental aspects of analysis of power system voltage stability-static and dynamic analysis, QV operation of on load tap changer in voltage stability, load flow and voltage stability, voltage security, magnitude and power angle of receiving end bus voltage at voltage stability limit. [10]

**Module-3**

**Power System Compensation and FACTs Devices:** Load compensation, line compensation, passive compensation — static shunt capacitor and reactor, uniformly distributed shunt compensation, shunt compensation at middle of the line using dynamic compensator, series capacitor compensator, comparison between shunt and series compensation, FACTs controllers, (series type, shunt type, combined shunt and series type FACTs controller), advantages of FACTs devices. [12]

**Module-4**

**Small Signal Stability and Subsynchronous Resonance:** Introduction, stability of a dynamic system, modes of oscillation, mechanism of tie line oscillator, small signal stability of a single machine on infinite bus (SMIB), modeling of small signal stability, effect of exciter on small signal stability, SSR in series compensated systems, modeling and analysis of mechanical system and analogy with electrical system, countermeasures to SSR. [10]

**Books**

1. Power system analysis, operation and control. A.Chakrabarti and S. Halder, PHI publication, (3rd Edn.)
2. Power system dynamics, stability and control. K.R. Padiyar, BS publication. (2nd Edn.)
3. Reactive power control and voltage stability of EHV power transmission system. A. Chakrabarti, D,P Kothari,. A.K Mukhapadhyay and A.De, PHI publication. (1st Edn.)

**ENERGY MANAGEMENT AND AUDIT [New]**

EE801C
Contacts: 3L
Credit: 3

**Module - 1:** (9 Lectures)

**Module-2:** (9 Lectures)
Basics of energy and its various forms: (a) thermal (b) Electricity (c) Non-Conventional Sources
Electricity: AC & DC, Load Management, Maximum Demand Control, Aggregated Technical & Commercial Losses (ATC), Electricity Tariffs.

Module-3 (9 Lectures):

Module-4 (9 Lectures):
Energy Audit: Definition, Requirements for Energy Audit, Different Approaches viz, Preliminary and Detailed Energy Audit, Case Studies for Real Systems.

Books:
3. www.bee.org

REFERENCES:
1. NPC energy audit manual and reports

Non linear Control systems[New]
EE801D
Contacts: 3L
Credit: 3

Module-I: (9 Lectures)
Introduction: Block diagram and State Variable representations of Nonlinear Systems; Behavior of Nonlinear Dynamic Systems: (Multiple Equilibria, Limit Cycles, bifurcation); Examples of Simple Nonlinear Models: Pendulum Equation, Tunnel-Diode Circuit, Mass-Spring System, Negative-Resistance Oscillator; Common Nonlinearities. (6)

Small perturbation Linearization of nonlinear systems in state variable form: Linearization about equilibrium point, about nominal trajectory, Jacobian of simple nonlinear systems, Stability analysis by Lyapunov’s First Theorem. (3)

Module-II: (7 Lectures)

Module-III: (11 Lectures)
Frequency Domain Analysis of Feedback Systems: Absolute Stability, Circle Criterion, Popov Criterion, Closed loop Stability analysis and limit cycle prediction using Describing Function Method. (9)
Passivity: Memory-less Functions, State Models, Positive Real Transfer Functions, L2 and Lyapunov Stability, Feedback Systems: Passivity Theorems (statements only). (2)
West Bengal University of Technology  
BF-142, Salt Lake City, Kolkata-700064

Revised & Final Syllabus of B.Tech in EE upto 8th Semester (To be followed from the academic session July 2007, i.e. for the students who were admitted in Academic Session 2006-2007). The syllabi of other semesters will be published soon.

Module-IV: (9 Lectures)
Feedback Linearization: Motivation, Input–Output Linearization, Full-State Linearization, State Feedback Control and Stabilization. (5)
Sliding Mode Control: Overview of SMC, Motivating Examples: Stabilization of second order system; Advantages and disadvantages. (4)

Text Book

Ref Books:
6. D. Roychoudhuri, Modern Control Engineering (Chapter 14), Prentice Hall of India, 2005

Elective-II

COMMUNICATION ENGG
EE802A
Contacts: 3L
Credit: 3

Linear modulations - AM, DSB, SSB and VSB. Envelope and synchronous detection. Carrier recovery-different loops e.g. PLL etc. Circuits to generate linear modulated signals. Low and high power modulators. Exponential modulation. Frequency and phase modulations. Generation of FM & PM. Radio receivers-superheterodyne principle. AGC, Elements of antenna technology, wave guide and microwave technology.

Noise sources and their characteristics, noise temperature, noise figure and bandwidth. SNR, performance of AM, PM and pulse modulation over different transmission channels.


Elements of satellite communications - tracking and control, launching. Propagation characteristics. Satellite transponders and antennas. Modern trends in communications systems.

Books:
2. G. Kennedy - Electronic communication Systems - TMH
### Sensors & Transducers [New]

**EE802B**  
Contacts: 3L  
Credit: 3

#### Module I

<table>
<thead>
<tr>
<th>Topic</th>
<th>Credit</th>
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<tbody>
<tr>
<td>Definition, principles of sensing and transduction, classification</td>
<td>1</td>
</tr>
<tr>
<td>Mechanical and Electromechanical sensors</td>
<td></td>
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<tr>
<td>Resistive (potentiometric) type: resolution, accuracy, sensitivity</td>
<td>1</td>
</tr>
<tr>
<td>Strain Gauges: theory, types, sensitivity, gauge factor, variation with temperature</td>
<td>1</td>
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<tr>
<td>Inductive sensors: common types- reluctance change type, mutual inductance change type, transformer action type, magnetostrictive type</td>
<td>1</td>
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<tr>
<td>LVDT: Construction, output-input relationship, I/O curve, discussion</td>
<td>1</td>
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<tr>
<td>Proximity sensor</td>
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#### Module II

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<tr>
<th>Topic</th>
<th>Credit</th>
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<tbody>
<tr>
<td>Capacitive sensors: Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type: calculation of sensitivities</td>
<td>3</td>
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<tr>
<td>Stretched Diaphragm type: microphones, response characteristics</td>
<td>2</td>
</tr>
<tr>
<td>Piezoelectric elements: piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, force and stress sensing, ultrasonic sensors</td>
<td>3</td>
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</table>

#### Module III

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<thead>
<tr>
<th>Topic</th>
<th>Credit</th>
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<tbody>
<tr>
<td>Thermal sensors:</td>
<td></td>
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<tr>
<td>Material expansion type: solid, liquid, gas and vapour</td>
<td>2</td>
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<tr>
<td>Resistance change type: RTD, materials, construction, tip sensitive and stem sensitive type, Thermister materials, shapes, ranges, accuracy specifications.</td>
<td>3</td>
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<tr>
<td>Thermoemf sensors: types, thermoelectric powers, general consideration</td>
<td>1</td>
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<tr>
<td>Junction semiconductor type IC and PTAT type</td>
<td>2</td>
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<tr>
<td>Radiation sensors: types, characteristics and comparisons</td>
<td>2</td>
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<tr>
<td>Pyroelectric type</td>
<td>1</td>
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#### Module IV

<table>
<thead>
<tr>
<th>Topic</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>Magnetic sensors:</td>
<td></td>
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<tr>
<td>Sensors based on Villari effect for assessment of force, torque, proximity; Wiedemann effect for yoke coil sensors, Thomson effect.</td>
<td>4</td>
</tr>
<tr>
<td>Hall effect and Hall drive, performance characteristics</td>
<td></td>
</tr>
<tr>
<td>Radiationsensors: LDR, photovoltaic cells, photodiodes, photo emissive cells- types, materials, construction, response</td>
<td>2</td>
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<tr>
<td>Geiger counters, Scintillation detectors</td>
<td>2</td>
</tr>
<tr>
<td>Introduction to Smart sensors</td>
<td>2</td>
</tr>
<tr>
<td>Humidity, pH, conductivity</td>
<td>1</td>
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</tbody>
</table>
Velocity, Acceleration:
Electromagnetic velocity sensor; spring-mass-system, measurement of deflection
principle of accelerometers, sensitivity, noise
Flow:
Pressure gradient technique; (orifice, venture, pitot,) rotameter thermal transport technique; electromagnetic
sensor, laser doppler anemometry; ultrasonic sensors

<table>
<thead>
<tr>
<th>Books:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. D Patranabis, Sensors and Transducers, PHI, 2nd ed.</td>
</tr>
</tbody>
</table>

AI and Soft computing
EE802C
Contacts: 3L
Credit: 3

Machine Learning & AI - Introduction, hierarchical perspective and foundations. Rote Learning, Learning by advice, Learning in problem solving inductive learning, explanation based learning, learning from observation and discovery, learning by analogy, introduction to formal learning theory.

Biological neurons and brain, models of biological neurons, artificial neurons and neural networks, Early adaptive nets Hopfield nets, back error propagation competitive learning lateral inhibition and feature maps, Stability - Plasticity and noise saturation dilemma, ART nets, cognition and recognition.

Neural nets as massively parallel, connectionist architecture, Application in solving problems from various are as e.g., AI, Computer Hardware, networks, pattern recognition sensing and control etc.

Books:
1. P H Winston - Artificial Intelligence - Pearson Education
2. Bishop, Neural Networks for Pattern Recognition, OUP
3. Cohen, Empirical Methods for AI, PHI
4. Haykin, Neural Network, Pearson Education PHI
5. E Charniak and W Midermott - Introduction to Artificial Intelligence - Pearson Education.
7. Shivanandan, Artificial Neural Network, Vikas

Project Management & Operation Research
EE802D
Contacts: 3L
Credit: 3
Project formalities - feasibility study and economic evaluation; UNI DO, OECD and RBI guidelines. Network based project management-graph-theoretic applications. CPM, PERT, GERT and DCPM activities. Scheduling with limited resources, cash scheduling to multi projects situation. Project monitoring and control. Project management under risk and uncertainty.
Operations research-decision-making, development of OR. Linear programming; Formulating of LP models, graphical solution, simplices method, duality theory and application. Transportation problem, Assignment problem. Waiting line models; elements of queuing models. Poisson arrival and exponential service time distribution, M/M/1 Queue. Finite population models. Queuing art models. Applications. Simulation; modeling, use of random members, flow-chart development, Inventory Control-introduction, costs, deterministic and stochastic models, buffer stocks.

Books:
3. Panneerselvam, Production & Operations Management, PHI
4. Taha - Operation Research, Pearson Education, PHI
5. Kalavathy, Operation Research, Vikas
6. Patel, Project Management, Vikas
7. Juran - Quality Planning & Analysis 3rd Edn. - MGH
10. Adam & Ebert - Production & Operations Management: Concepts, Models and Behaviour 5th Edn. – PHI/ Pearson Education.