### ECE SECOND YEAR: THIRD SEMESTER

#### A. THEORY

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**Total of Semester:** 35 29

### ECE SECOND YEAR: FOURTH SEMESTER

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### Third Year - Fifth Semester

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Laboratories to have both physical experiments and simulation. Only virtual laboratory is not accepted.

### Third Year - Sixth Semester

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### Fourth Year - Eighth Semester

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NUMERICAL METHODS
Code: M(CS) 301
Contacts: 2L +1T
Credits: 2

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. (4)

Interpolation: Newton forward/backward interpolation, Lagrange’s and Newton’s divided difference interpolation. (5)

Numerical integration: Trapezoidal rule, Simpson’s 1/3 rule, Expression for corresponding error terms. (3)

Numerical solution of a system of linear equations:
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. (6)

Numerical solution of Algebraic equation:
Bisection method, Regula-Falsi method, Newton-Raphson method. (4)

Numerical solution of ordinary differential equation: Euler’s method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method. (6)

Text Books:

References:
2. Baburam: Numerical Methods, Pearson Education.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.

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

Note 1: The entire syllabus has been divided into four modules.

Note 2: Structure of Question Paper
There will be two groups in the paper:

Group A: Ten questions, each of 2 marks, are to be answered out of a total of 15 questions, covering the entire syllabus.

Group B: Five questions, each carrying 10 marks, are to be answered out of (at least) 8 questions. Students should answer at least one question from each module.

At least 2 questions should be set from each of Modules II & IV.
At least 1 question should be set from each of Modules I & III. Sufficient questions should be set covering the whole syllabus for alternatives.

Module I: Fourier Series & Fourier Transform [8L]

Topic: Fourier Series:
Sub-Topics: Introduction, Periodic functions: Properties, Even & Odd functions: Properties, Special wave forms: Square wave, Half wave Rectifier, Full wave Rectifier, Saw-toothed wave, Triangular wave. (1)
Euler’s Formulae for Fourier Series, Fourier Series for functions of period 2π, Fourier Series for functions of period 2l, Dirichlet’s conditions, Sum of Fourier series. Examples. (1)

Topic: Fourier Transform:
Sub-Topics: Fourier Integral Theorem (statement only), Fourier Transform of a function, Fourier Sine and Cosine Integral Theorem (statement only), Fourier Cosine & Sine Transforms of elementary functions. (1)

Convolution Theorem (statement only), Inverse of Fourier Transform, Examples. (2)
Module II: Calculus of Complex Variable [13L]

Topic: Introduction to Functions of a Complex Variable.

Sub-Topics: Complex functions, Concept of Limit, Continuity and Differentiability. (1)

Analytic functions, Cauchy-Riemann Equations (statement only). Sufficient condition for a function to be analytic. Harmonic function and Conjugate Harmonic function, related problems. (1)

Construction of Analytic functions: Milne Thomson method, related problems. (1)

Topic: Complex Integration.

Sub-Topics: Concept of simple curve, closed curve, smooth curve & contour. Some elementary properties of complex Integrals. Line integrals along a piecewise smooth curve. Examples. (2)

Cauchy’s theorem (statement only). Cauchy-Goursat theorem (statement only). Examples. (1)

Cauchy’s integral formula, Cauchy’s integral formula for the derivative of an analytic function, Cauchy’s integral formula for the successive derivatives of an analytic function. Examples. (2)

Taylor’s series, Laurent’s series. Examples (1)

Topic: Zeros and Singularities of an Analytic Function & Residue Theorem.

Sub-Topics: Zero of an Analytic function, order of zero, Singularities of an analytic function. Isolated and non-isolated singularity, essential singularities. Poles: simple pole, pole of order m.

Examples on determination of singularities and their nature. (1)

Residue, Cauchy’s Residue theorem (statement only), problems on finding the residue of a given function, evaluation of definite integrals:

\[
\int_0^\infty \sin \frac{x}{x} \, dx, \quad \int_0^{2\pi} \frac{d\theta}{a+bcos \theta + c \sin \theta}, \quad \int_C \frac{P(z)}{Q(z)} \, dz
\]

(elementary cases, \(P(z)\) & \(Q(z)\) are polynomials of 2nd order or less). (2)

Topic: Introduction to Conformal Mapping.

Sub-Topics: Concept of transformation from z-plane to w-plane. Concept of Conformal Mapping. Idea of some standard transformations. Bilinear Transformation and determination of its fixed point. (1)

Module III: Probability [8L]

Topic: Basic Probability Theory

Sub-Topics: Classical definition and its limitations. Axiomatic definition.

Some elementary deduction: i) \(P(O)=0\), ii) \(0\leq P(A)\leq 1\), iii) \(P(A')=1-P(A)\) etc. where the symbols have their usual meanings. Frequency interpretation of probability. (1)

Addition rule for 2 events (proof) & its extension to more than 2 events (statement only). Related problems.

Conditional probability & Independent events. Extension to more than 2 events (pairwise & mutual independence). Multiplication Rule. Examples. Baye’s theorem (statement only) and related problems. (3)


Sub-Topics: Definition of random variable. Continuous and discrete random variables. Probability density function & probability mass function for single variable only. Distribution function and its properties (without proof). Examples. Definitions of Expectation & Variance, properties & examples. (2)

Some important discrete distributions: Binomial & Poisson distributions and related problems.

Some important continuous distributions: Uniform, Exponential, Normal distributions and related problems. Determination of Mean & Variance for Binomial, Poisson & Uniform distributions only. (2)

Module IV: Partial Differential Equation (PDE) and Series solution of Ordinary Differential Equation (ODE) [13L]

Topic: Basic concepts of PDE.

Sub-Topics: Origin of PDE, its order and degree, concept of solution in PDE. Introduction to different methods of solution: Separation of variables, Laplace & Fourier transform methods. (1)

Topic: Solution of Initial Value & Boundary Value PDE’s by Separation of variables, Laplace & Fourier transform methods.

Sub-Topics:

PDE I: One dimensional Wave equation. (2)
**CIRCUIT THEORY & NETWORKS**

**Code : EC 301**

**Contacts : 3L + 1T = 4hrs  
Credits : 4**

<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
<th>Hrs</th>
</tr>
</thead>
</table>
| 1.     | **a)** Resonant Circuits: Series and Parallel resonance [1L], (*) Impedance and Admittance Characteristics, Quality Factor, Half Power Points, Bandwidth [2L], Phasor diagrams, Transform diagrams [1L], Practical resonant and series circuits, Solution of Problems [Tutorial - 1L].
|        | **b)** Mesh Current Network Analysis: Kirchoff’s Voltage law, Formulation of mesh equations [1L], Solution of mesh equations by Cramer’s rule and matrix method [2L], Driving point impedance, Transfer impedance [1L], Solution of problems with DC and AC sources [1L]. | 6 |
| 2.     | **a)** Node Voltage Network Analysis: Kirchoff’s Current law, Formulation of Node equations and solutions [2L], driving point admittance, transfer Admittance [1L], Solution of problems with DC and AC sources [1L].
|        | **b)** Network Theorems: Definition and Implication of Superposition Theorem [1L], Thevenin’s theorem, Norton’s theorem [1L], Reciprocity theorem, Compensation theorem [1L], maximum Power Transfer theorem [1L], Millman’s theorem, Star delta transformations [1L], Solutions and problems with DC and AC sources [1L]. | 6 |
| 3.     | **Graph of Network:** Concept of Tree and Branch [1L], tree link, junctions, (*) Incident matrix, Tie set matrix [2L], Coupled Circuits: Magnetic coupling, polarity of coils, polarity of induced voltage, concept of Self and mutual inductance, Coefficient of coupling, Solution of Problems.
|        | Circuit transients: DC transients in R-L and R-C Circuits with and without initial charge, (*) R-L-C Circuits, AC Transients in sinusoidal R-L, R-C and R-L-C Circuits, Solution of Problems [2L]. | 8 |
| 4.     | Laplace transform: Concept of Complex frequency [1L], transform of f(t) into F(s) [1L], transform of step, exponential, over damped surge, critically damped surge, damped and undamped sine functions [2L], properties of Laplace transform [1L], linearity, real differentiation, real integration, initial value theorem and final value theorem [1L], inverse Laplace transform [1L], application in circuit analysis, Partial fraction expansion, Heaviside’s expansion theorem, Solution of problems [1L].
|        | (*) Laplace transform and Inverse Laplace transform [2L]. Two Port Networks: Relationship of Two port network variables, short circuit admittance parameters, open circuit impedance parameters, transmission parameters, relationship between parameter sets, network functions for ladder network and general network. | 8 |

Old module 9 viz. SPICE deleted for consideration in Sessional Subject.

**Problems for Module 1a:**

**Ex. 1.** A parallel RLC Circuit has R = 100 K Ohms, L = 10 mH, C = 10 nF. Find resonant frequency, bandwidth and Quality factor.

**Ex. 2.** Two coils one of R = 0.51 Ohms, L = 32 mH, other of R = 1.3 Ohms, L = 15 mH, and two capacitors of 25 micro F and 62 micro F are in series with a resistance of 0.24 Ohms. Determine resonance frequency and Q of each coil.

**Ex. 3.** In a series circuit with R = 50 Ohms, L = 0.05 mH and C = 20 micro F, frequency of the source is varied till the voltage across the capacitor is maximum. If the applied voltage is 100 V, find the maximum voltage across the capacitor and the frequency at which this occurs. Repeat the problem with R = 10 Ohms.

**Problems for Module 1b and 2:**
Examples for mesh current in networks like T, \( \pi \), bridged T and combination of T and \( \pi \).

*See Annexure-1 for the figures*

**Problems for Module- 2a:**

**Ex.1.** The network of Fig.1 – Mod.4 is in the zero state until \( t=0 \) when switch is closed. Find the current \( i_1(t) \) in the resistor R3.

Hints: the Fig.1 – Mod.4 shows the same network in terms of transform impedance with the Thevenin equivalent network.

**Ex.2.** Find the Norton’s equivalent circuit for the circuit Fig.2 – Mod.4.

Hints: As a 1st step, short the terminals ab. This results in the Circuit of Fig.2.(a). By applying KCL at node a, we have, 
\[(0-24)/4 + \text{isc} = 0; \text{i.e. isc} = 9 \text{ A}.\]
To find out the equivalent Norton’s impedance \( R_N \), deactivate all the independent sources, resulting in a circuit of Fig.2.(b), \( R_N = (4\times12)/(4+12) = 3 \text{ Ohms}. \) Thus we obtain Norton equivalent circuit of Fig.2 (c).

**Problems for Module – 2b:**

**Ex.1.** Draw the graph, one tree and its co tree for the circuit shown in Fig.1 – mod.5.

Hints: In the circuit there are four nodes (\( N=4 \)) and seven branches (\( B=7 \)). The graph is so drawn and appears as in Fig. 1 (a). Fig.1(b) shows one tree of graph shown in Fig. 1(a). The tree is made up of branches 2, 5 and 6. The co tree for the tree of Fig.1 (b) is shown in Fig. 1(c). The co tree has \( L=B-N+1=7-4+1=4 \) Links.

**Ex.2.** (a). For the circuit shown in Fig.2- Mod.5, construct a tree so that \( i_1 \) is a link current. Assign a complete set of link currents and find \( i_1(t) \).

(b). Construct another tree in which \( v_1 \) is a tree branch voltage. Assign a complete set of tree branch voltages and \( v_1(t) \).

Take \( i(t) = 25 \sin 1000t \) A, \( v(t) = 15 \cos 1000t \).

**Tutorials:** (*):Bold and Italics.

**Text Books:**

3. D.A.Bell- Electrical Circuits- Oxford
Reference Books:

1. A.B. Carlson - Circuits - Cengage Learning
7. P. Ramesh Babu - Electrical Circuit Analysis - Scitech
10. Sivandam - “Electric Circuits and Analysis”, Vikas
Module - 1: Energy Bands and Charge Carriers in Semiconductors

**Details:**
- Energy-band (E-k) diagram, effective mass, wave vector, Debye length, Direct & indirect band-gap semiconductors; Carrier distribution, Fermi-level, Intrinsic & Extrinsic semiconductors, Non-equilibrium in carrier distribution; drift, diffusion, scattering; Piezo & Hall effects. [8]
- Concept of the effective mass & crystal momentum, concept of wave-vector `k`; Intrinsic & extrinsic semiconductors, idea about degeneracy and non-degeneracy. (2L)
- Carrier concentration in terms of bulk Density of states and Fermi-Dirac distribution (no derivation, expression and significance only); Concept of Fermi level, F.L. shift with doping & temperature; (2L)
- Non-equilibrium condition: Drift & diffusion of carriers with simple expressions; Hall effect & Piezo-electric effect, Carrier scattering (basic idea only).
- Generation and re-combination, quasi-Fermi energy level (concept only) (3L)

Module - 2: Rectifier and detector diodes

**Details:**
- P-N junction & Schottky junction physics, I-V relation, Junction capacitances, Diode switching, Optical devices & Solar cells, Tunnel diode. (10)
- Homo- and Hetero-junctions – examples of semiconductor-semiconductor junction (Homo) & Metal-metal, Metal-S.C. junctions (Hetero-) (1L);
- Recapitulation of the rectifying properties of these two types of junctions; Homo-junction – Semiconductor-semiconductor p-n junction & rectification (recapitulation) (1L); Plot of junction voltage, field and depletion charge with distance by solving simple 1D Poisson's Equation (Gradual Channel & Depletion Approximations) (1L); Schottky contact & Schottky diode (1L); Junction capacitances in p-n diodes (recapitulation) and their expressions; Application of Diode capacitance in Varactor Diodes (1L); Derivation for Forward and Reverse current, piece-wise linear diode-characteristics, concept of Diode resistance & Differential diode resistance, (1L); Diode switching & diode switch, properties of rectifier and switching diodes (1L); Importance of reverse current in optical detectors, photo-diodes, solar cells (1L); Spontaneous emission & Stimulated emission - optical devices (basic idea only) (1L), Tunnel diode (basic principle only - importance of negative resistance) (1L).

Module - 3: Bipolar Junction Transistors

**Details:**
- Physical mechanism, current gain, minority current distribution; Punch-through and avalanche effect; High voltage and high power transistors; Frequency limitations, high frequency transistors, Power transistors. [8]
- Concept of Field effect device (recapitulation), channel modulation & channel isolation (1L); JFET - behaviour, characteristics (1L); MOSFET - channel inversion, Ideal Threshold voltage (1L), MOS capacitances, depletion width, surface field and potential (by solving Poisson's equation with gradual channel & depletion approximations) (2L); Real MOSFET & Threshold voltage for real MOSFET, (1L); I-V characteristics with expressions for saturation and non-saturation regions (concepts but no detail derivations, empirical relations to be used for solving problems) (1L); Equivalent circuit for MOSFET (1L); MOSFET for VLSI - scaling issues (basic concept of Short Channel Effects only) (1L).

**Text Books:**
- Neamen- Semiconductor Physics and Devices TMH
- Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
- Maini & Agrawal- Electronics Devices and Circuits- Wiley

**Reference Books:**
- Milman, Halkias & Jit- Electronics Devices and Circuits- TMH
- Bell-Electronics Devices and Circuits-Oxford
- Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
- Singh & Singh- Electronics Devices and Integrated Circuits- PHI
- Bogart, Bisley & Rice- Electronics Devices and Circuits- Pearson
- Kasap-Principles of Electronic Materials and Devices- TMH
- Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson
- Salivahanan, Kumar & Vallavaraj- Electronics Devices and Circuits- TMH

**Learning Outcome:**

Module - 1: Student gains the ability to identify semiconductors which are elemental or compound type; Direct and indirect band-gap type so that
they may be used in optical and non-optical devices; this empowers the student to explain the importance of Fermi level in identifying intrinsic and extrinsic n- and p-type semiconductors, to predict how Fermi-level changes with doping; identify degenerate and non-degenerate semiconductors; indicate the effect of temperature on carrier concentration.

**Module - 2:** Focus is on understanding the junction phenomena including alignment of Fermi-level at the interface of a p-n junction and Schottky junction, and its non-alignment due to the application of junction potential. The student will be able to draw the I-V characteristics; acquire the ability to evaluate the dependence of reverse saturation (drift) current on minority carrier concentration and forward diffusion component on potential barrier; the student will calculate the junction capacitances and compare the switching capability of the minority carrier p-n diode with the majority carrier based Schottky diode; to highlight the importance of peak-inverse voltage for a diode and compare the peak inverse voltages of Si and Ge diodes.

**Practical ability:** Diode specification; Diode numbers and lead specification; Drawing diode characteristics and calculation of differential resistance; load-line analysis of simple diode circuits. [To be practiced in the laboratory]

**Module - 3:** The student will appreciate the importance of varying the reverse saturation current across the reverse biased base-collector junction by varying the minority carrier concentration using electrical means i.e. forward biased emitter-base junction; acquire the ability to treat the BJT as a two port device and explain transistor action for output current control by changing input current; The student will be able to use CE, CB and CC modes for different applications and design biasing circuits with BJTs.

**Practical ability [For Laboratory Practice]:** Transistor lead testing and transistor testing; Transistor biasing for different classes of amplifiers; [To be practiced in the laboratory]

**Module - 4:** Ability to calculate the threshold voltages for different MOSFETs; ability to compute the effect of Gate voltages on the junction capacitances; ability to bias MOSFETs and JFETs.

**Practical ability [For Laboratory Practice]:** JFET and MOSFET specifications; Biasing of FETs. [To be practiced in the laboratory]

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**SIGNALS AND SYSTEMS**

**Code:** EC 303  
**Contacts:** 3L +0T =3hrs  
**Credits:** 3

**Pre requisite:** First year courses (semester I & II) covering
1. (1) Concepts in electrical and electronics circuits (Basic Electrical and Electronics Engg I & II).
2. (2) Knowledge in algebra and calculus with problem solving capability (studied in Mathematics-I).
3. (3) Fundamental concepts on Laplace Transformation (studied in Mathematics-II)
4. (4) Fundamental concepts on Laplace Transformation (studied in Mathematics-II)

**Genesis:** The scope of this paper is to introduce a panoramic view of signals & systems so that the students may understand the basic concepts of various systems and signal processing and the way the signals interact with the physical systems. This understanding is not only the prerequisite to study the subject DSP (to be introduced in the higher semester), but also crucial for understanding fundamental concepts in communication engineering in general and to some extent for other upcoming subjects such as control engineering and circuit analysis/synthesis.

**Outcome:** The course will enable the students to study the various tools of signal analysis and acquire confidence in studying all other communication related subjects (in particular DSP) in the subsequent semesters.

<table>
<thead>
<tr>
<th>Module No</th>
<th>Topic</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Signal Transformation: Fourier transformation of continuous and discrete time signals and their properties. Laplace transformation- analysis with examples and properties. Parseval’s theorem; Convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems.</td>
<td>8</td>
</tr>
<tr>
<td>5.</td>
<td>Laplace Transform: Recapitulation, Analysis and characterization of LTI systems using Laplace transform: Computation of impulse response and transfer function using Laplace transform.</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>Sampling Theorem: Representation of continuous time signals by its sample –Types of sampling. Sampling theorem. Reconstruction of a Signal from its samples, aliasing–sampling of band pass signals.</td>
<td>6</td>
</tr>
<tr>
<td>8.</td>
<td>Random Signals &amp; Systems: Definitions, distribution &amp; density functions, mean values &amp; moments, function of two random variables, concepts of correlation, random processes, spectral densities, response of LTI systems to random inputs.</td>
<td>32 hrs</td>
</tr>
</tbody>
</table>

**Total:** 32 hrs

**Text Books:**
4. S.Haykin & B.V.Veen, Signals and Systems- John Wiley
5. A.Nagoor Kani- Signals and Systems- McGraw Hill

**References:**
2. C-T Chen- Signals and Systems- Oxford
3. E WKamen &BS Heck- Fundamentals of Signals and Systems using the Web and MATLAB- Pearson
4. B.P.Lathi- Signal Processing & Linear Systems- Oxford
5. P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e- Sceitech
6. M.I.Roberts, Signals and Systems Analysis using Transform method and MATLAB, TMH
7. S Ghosh- Signals and Systems- Pearson
8. M.H.Hays- Digital Signal Processing “, Schaum’s outlines, TMH
10. Phillip, Parr & Riskin- Signal, Systems and Transforms- Pearson
Module-1: [10]
   a) Filters and Regulators: Capacitor filter, $\pi$-section filter, ripple factor, series and shunt voltage regulator, percentage regulation, 78xx and 79xx series, concept of SMPS.  
   
   b) Transistor Biasing and Stability: Q-point, Self Bias-CE, Compensation techniques, h-model of transistors. Expression for voltage gain, current gain, input and output impedance, trans-resistance & trans-conductance; Emitter follower circuits, High frequency model of transistors.

Module -2: [10]
1. Transistor Amplifiers: RC coupled amplifier, functions of all components, equivalent circuit, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, and concept of wide band amplifier.
2. Feedback Amplifiers & Oscillators: Feedback concept, negative & positive feedback, voltage/current, series/shunt feedback, Berkhausen criterion, Colpitts, Hartley's, Phase shift, Wein bridge and crystal oscillators.

Module -3: [10]
1. Operational Amplifier: Ideal OPAMP, Differential Amplifier, Constant current source (current mirror etc.), level shifter, CMRR, Open & Closed loop circuits, importance of feedback loop (positive & negative), inverting & non-inverting amplifiers, voltage follower/buffer circuit.

Module -4: [8]
1. Power amplifiers – Class A, B, AB, C, Conversion efficiency, Tuned amplifier
2. Multivibrator – Monostable, Bistable, Astable multivibrators; Monostable and astable operation using 555 timer.
3. Special Functional Circuits: VCO and PLL.

Total: 40 hrs

Text Books:
1. Sedra & Smith-Microelectronic Circuits- Oxford UP

Reference Books:
2. Rashid-Microelectronic Circuits-Analysis and Design- Thomson (Cengage Learning)
4. Razavi- Fundamentals of Microelectronic s- Wiley
7. Bell- Operational Amplifiers and Linear ICs- Oxford UP
9. Gayakwad R.A – OpAmps and Linear IC’s, PHI
Tutorial Guidance:

**Prerequisite:** Basic knowledge about components R.L.C, Network Theorems (Kirchoffs law, Thevenin's theorem, Miller theorem etc.). Basic knowledge about the operation of semiconductor devices (Transistor, Diode, UJT, SCR etc.), Ohms Law, Voltage current equations. Basic knowledge of Differentiation, Integration, Differential equation, matrix etc.

**Basic level of understanding:** Current Voltage equation. Direction of current flow. Device limitations, Power consumptions and their limits, usage of appropriate device in the problem. Device selection and comparison, advantages and disadvantages.

**Outcome of learning:** Students will be able to design, test and examine simple circuits with transistor, op-amp, amplifiers, oscillators etc. They will be able to test, repair, modify and take-up design exercise. They will have clear knowledge of basic circuit analysis and its functions and their limitations. Most importantly they will be able to recognize, understand, modify and repair majority of circuits used in professional equipment design.

### Module: 1 Filter and regulator

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference book (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitor filter, I section filter ripple factor, series and shunt voltage regulator, percentage regulator, 78xx and 79xx series, concepts of smps</td>
<td>Linear integrated circuits-D.Roy Choudhury, Shail B. Jau(Chapter 6&amp;7)</td>
</tr>
<tr>
<td></td>
<td>Electronic Devices and Circuit Theory-Boylested Chapter 18)</td>
</tr>
</tbody>
</table>

**Assignment:** (These are typical examples, indicative of the type of problems to be set for tutorials.)

1. Determine the regulated voltage and circuit currents for the shunt regulator.

![Circuit diagram 1]

2. Calculate the regulated output voltage in the ckt of fig.

![Circuit diagram 2]

3. A 500 μF capacitor provides a load current of 200 mA at 8% ripple; calculate the pick rectified voltage obtained from the 60 Hz supply and the dc voltage across the filter capacitor.

4. Calculate the size of the filter capacitor needed to obtained a filtered voltage with 7% ripple at a load of 200mA. The full wave rectified voltage is 30v, and the supply is 60 Hz.
Module -2 : Transistor Biasing and stability

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference Book (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q Point, self – Bias – CE, compensation technique, h-module of transistors, Expression for voltage gain, current, gain Input and output impedance, trans- resistance and Tran conductance emitter follower circuits</td>
<td>Electronics –fundamental— D Chattopadhyaya &amp; P.C. Rakhit (Chapter—8)</td>
</tr>
<tr>
<td>High frequency modes of transistor</td>
<td>Microelectronic circuits—Sedra &amp; Smith (Chapter—3)</td>
</tr>
</tbody>
</table>

Assignment: (These are typical examples, indicative of the type of problems to be set for tutorials.)

1. Find the Q point of a self–bias transistor circuit with the following specification: - Vcc= 22.5 volt, R1= 5.6 KΩ, R2= 1 KΩ, R3= 90 KΩ, R4= 10 KΩ Vreq=0.7 volt and β=55 Assume Ib= 0.5 Ic

2. A CE transistor amplifier is characterised by hfe = 2 KΩ, hie = 50 and hie = 2.5*10^4 A/V. If the load resistance is 4 KΩ and the source resistance is 200 Ω determine the input resistance, the output resistance and the voltage, current and power gain.

3. A particular BJT operating at Ic= 2mA has Cβ=1 pf, Cε=10 pf and β = 150. What are f0 & f1 for this situation?

Module -3: Transistor Amplifiers:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference Book (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC coupled amplifier, function of all_components equivalent circuit, derivation of voltage gain, current gain, input impedance, frequency response characteristics, lower and upper half frequencies, bandwidth and concept of wide band amplifier.</td>
<td>Electronics Devices and Circuits----</td>
</tr>
<tr>
<td></td>
<td>S Salivahanan</td>
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<tr>
<td></td>
<td>N. Suresh kumar</td>
</tr>
<tr>
<td></td>
<td>A. Vallavaraj</td>
</tr>
</tbody>
</table>

Assignment:

1. A CE-RC coupled amplifier uses transistors with the following h-parameters: hie = 2 KΩ, hie = 50, hie = 2*10^4. The value of gb at the operating point is 200mΩ. The biasing resistor R1 &R2 may be neglected being large in comparison with R1. The load resistor Rl = 5 KΩ. Let the total shunt capacitance C= 200pf in the input Ckt. and the coupling capacitor Cc= 7 µf. Calculate for one stage of the amplifier (a) mid band current gain (b) mid band voltage gain (c) lower and higher 3 db frequencies and (d) gain-bandwidth product.

Module – 4: Feed back Amplifier and Oscillator

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference Book (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed back concept, negative and positive feed back, voltage/current, series / shunt feed back, bark house ,ultris, Hartley’s , phase shift, Wein bridge and crystal oscillator.</td>
<td>(1) Electronics devices and circuits (Chapter 14&amp; 15)</td>
</tr>
<tr>
<td></td>
<td>S Salivahanan</td>
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<td>N. Suresh kumar</td>
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<td>A. Vallavaraj</td>
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<td>(2) Electronics-Fundamentals and Applications-----</td>
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<td></td>
<td>D Chattopadhyay</td>
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<td>P. C. Rakhit ( Chapter—10)</td>
</tr>
</tbody>
</table>

Assignment: (These are typical examples, indicative of the type of problems to be set for tutorials.)

1. An Hartley oscillator is designed with L1, 20 µH, L2 = 2 mH and a variable capacitor. Determine the range of values if the frequency is varied between 950 and 2050 KHz.

2. A Colpitts oscillator is designed with C1 = 100pf and C2 = 7500pf. The inductance is variable. Determine the range of inductance values, if the frequency of oscillator is vary between 0.950 and 2050 KHz

3. In an RC phase shift oscillator, if its frequency of oscillation is 955 Hz and R1 = R2 = R3 = 680 KΩ, Find the value of capacitors.

4. In the Wein –Bridge oscillator, if the RC network consists of resistance of 200 KΩ and the capacitance of 300pf, find its frequency of oscillation.

5. A crystal has the following parameters: L = 0.33 H, C= 0.065 pf, Cε 1.0 pf and R = 5.5 KΩ. Find the series resonant frequency and Q factor of the crystal.

6. The open loop gain of an amplifier is -200. A voltage series negative feed back is used with a feed back ratio of -0.02. The input and the output impedance of the amplifier are 2 KΩ and 40 KΩ respectively in the absence of feedback. Determine the closed loop gain, and the input and the output impedance when the feed back circuit is completed.

Module: 5 Operation Amplifier:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference: (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal opAmp,CMRR,Open &amp;Closed loop circuit, Importance of feedback loop(+ve&amp;-ve),Inverting &amp; Non inverting Amplifier</td>
<td>(1) Op amps and linear Integrated Circuits - R. A. Gayakwad</td>
</tr>
<tr>
<td>Constant Current source(Current mirro etc), Level shifter, Voltage follower/Buffer Circuit, Differential Amplifier</td>
<td>(2) Linear integrated circuits-D.Roy Choudhury, shail B.Jain</td>
</tr>
</tbody>
</table>

Assignment: (These are typical examples, indicative of the type of problems to be set for tutorials.)

1. For the ckt shown in figure , calculate the expression of vo /vi
(2) Design a current source (current Mirror) for generating $I_o=25 \mu A$. Assume: $V_{cc}=15\,\text{V}$, $\beta=100$

(3) For the current mirror shown in figure, determine $R$ so that $I_o=100 \mu A$

Module: 6  Application of operational amplifier

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference: book(optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adder, Integrator, Differentiator, Comparator, Schmitt trigger,</td>
<td>Linear integrated circuits-D Roy choudhury, shail</td>
</tr>
<tr>
<td>Instrumentation amplifier, log &amp; anti log amplifier, Transconductance</td>
<td></td>
</tr>
<tr>
<td>Multiplier, Precision Rectifier, V to I and I to V converter, free</td>
<td></td>
</tr>
<tr>
<td>running oscillator</td>
<td>B.Jain</td>
</tr>
</tbody>
</table>

Assignment:
(1) in the ckt of figure, it can be shown that $V_o = a_1V_1 + a_2V_2 + a_3V_3$. Find the values of $a_1$, $a_2$ and $a_3$. Also find the value of $V_o$, if (1) $R_4$ is short ckt (2) $R_4$ removed (3) $R_1$ is short circuited.
(2) For the instrumentation amplifier shown in figure, verify that \( V_o = \frac{1}{1+R_2/R_1+2R_2/R_1} (V_2-V_1) \)

(3) Prove that the circuit shown in figure is a non inverting integrator with \( V_o = \frac{2}{Rc} \int V_i \, dt \); where \( R_1=R_2=R_3=R_4=R \)

---

**Module: 7  power Amplifier**

**Assignment:**

1. A transformer coupled class A power Amplifier supplies power to an 80 \( \Omega \) load connected across the secondary of a step-down transformer having a turn ratio 5:1. Determine the maximum power output for a zero signal collector of 120 mA.

2. A CE power amplifier operates under Class A condition with a collector supply of 46 volt. The load line passes through the point (i) \( V_c=46 \) volt, \( I_c=0 \) and (ii) \( V_c=0 \), \( I_c=2A \). The Q-point is chosen at \( I_{cq}=0.8A \) and \( V_{cq}=27.6 \) volt, calculate the maximum ac power output, the dc power input and the efficiency.

3. A single turned amplifier has the following parameters: \( L=120\mu \)A, \( C=100P \), \( R=10 \) \( \Omega \), \( h_{oe}=50*10^{-6} \), \( h_{o}=100 \), \( h_{e}=2.5K \Omega \), \( R_1=10K \Omega \). Calculate (i) The resonant frequency (ii) The bandwidth (iii) the maximum voltage gain.

**Module: 8  Multivibrator**

**Assignment:**

1. In an Astable multivibrator, \( R_A=2.2 \ K\Omega \), \( R_B=6.8 \ K\Omega \), and \( C=0.01\mu F \), calculate (i) \( t_{HIGH} \), (ii) \( t_{LOW} \), (iii) free running freq, (iv) duty cycle.

2. In a monostable multivibrator, the frequency of the input triggering is 15 \( KH \)z. If the value of \( C=0.01\mu F \), calculate the value of resistance \( R \).

**Module: 9 Special Functional Circuit**

1. In the VCO, calculate the change in output Frequency if the supply voltage is varied between 9 volt and 11 volt. Assume \( V_{cc}=12V \), \( R_T=6.8 \ K\Omega \), \( C_T=75P \), and \( R_1=15 \ K\Omega \), and \( R_2=100 \ K\Omega \).

2. Determine the dc control voltage \( V_c \) at lock if signal frequency \( f_s=10KH \)z, VCO free running frequency is 10.66\( KH \)z and the voltage to frequency transform coefficient of VCO is 6600\( H \)z/V.

3. Calculate the output frequency \( f_o \), lock range \( \Delta f_r \), and capture range \( \Delta f_c \) of a 565 PLL if \( R_T=10 \ K\Omega \), \( C_T=0.01\mu F \), and \( C=10\mu F \).
Reference Book(optional)

a) Linear Integrated Circuit:---------D.Roy Choudhary
   S.B. Jain (Chapter-9)


c) Electronics Devices and Circuits: -------- Salivahanan,N.S.Kumar

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**Practical Detailed manuals will be uploaded later.**

**NUMERICAL METHODS**

**Code : M(CS) 391**

**Credits : 1**

1. Assignments on Newton forward /backward, Lagrange’s interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson’s 1/3 rule, Weddle’s rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Euler’s and Runga-Kutta methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

**Circuits and Networks Laboratory**

**Code: EC391**

**Contacts: 3P**

**Credits: 2**

1. Characteristics of Series & Parallel Resonant circuits
2. Verification of Network Theorems
3. Transient Response in R-L & R-C Networks : simulation / hardware
4. Transient Response in RLC Series & Parallel Circuits & Networks ; simulation / hardware
5. Determination of Impedance (Z), and Admittance (Y) parameters of Two-port networks
6. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion in s-domain and cascade connection of second-order systems using MATLAB
7. Determination of Laplace Transform, different time domain functions, and Inverse Laplace Transformation using MATLAB
8. Note: An Institution / college may opt for some other hardware or software simulation wherever possible in place of MATLAB

**Solid State Devices Laboratory**

**Code: EC392**

**Contacts: 3P**

**Credits: 2**

Perform any four experiments:

Ex 1: Study input characteristics of BJT in common-emitter configuration.
Ex 2: Study output characteristics of BJT in common-emitter configuration for different base currents and hence determine hybrid parameters.
Ex 3: Study output characteristics of BJT in common-emitter configuration and find performance parameters (Voltage Gain, Current Gain, Input Impedance, Output Impedance).
Ex 4: Study the variation of small-signal voltage gain with frequency of a common-emitter RC coupled amplifier.
Ex 5: Study of drain characteristics and transfer characteristics of a JFET and hence determine the FET parameters (drain resistance, transconductance & amplification factor).
Ex 6: Study the variation of small-signal voltage gain with frequency of a JFET.

**Module 2:**

Perform any two experiments

Ex 1: Study of C-V characteristics of a Varactor diode by appropriate software.
Ex 2: Study of C-V characteristics of a MOS structure by appropriate software.
Ex 3: Study of drain characteristics and transfer characteristics of a MOSFET and hence determine the FET parameters (drain resistance, transconductance & amplification factor).

**Signals and Systems Laboratory**

**Code: 393**

**Contacts: 3P**

**Credits: 2**

1. To study Z-transform of: a) Sinusoidal signals b) Step functions.
2. To compare Fourier and Laplace transformations of a signal.
3. To study convolution theorem in time and frequency domain.
5. To study LPF & HPF, band pass and reject filters using RC circuits.
6. To demonstrate how analog signals are sampled and how different sampling rates affect the outputs.
7. To study sampling theorem for low pass signals and band pass signals.
8. To determine the components of: a) Square wave b) Clipped sine wave.

Analog Electronic Circuits Laboratory
Code: EC394.
Contacts: 3P
Credits: 2

Any 8 experiments. A College has to design a new design oriented experiment.

1. Study of Diode as clipper & clamper
2. Study of Zener diode as a voltage regulator
3. Study of ripple and regulation characteristics of full wave rectifier without and with capacitor filter
4. Study of characteristics curves of BJT & FET.
5. Design a two-stage R-C coupled amplifier & study of it’s gain & Bandwidth.
6. Study of class A & class B power amplifiers.
7. Study of class C & Push-Pull amplifiers.
10. Design a Bistable multivibrator using NE 555.
12. Design a simple function generator using IC.
14. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).
15. Study of D.A.C & A.D.C.

SEMESTER - IV

Theory

VALUES & ETHICS IN PROFESSION

HU-401
Contract: 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:


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:
Module 1:
Vector Calculus:

Module 2:
Electricity
2.1 Coulomb's law in vector form. Electrostatic field and its curl. Gauss’s law in integral form and conversion to differential form .
Electrostatic potential and field, Poisson's Eqn. Laplace's eqn (Application to Cartesian, Spherically and Cylindrically symmetric systems – effective 1D problems) Electric current, drift velocity, current density, continuity equation, steady current.

Module 3:
Magnetostatics & Time Varying Field:

Module 4:
Electromagnetic Theory:
4.1 Concept of displacement current Maxwell’s field equations, Maxwell's wave equation and its solution for free space. E.M. wave in a charge free conducting media, Skin depth, physical significance of Skin Depth, E.M. energy flow, & Poynting Vector.

Module 5:
Quantum Mechanics:

Course should be discussed along with physical problems of 1-D motion

Module 6:
Statistical Mechanics:
3.1 Concept of energy levels and energy states. Microstates, macrostates and thermodynamic probability, equilibrium macrostate. MB, FD, BE statistics (No deduction necessary), fermions, bosons (definitions in terms of spin, examples), physical significance and application, classical limits of quantum statistics Fermi distribution at zero & non-zero temperature, Calculation of Fermi level in metals, also total energy at absolute zero of temperature and total number of particles, Bose-Einstein statistics – Planck’s law of blackbody radiation.
CH401: Basic Environmental Engineering & Elementary Biology

Contacts : 3L
Credits : 3

General
Basic ideas of environment, basic concepts, man, society & environment, their interrelationship.

1L
Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development.

2L
Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function.

1L
Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering.

2L
Ecology
Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem-components types and function.

1L
Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web.

2L
Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur].

1L
Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.

2L
Air pollution and control
Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause.

1L
Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.

1L
Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth’s heat budget.

1L
Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).

2L
Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.

2L
Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant.

Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN.

2L
Smog, Photochemical smog and London smog.
Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification.

1L
Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

1L
Water Pollution and Control
Hydrosphere, Hydrological cycle and Natural water.
Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds.  

River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH.  

Lake: Eutrophication [Definition, source and effect].  

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)  

Standard and control: Waste water standard [BOD, COD, Oil, Grease].  

Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]  

Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition.  

Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic

Land Pollution  

Lithosphere; Internal structure of earth, rock and soil  

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal methods: Open dumping, Land filling, incineration, composting, recycling.  

Solid waste management and control (hazardous and biomedical waste).  

Noise Pollution  

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]  

Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level. $L_{10}$ (18 hr Index). $L_{eq}$.  

Noise pollution control.  

Environmental Management:  

Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.  

References/Books  

Transmission Lines

4. Transmission Lines; Concept of Lumped parameters and Distributed parameters. Line Parameters, Transmission line equations and solutions, Physical significance of the solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart -Applications; Load Matching Techniques / Quarter wave Matching, Bandwidth problem; Low loss RF transmission lines, line as circuit elements. [10]

5. Types of transmission line (open 2-wire, coaxial line, micro strip coplanar waveguide), applications and limitations: Design principle, Power handling capacity, Power Dissipation, Breakdown with coaxial line and micro strip line as examples. [4]

Radiation of E M Waves


Text Books
2. Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education

Reference Books
2. Fields & Waves in Communication Electronics, S. Ramo, J. R. Whinnery & T. Van Duzer, John Wiley

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS

Code : EC 402
Contacts : 3L +1T =4hrs
Credits :4

Module1.

a) Data and number systems; Binary, Octal and Hexadecimal representation and their conversions; BCD,ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1’s and 2’s complement methods, Binary arithmetic. [5]

b) Venn diagram, Boolean algebra; Various Logic gates- their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method [6]

c) Combinational circuits- Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator. [5]

Module-2:

b) Memory Systems: RAM, ROM, EPROM, EEPROM [4]

c) Design of combinational circuits-using ROM, Programming logic devices and gate arrays. (PLAs and PLDs) [4]

module-3:

Sequential Circuits- Basic memory element-S-R, J-K, D and T Flip Flops, various types of Registers and counters and their design, Irregular counter, State table and state transition diagram, sequential circuits design methodology. [6]

Module-4:

a) Different types of A/D and D/A conversion techniques. [4]

b) Logic families- TTL, ECL, MOS and CMOS, their operation and specifications. [6]

Total: 40 hours
Textbooks:
1. A.Anand Kumar, Fundamentals of Digital Circuits- PHI
2. A.K.Maini- Digital Electronics- Wiley-India

Reference:
1. Morries Mano- Digital Logic Design- PHI
2. R.P.Jain—Modern Digital Electronics, 2/e , Mc Graw Hill
6. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson
11. P.Raja- Digital Electronics- Scitech Publications

Practical

TECHNICAL REPORT WRITING & LANGUAGE LABORATORY PRACTICE
Code: HU481
Cr-2

Guidelines for Course Execution:

Objectives of this Course: This course has been designed:
1. To inculcate a sense of confidence in the students.
2. To help them become good communicators both socially and professionally.
3. To assist them to enhance their power of Technical Communication.

Detailed Course Outlines:
A. Technical Report Writing : 2L+6P
   1. Report Types (Organizational / Commercial / Business / Project )
   2. Report Format & Organization of Writing Materials
   3. Report Writing (Practice Sessions & Workshops)

B. Language Laboratory Practice

I. Introductory Lecture to help the students get a clear idea of Technical Communication & the need of Language Laboratory
Practice Sessions: 2L
2. Conversation Practice Sessions: (To be done as real life interactions) 2L+4P
   a) Training the students by using Language Lab Device/Recommended Texts/cassettes /cd's to get their Listening Skill & Speaking Skill honed
   b) Introducing Role Play & honing over all Communicative Competence
3. Group Discussion Sessions: 2L+6P
   a) Teaching Strategies of Group Discussion
   b) Introducing Different Models & Topics of Group Discussion
   c) Exploring Live /Recorded GD Sessions for mending students' attitude/approach & for taking remedial measure
Interview Sessions; 2L+6P
   a) Training students to face Job Interviews confidently and successfully
   b) Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication

4. Presentation: 2L+6P
   a) Teaching Presentation as a skill
   b) Strategies and Standard Practices of Individual /Group Presentation
   c) Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual Aids

5. Competitive Examination: 2L+2P
   a) Making the students aware of Provincial/National/International Competitive Examinations
   b) Strategies/Tactics for success in Competitive Examinations
   c) SWOT Analysis and its Application in fixing Target

Books – Recommended:
Nira Konar: English Language Laboratory: A Comprehensive Manual PHI Learning, 2011

References:
Adrian Duff et. al. (ed.): Cambridge Skills for Fluency
A) Speaking (Levels 1-4 Audio Cassettes/Handbooks)
Group 1: Experiments on Electricity and Magnetism

1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
3. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
4. Determination of specific charge (e/m) of electron by J.J. Thomson’s method.

Group 2: Quantum Physics

6. Determination of Planck’s constant using photocell.
7. Determination of Lande’g factor using Electron spin resonance spectrometer.
8. Determination of Stefan’s radiation constant
9. Verification of Bohr’s atomic orbital theory through Frank-Hertz experiment.
10. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum

Group 3: Modern Physics

11. Determination of Hall co-efficient of semiconductors.
13. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

a) A candidate is required to perform 3 experiments taking one from each group. Initiative should be taken so that most of the Experiments are covered in a college in the distribution mentioned above. Emphasis should be given on the estimation of error in the data taken.

b) In addition a student should perform one more experiments where he/she will have to transduce the output of any of the above experiments or the experiment mentioned in c] into electrical voltage and collect the data in a computer using phoenix or similar interface.

c) Innovative experiment: One more experiment designed by the student or the concerned teacher or both.

Note:

i. Failure to perform each experiment mentioned in b] and c] should be compensated by two experiments mentioned in the above list.
ii. At the end of the semester report should sent to the board of studies regarding experiments, actually performed by the college, mentioned in b] and c]
iii. Experiment in b] and c] can be coupled and parts of a single experiment.

Recommended Text Books and Reference Books:
For Both Physics I and II

1. B. Dutta Roy (Basic Physics)
2. R.K. Kar (Engineering Physics)
3. Mani and Meheta (Modern Physics)
4. Arthur Baiser (Perspective & Concept of Modern Physics)

Physics I (PH101/201)

Vibration and Waves

6. Kingsler and Frey
7. D.P. Roychaudhury
8. N.K. Bajaj (Waves and Oscillations)
9. K. Bhattacharya
10. R.P. Singh (Physics of Oscillations and Waves)
11. A.B. Gupta (College Physics Vol.II)
12. Chattopadhya and Rakshit (Vibration, Waves and Acoustics)

Optics

3. Möler (Physical Optics)
4. A.K. Ghatak
5. E. Hecht (Optics)
6. E. Hecht (Schaum Series)
7. F.A. Jenkins and H.E. White
8. 6. Chita Ranjan Dasgupta (Degree Physics Vol 3)
Quantum Physics
4. Eisberg and Resnick
5. A.K. Ghatak and S. Lokenathan
6. S.N. Ghoshal (Introductory Quantum Mechanics)
7. E.E. Anderson (Modern Physics)
8. Haliday, Resnick and Crane (Physics vol.III)
9. Binayak Dutta Roy [Elements of Quantum Mechanics]

Crystallography
2. A.J. Dekker
3. Aschroft and Mermin
4. Ali Omar
5. R.L. Singhal
6. Jak Tareen and Trn Kutty (Basic course in Crystallography)

Laser and Holography
2. A.K. Ghatak and Thyagarajan (Laser)
3. Tarasov (Optics)
4. P.K. Chakraborty (Optics)
5. B. Ghosh and K.G. Majumder (Optics)
6. B.B. Laud (Laser and Non-linear Optics)

Physics II (PH 301)

Classical Mechanics (For Module 5.1 in PH 301)
H. Goldstein
A.K. Roychaudhuri
R.G. Takwal and P.S. Puranik
Rana and Joag
M. Speigel (Schaum Series)
J.C. Upadhyya (Mechanics)

Electricity and Magnetism
9. Reitz, Milford and Christy
10. David J. Griffith
11. D. Chattopadhyay and P.C. Rakshit
12. Shadowitz (The Electromagnetic Field)

Quantum Mechanics
10. Eisberg and Resnick
11. A.K. Ghatak and S. Lokenathan
12. S.N. Ghoshal (Introductory Quantum Mechanics)
13. E.E. Anderson (Modern Physics)
14. Haliday, Resnick and Crane (Physics vol.III)
15. Binayak Dutta Roy [Elements of Quantum Mechanics]

Statistical Mechanics
1. Sears and Sallinger (Kinetic Theory, Thermodynamics and Statistical Thermodynamics)
2. Mondal (Statistical Physics)
3. S.N. Ghoshal (Atomic and Nuclear Physics)
4. Singh and Singh
5. B.B. Laud (Statistical Mechanics)
6. F. Reif (Statistical Mechanics)

Dilectrics

Electromagnetic Wave and Transmission Lines
Code: EC491
Contacts: 3P
Credits: 2

[At least THREE experiments from Module I and FOUR experiments from Module II]

Module I:
1. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the loadend.
2. Input Impedance of a terminated coaxial line using shift in minima technique.
3. Study of Smith chart on Matlab platform.
4. Simulation study of Smith chart - Single and double stub matching.

Module II:
5. Radiation Pattern of dipole antenna.
6. Radiation Pattern of a folded-dipole antenna.
7. Radiation pattern of a 3-element Yagi-Uda Antenna.
9. Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.
10. Study of Spectrum Analyzer.

Digital Electronic & Integrated Circuits Laboratory
Code: EC492
Contacts: 3P
Credits: 2

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 and vice-versa.
3. Four-bit parity generator and comparator circuits.
4. Construction of simple Decoder and Multiplexer circuits using logic gates.
5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
8. Realization of Universal Register using JK flip-flops and logic gates.
   Realization of Universal Register using multiplexer and flip-flops.
9. 
13. Design of Sequential Counter with irregular sequences.
14. Realization of Ring counter and Johnson’s counter.
15. Construction of adder circuit using Shift Register and full Adder.
Economics for Engineers
HU-501
Credits: 3

Module-I

Module-II

Module-III
5. Inflation And Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.

Module-IV

Readings
2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
5. R.Paneer Seelvan: Engineering Economics, PHI

EC501 - Analog Communication

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Topic</th>
<th>Credits</th>
<th>Hrs</th>
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<tbody>
<tr>
<td>4</td>
<td>Angle Modulation: a) Frequency Modulation (FM) and Phase Modulation (PM): Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Bessel's functions and Fourier series. (2); Phasor diagram (1); b) Generation of FM &amp; PM: Narrow and Wide-band angle modulation, Basic block diagram representation of generation of FM &amp; PM, Concept of VCO &amp; Reactance modulator (2) c) Demodulation of FM and PM: Concept of frequency discriminators (1), Phase Locked Loop (2)</td>
<td>4</td>
<td>9</td>
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Mod- 4 Multiplexing 8

26
a) Frequency Division Multiplexing, Time Division Multiplexing, (FDM) (1)
b) Stereo – AM and FM: Basic concepts with block diagrams (2)
c) Random Signals and Noise in Communication System:
   i) Noise in Communication systems – Internal & External noise, Noise Temperature, Signal-to-Noise ratio, White noise, thermal noise, Figure ofMerit. (2)
   ii) Noise performance in Analog Communication systems: SNR calculation for DSB/TC, DSB-SC, SSB-TC, SSB-SC & FM. (5)  

<table>
<thead>
<tr>
<th>Text Books:</th>
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<tbody>
<tr>
<td>8. B.P.Lathi – Communication Systems- BS Publications</td>
</tr>
<tr>
<td>2. V Chandha Sekar – Analog Communication- Oxford University Press</td>
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<tbody>
<tr>
<td>11. Singh &amp; Sapre—Communication Systems: 2/e, TMH</td>
</tr>
<tr>
<td>15. S Sharma, Analog Communication Systems- Katson Books</td>
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</tbody>
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**Learning outcome:**
Module – 1: The learner must be able to appreciate the need for modulation and calculate the antenna size for different carrier frequencies. From the functional representation of the modulated carrier wave, the learner must be able to identify the type of modulation, calculate the side-band frequencies, identify the modulating and carrier frequencies, decide the type of generation method to be adopted. Solve problems.

Module – 2: After understanding the basic concepts the learner must be able to compare between the different demodulation methods, design an envelope detector, calculate the IF and image frequencies for the superheterodyne receivers given the carrier and modulating frequencies, calculate the oscillator frequency.

Module – 3: From the functional representation of the modulated carrier wave, the learner must be able to identify the type of modulation, calculate the side-band frequencies, identify the modulating and carrier frequencies, decide the type of generation method to be adopted. Solve problems.

Module – 4: Appreciate the importance of Multiplexing, find out their application areas. The learner must be able to calculate the Noise temperature & SNR for different systems, also compare between the performance of the different modulation methods by comparing their SNR.

**Microprocessor & Microcontroller**

**Code: EC502**

**Contact:** 3L + 1T

**Credits:** 4

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1 | Introduction to Microcomputer based system. History Evolution of Microprocessor and microcontrollers and their advantages and disadvantages.

   Assembly language programming: Addition, Multiplication, Block Transfer, Ascending order, Descending order, Finding largest & smallest number, Look-up table etc.

   Arithmetic operations:

   Logical operations:

   Jump and call instructions:

   Moving data:

   External data moves, code memory read only data moves, PUSH and POP opcodes, data exchanges. |

| 2 | 8051 architecture:

   8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts.

   Assembly language Programming using 8051

   Moving data:

   External data moves, code memory read only data moves, PUSH and POP opcodes, data exchanges. |

| 3 | The 8086 microprocessor: Architecture, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts.

   Assembly language programming: Addition, Multiplication, Block Transfer, Ascending order, Descending order, Finding largest & smallest number etc. |

| 4 | Support IC chips: 8255, 8253 and 8251: Block Diagram, Pin Details, Modes of operation, control word(s) format.

   Interfacing of support IC chips with 8085, 8086 and 8051.

   Memory interfacing with 8085, 8086 & 8051.

   ADC / DAC interfacing with 8085, 8086 & 8051. |

| 5 | Brief introduction to PIC microcontroller (16F877): Architecture, PIN details, memory layout etc. |
TEXT BOOKS:

13. Microprocessor architecture, programming and application with 8085 – R. Gaonkar (Penram International) (strongly recommended)
14. The 8051 microcontroller - K. Ayala (Thomson)
15. Microprocessors & interfacing – D. V. Hall (Tata Mcgraw-hill)
16. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
17. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)
18. An Introduction to Microprocessor and Applications – Krishna Kant (Macmillan)

References:

Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan
8086 Microprocessor – K. Ayala (Cengage learning)
The 8051 microcontrollers – Uma Rao and Andhe Pallavi (PEARSON).

Learning outcome:

On completion of this course, students are expected to be capable of understanding the history and need of microprocessor, the internal architecture details, instruction sets, their timing diagram and various addressing modes of 8085/8086 microprocessor and 8051 microcontroller. They will also learn the basic concept of serial and parallel data communication of 8085. Students become able to understand various interrupts and their uses using 8085/8086 Microprocessor and 8051 Microcontroller. Students will also learn to interface 8255/8253/8251 peripheral chips and I/O devices with the same processors and controller. A basic introductory concept on PIC microcontroller also developed through this course. It is expected that students will be able to design systems based on above mentioned processors and controller by means of efficient assembly language programing.

CONTROL SYSTEMS

Code: EC503
Contact: 3L
Credits: 3

Module – I:

a) INTRODUCTION
Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer functions - Translational and Rotational mechanical systems

b) TRANSFER FUNCTION REPRESENTATION
Transfer Function of linear systems, Block diagram representation of systems considering electrical systems as examples -Block diagram algebra – Representation by Signal flow graph - Reduction using mason’s gain formula.

Module – II:

a) TIME RESPONSE ANALYSIS

b) STABILITY ANALYSIS IN S-DOMAIN
The concept of stability – Routh’s stability criterion – limitations of Routh’s stability. Root Locus Technique: The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

Module – III:

a) FREQUENCY RESPONSE ANALYSIS
Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots.

b) STABILITY ANALYSIS IN FREQUENCY DOMAIN
Polar Plots, Nyquist Plots Stability Analysis.

Module - IV :

a) CLASSICAL CONTROL DESIGN TECHNIQUES
Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain, PID Controllers.

b) STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS
Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it’s Properties – Concepts of Controllability and Observability

TEXT BOOKS:


REFERENCE BOOKS:

Computer Architecture  
Code: EC504A  
Contact: 3L + 1T  
Credits: 4


[Learning Outcome: Students will come to know about basic of computer organization & architecture]

Module 2: Memory Organization: Memory system overview, Cache memory organizations, Techniques for reducing cache misses; Hierarchical memory technology: Inclusion, Coherence and locality properties; Virtual memory organization, mapping and management techniques, memory replacement policies.

[Learning Outcome: Students will come to know about basic of computer memory structure & different mapping technique]

Module 3: CPU Organization: Fundamentals, Processor-memory communication [Clock cycles and Timing Diagram], Instruction cycle, RISC & CISC based architecture.

[Learning Outcome: Students will come to know about different CPU architecture & Processor-memory communication technique]

Module 4: Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards, Flynn’s classification –SISD, SIMD, MISD, MIMD architectures, Pipeline optimization techniques.

[Learning Outcome: Students will come to know about pipelining architecture]

Module 5: Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super pipelined and VLIW processor architectures, Array and Vector processors.

[Learning Outcome: Students will come to know about parallelism]

Module 6: Overview of HDL: VHDL basics programming concept, Structural, dataflow, behavioural & mixed style modeling techniques.

[Learning Outcome: Students will come to know about VHDL programming techniques]

Overall Learning Outcome: This course is a formidable prerequisite for the course Operating System, Embedded System to be offered in the subsequent semester.

Text & Reference books:
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky —“Computer Organization”, 5/e, MGH
5. Pedroni——“Circuit Design And Simulation With VHDL”, 2/e, PHI

Data Structure & C  
Code: EC504B  
Contact: 3L + 1T  
Credits: 4

Pre-requisites: CS 201 (Basic Computation and Principles of C), M101 & M201 (Mathematics), basics of set theory

Module -I: [8L] Linear Data Structure
Introduction (2L): Why we need data structure?  
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.  
Algorithms and programs, basic idea of pseudo-code.  
Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.  
Array (2L):  
Different representations – row major, column major.  
Sparse matrix - its implementation and usage. Array representation of polynomials.  
Linked List (4L):  
Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module -II: [7L] Linear Data Structure
[Stack and Queue (5L):  
Stack and its implementations (using array, using linked list), applications.  
Queue, circular queue, dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications.  
Recursion (2L):  
Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.  
Applications - The Tower of Hanoi, Eight Queens Puzzle.
Module -III. [15L] Nonlinear Data structures

**Trees (9L):**
- Basic terminologies, forest, tree representation (using array, using linked list).
- Binary trees - binary tree traversal (pre-, in-, post-order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree.
- Binary tree search-operations (creation, insertion, deletion, searching).
- Height balanced binary tree – AVL tree (insertion, deletion with examples only).
- B-trees – operation (insertion, deletion with examples only).

**Graphs (6L):**
- Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism).
- Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list.
- Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications.
- Minimal spanning tree – Prim’s algorithm (basic idea of greedy methods).

**Learning outcome:**
Ideally this course should act as a primer/pre-requisite for CS 503 (Design and Analysis of Algorithms). On completion of this course, students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them in C, how their drawbacks can be overcome and what the applications are and where they can be used. Students should be able to learn about the data structures/methods/algorithms mentioned in the course with a comparative perspective so as to make use of the most appropriate data structure/method/algorithm in a program to enhance the efficiency (i.e. reduce the run-time) or for better memory utilization, based on the priority of the implementation. Detailed time analysis of the graph algorithms and sorting methods are expected to be covered in CS 503 but it is expected that the students will be able to understand at least the efficiency aspects of the graph and sorting algorithms covered in this course. The students should be able to convert an inefficient program into an efficient one using the knowledge gathered from this course.

**Practical**

**Analog Communication Lab**
**Code:** EC591
**Contact:** 3P
**Credits:** 2

1. Measurement of modulation index of an AM signal.
2. Measurement of output power with varying modulation index an AM signal (for both DSB- & SSB).
3. Measurement of distortion of the demodulated output with varying modulation index of an AM signal (for both DSB-SC & SSB).
4. Measurement of power of different frequency components of a frequency modulated signal & the measurement of the bandwidth.
5. Design a PLL using VCO & to measure the lock frequency.
6. Design a FM demodulator using PLL.
9. Study of waveforms of various functional points (output of RF, IF & video) of a B/W TV receiver.
10. Study of the vertical & horizontal sweep of the time base unit of a B/W TV.
11. One innovative experiment.

**Microprocessors & Microcontrollers Lab**
**Code:** EC-592
**Contact:** 3P
**Credits:** 2

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>c)</td>
<td>Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical) Assignments based on above.</td>
</tr>
<tr>
<td>d) a)</td>
<td>Familiarization with 8085 &amp; 8051simulator on PC. Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the simulator Assignments based on above</td>
</tr>
<tr>
<td>e)</td>
<td>Programming using kit and simulator for:</td>
</tr>
</tbody>
</table>

i) Table look up

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Syllabus for B.Tech(ECE) Second Year
Revised Syllabus of B.Tech ECE (for the students who were admitted in Academic Session 2010-2011)

Control System Lab
Code: EC583
Contact: 3P
Credits: 2

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of the Experiment</th>
<th>Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Familiarization with MATLAB Control System tool Box, MATLAB– SIMULINK tool box &amp; pSPICE.</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Determination of step response for 1st order &amp; 2nd order system with amity feedback on CRO &amp; calculation of control system specifications for variations of system design.</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>Simulation of step response &amp; impulse response for Type-I &amp; Type-II system with unity feedback using MATLAB &amp; pSPICE.</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>Determination of root locus, Bode-plot, Nyquist Plot, using MATLAB control system toolbox for a given 2nd order transfer function &amp; determination of different control system specifications.</td>
<td>6</td>
</tr>
<tr>
<td>8.</td>
<td>Determination of PI, PD, and PID controller action on 1st order simulated process.</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>Evaluation of steady-state error, setting time, percentage peak overshoots, gain margin, phase margin with addition of lead compensator in forward path transfer functions using MATLAB &amp; pSPICE.</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>Study of position control system using servomotor.</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>Design and hardware implementation of a temperature controller using microprocessor/microcontroller.</td>
<td>6</td>
</tr>
</tbody>
</table>

Total 33 hours (11 classes each of 3 periods)

Computer Architecture Lab
Code: EC594A
Contact: 3P
Credits: 2

All laboratory assignments are based on Hardware Description Language (VHDL or Verilog) Simulation.

[Pre-requisite: The hardware based design has been done in the Digital Electronic & Integrated Circuits in 4th semester.]

- HDL introduction
- Basic digital logic base programming with HDL
- 8-bit Addition, Multiplication, Division
- 8-bit Register design
- Memory unit design and perform memory operations.
- 2-bit, 4-bit, 8-bit simple ALU design
- 8-bit simple CPU design
- Interfacing of CPU and Memory

Data Structure & C Lab
Code: EC594B
Contact: 3P
Credits: 2

Experiments should include but not limited to:

Implementation of array operations:

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
Syllabus for B.Tech(ECE) Second Year

Revised Syllabus of B.Tech ECE (for the students who were admitted in Academic Session 2010-2011)

using linked lists:
Polynomial addition, Polynomial multiplication
Sparse Matrices : Multiplication, addition.
Recursive and Nonrecursive 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.

(Detailed instructions for Laboratory Manual to follow for further guidance. The details will be uploaded in the website from time to time)

SEMESTER - VI

Theory

Principles of Management
HU-601
Contracts: 2L
Credits- 2

Module-I
1. Basic concepts of management: Definition – Essence, Functions, Roles, Level.

Module-II
5. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship.

Module-III

Module-IV

Readings:

Digital Communication
EC-601
Contracts: 3L
Credits- 3

MODULE – I:

Probability Theory and Random Processes:
Conditional probability, communication example, joint probability, statistical independence, random variable-continuous and discrete, cumulative distribution function, probability density function – Gaussian, Rayleigh and Rician, mean, variance, random process, stationary and ergodic
processes, correlation coefficient, covariance, auto correlation function and its properties, random binary wave, power spectral density.

6L

MODULE – II:
Signal Vector Representation:
Analogy between signal and vector, distinguishability of signal, orthogonality and orthonormality, basis function, orthogonal signal space, message vector, signal constellation, geometric interpretation of signals, likelihood functions, Schwarz inequality, optimal detection, orthogonalization procedure, response of the noisy signal at the receiver, maximum likelihood decision rule, decision boundary, optimum correlation receiver: probability of error, error function, complementary error function, Type-I and Type-II errors.

6L

MODULE – III:
Digital Data Transmission:
Concept of sampling, Pulse Amplitude Modulation (PAM), interlacing and multiplexing of samples, Pulse Code Modulation (PCM), quantization, uniform and non-uniform quantization, quantization noise, binary encoding, A-Law and µ-law companding, differential PCM, delta modulation and adaptive delta modulation.

Digital transmission components, source, multiplexer, line coder, regenerative repeater, concept of line coding – polar/unipolar/bipolar NRZ and RZ, Manchester, differential encoding and their PSDs, pulse shaping, Inter Symbol Interference (ISI), Eye pattern, Nyquist criterion for zero ISI, equalizer, zero forcing equalizer, timing extraction.

10L

MODULE – IV:
Digital Modulation Techniques:
Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, basic digital carrier modulation techniques: ASK, FSK and PSK.

Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying (GMSK), DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution.

Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods.

LTI Systems:
Analogy between signal and vector, distinguishability of signal, orthogonality and orthonormality, basis function, orthogonal signal space, message vector, signal constellation, geometric interpretation of signals, likelihood functions, Schwarz inequality, optimal detection, orthogonalization procedure, response of the noisy signal at the receiver, maximum likelihood decision rule, decision boundary, optimum correlation receiver: probability of error, error function, complementary error function, Type-I and Type-II errors.

6L

TEXT BOOKS:

k) Digital Communications, S. Haykin, Wiley India.
m) Wireless Communication and Networks : 3G and Beyond, I. Saha Misra, TMH Education.
o) REFERENCE BOOKS:
e) Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.
f) Digital Communication, A. Bhattacharya, TMH Publishing Co.

Digital Signal Processing
EC- 602
Contracts: 3L
Credits- 3

MODULE – I:
Discrete-time signals:
Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences – periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences.

3L

LTI Systems:
Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.

6L

MODULE – II:
Z-Transform:
Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples and exercises, characteristic families of signals along with ROCs, correlation, convolution and multiplication using Z-transform, initial value theorem, Perseval’s relation, inverse Z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.

6L

Discrete Fourier Transform:
Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises.

5L
Syllabus for B.Tech(ECE) Second Year

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**Fast Fourier Transform:**
Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises. 4L

**MODULE – III:**
**Filter Design:**
Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transforms, design of linear phase FIR filters, no. of taps, rectangular, Hamming and Blackman windows. 5L

**MODULE – IV:**
**Digital Signal Processor:**
Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor, writing of small programs in Assembly Language. 4L

**FPGA:**
Architecture, different sub-systems, design flow for DSP system design, mapping of DSP algorithms onto FPGA. 3L

**TEXT BOOKS:**

**REFERENCE BOOKS:**
15. Digital Signal Processing, A. Nagoor Kani, TMH Education
18. Texas Instruments DSP Processor user manuals and application notes.
19. Xilinx FPGA user manuals and application notes.

**Telecommunication System**
EC-603
Credits- 3L

**Topic**

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Topic</th>
<th>Periods/Cl asses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Telephone Systems: Evolution of Telecommunication; Components and Examples of Telecommunication systems; Pulse dialing &amp; Tone dialing; Telephone Instruments -rotary dial and push button types.</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Telecommunication Transmission Lines: Copper, Co-axial, and Fiber optic cables; Transmission Bridge - Hybrid circuit for 2-wire to 4-wire conversion and vice versa. PCM Carriers; American and European standards of carrier channels.</td>
<td>6</td>
</tr>
<tr>
<td>3.</td>
<td>Subscriber Loop Systems: BORSCHT Functions; Switching hierarchy &amp; routing, signaling techniques-in channel &amp; common channel signaling, SS7.</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>Switching System: Electro-mechanical switching-Strowger &amp; Crossbar; Circuit Switching &amp; Packet Switching, Digital Switching systems - Time division Time switch, Time multiplexed Space switch, Time multiplexed Time switch, Hybrid switching; TS, ST, STS, TST systems; Architecture of 5ESS systems;</td>
<td>6</td>
</tr>
<tr>
<td>5.</td>
<td>Stored Program Control: Software architecture, Application software; Electronic Exchanges, Introduction to cordless telephones and Digital PBX</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>Traffic Engineering: Blocking network, blocking probability, grade of service, traffic load, Erlang-B and C-congestion formulas-case studies</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>Modems and Their Standards: RS 232C; DTE and DCE, Facsimile Transmission, Broad band transmission- ISDN, DSL and ADSL, ISDN and B-ISDN</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>IP Telephony: Voice over IP, Session initiation protocol, H.323 signaling, IP multimedia service</td>
<td>4</td>
</tr>
</tbody>
</table>

**TOTAL LECTURE HOURS: 35**

**Text Books:**

b) T. Viswanathan, “Telecommunications Switching Systems & Networks”, PHI

c) J.C.Bellamy “Digital Telephony”- Wiley-India

**Reference Books:**

1. O Hersent, D Gurle, J P Petit “IP Telephony” Pearson
2. J.E.Flood “Telecommunications Switching, Traffic and Networks” Pearson
3. R L Freeman “Telecommunication System Engineering”- Wiley-India
4. A Gokhale “Introduction to Telecommunication“- Cengage Learning

34
Antenna Theory & Propagation
EC-604A
Contracts: 3L
Credits- 3

Module-I
A. Review of Maxwell’s Equation; Radiation of e.m waves and introducing Antenna; Vector Potential and Retarded Vector Potential; Radiation fields of a Hertzian dipole(electric); Duality Principle, Radiation fields due to short magnetic dipole.
B. Antenna Characteristics: Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain; Impedance, VSWR, Polarization; Effective height and Receive Aperture; Noise Temperature of Antenna.

Module-II
A. Radiation fields and Characteristics of λ/2 dipole; discussion on λ/4 monopole antenna; Current distribution and Radiation patterns of center-fed dipoles of length λ, 3λ/2 and 2 λ. Horizontal and Vertical antennas over a plane ground.
B. Antenna Arrays: electric Field due to 2 element arrays, 3 element Arrays; Pattern Multiplication; Uniform Linear Array: End fire and Broad side; Phased array.

Module-III
A. Characteristics and properties of : Travelling Wave Antenna, Helical Antenna, Folded Dipole, Yagi-Uda Array, Loop Antenna, Electrically Short Antennas, Broad Band Antenna (Log periodic Antenna), Microstrip Patch Antenna.
B. Radiation from an aperture: Sectoral and Pyramidal Horn Antennas, Design of Optimum Horn Antenna; Parabolic and Corner Reflectors and feed systems.

Module-IV

Recommended (Text Books)
1. Antenna (for all application), John D. Kraus and Ronald J. Marhefka; Tata- MacGraw Hill, 3rd Edition
3. Antenna Theory: Analysis & Design, Constantine A. Balanis; Willey, 3rd Edition

Reference Book

Information Theory & Coding
EC604B
Contracts: 3L
Credits- 3

Source Coding [7L]
Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes.

Channel Capacity And Coding [7L]
Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

Linear And Block Codes For Error Correction [8L]
Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes.

Cyclic Codes [7L]
Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes.

BCH Codes [8L]
Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.

Convolutional Codes [8L]
Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding.

Books
4. Information theory, coding and cryptography - Ranjan Bose; TMH.
5. Information and Coding - N Abramson; McGraw Hill.
6. Introduction to Information Theory - M Mansurpur; McGraw Hill.
7. Information Theory - R B Ash; Prentice Hall.
8. Error Control Coding - Sha Lin and D J Costello Jr; Prentice Hall.

Object Oriented Programming
Code: EC605A
Contact: 3L
Credits: 3
Object oriented design [10 L]
Concepts of object oriented programming language, Major and minor elements, Object, Class, relationships among objects, aggregation, links, relationships among classes-association, aggregation, using, instantiation, meta-class, grouping constructs.

Object oriented concepts [4 L]
Difference between OOP and other conventional programming – advantages and disadvantages. Class, object, message passing, inheritance, encapsulation, polymorphism

Basic concepts of object oriented programming using Java [22 L]
Implementation of Object oriented concepts using Java.
Language features to be covered:
Class & Object properties [6L]
Basic concepts of java programming – advantages of java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested & inner classes, basic string handling concepts- String (discuss charAt() , compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray(), toLowerCase(), toUpperCase(), trim() , valueOf() methods) & StringBuffer classes (discuss append(), capacity(), charAt(), delete(), deleteCharAt(), ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods), concept of mutable and immutable string, command line arguments, basics of I/O operations – keyboard input using BufferedReader & Scanner classes.

Reusability properties[6L] – Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages.

Exception handling & Multithreading [6L] – Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes.
Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads.

Applet Programming (using swing) [4L] – Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets, concept of delegation event model and listener, I/O in applets, use of repaint(), getDocumentBase(), getCodeBase() methods, layout manager (basic concept), creation of buttons (JButton class only) & text fields.

Textbooks/References:
1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
3. Patrick Naughton, Herbert Schildt – “The complete reference-Java2” – TMH
4. R.K Das – “Core Java For Beginners” – VIKAS PUBLISHING
5. Deitel and Deitel – “Java How to Program” – 6th Ed. – Pearson
6. Ivor Horton’s Beginning Java 2 SDK – Wrox
7. E. Balagurusamy – "Programming With Java: A Primer" – 3rd Ed. – TMH

Programming Languages
Code: EC605B
Contacts: 3L
Credits: 3

Introduction [3L]
Programming paradigms, Language translator, Basics of OOP, Structure of C++ program, Class and object, Abstraction and encapsulation, Polymorphism, Inheritance, Static and dynamic binding.

Declaration, Expression and statements [4L]
Data types, Variables, Constants, Operator and expression, Operator precedence and associativity. Statements: Labelled, Expression, Compound, Control, Jump, Declaration, Try-throw-catch.
Array, pointer and function [4L]
Array, Addresses, Pointer. Function: Declaration, Definition and call, Inline function, Main function argument, Reference variable, Function overloading, Default argument, Parameter passing, Recursion, Scope of variable, Return-by-value and Return-by-reference, Pointer to function.

Data abstraction through classes and user defined data types [6L]
Class, Members, Constructor and destructor, Copy constructor. Dynamic memory management: Operators new and delete, Malloc and free, Static member, Scope of class names, Scope of variables.

Operator Overloading [5L]
Overloading unary and binary operator, Overloaded function calls, Subscripting, class member access, Non-member operator, New and delete, Cast operator.

Class relationships [6L]
Introduction, Polymorphism, Coercion, Overloading, Parametric and inclusion polymorphism. Inheritance: direct and indirect superclasses, Multiple inheritance, Virtual base class, Friend, Virtual function, Abstract class, Overriding and hiding, Dynamic binding of functions, Virtual destructor and operators.

Template and Exception Handling [5L]
Class template, Member function inclusion, Function template, Specialization, Inheritance, Namespace. Concept of exception handling, Catch block, Nested try-catch block, Condition expression in throw expression, Constructor & destructor, Runtime standard exception.

Standard Library in C++ [3L]
Standard library function, Input and output, Iostream class hierarchy, Class ios, Other stream classes.

Object oriented design and modelling [4L]
Software development, Qualities of software system, Software architecture, Process life cycle, phases, Modularity, OO methodology, Modeling, UML overview, Object oriented design patterns.

Textbooks/References:
2. C++ object oriented programming paradigm, Debasis Jana, PHI
4. Programming In C++, Y. I. Shah and M.H. Thaker, ISTE/EXCEL BOOKS
5. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
6. Rajaram: Object Oriented Programming and C++, New Age International

ELECTRONIC MEASUREMENT AND INSTRUMENTATION
Code: EC605C
Contact: 3L
Credits: 3

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module I</td>
<td>Basic Measurement Concepts:</td>
<td></td>
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<tr>
<td></td>
<td>Measurement systems – Static and Dynamic Characteristics – Units and Standards of measurements, –errors analysis, – moving iron meters, dynamometer, wattmeter– multimeter, – True rms meters– Bridge measurements, Wheatstone Bridge, Kelvin, Wein, Maxwell, Hay, Schering and Anderson Bridges.</td>
<td>6</td>
</tr>
<tr>
<td>Module II</td>
<td>Basic Measurement Concepts:</td>
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<tr>
<td></td>
<td>Electronic Multimeter</td>
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<td></td>
<td>Current measurement with analog electronic instruments, Chopper stabilized amplifier for measurement of very low voltage and currents. Cathode Ray Oscilloscopes- Block Schematic, Principles and applications. Dual Trace and Dual Beam Oscilloscopes, Digital Storage Oscilloscopes</td>
<td>7</td>
</tr>
<tr>
<td>Module III</td>
<td>Signal Generator and Analysis</td>
<td></td>
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<tr>
<td>Module IV</td>
<td>Digital Instruments</td>
<td></td>
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<tr>
<td></td>
<td>Comparison of analog &amp; digital techniques- digital voltmeter- multimeter – frequency counters- measurement of frequency and time interval – extension of frequency range- measurement errors.</td>
<td>7</td>
</tr>
<tr>
<td>Module V</td>
<td>Data Acquisition Systems</td>
<td></td>
</tr>
</tbody>
</table>

Total Lecture Hours 34

Books:
Syllabus for B.Tech (ECE) Second Year

Revised Syllabus of B.Tech ECE (for the students who were admitted in Academic Session 2010-2011)

Digital Communication Lab
Code: EC691
Contact: 3P
Credits: 2

Practical

c) Design, implementation and study of all the properties of 7-length and 15-length pn sequences using shift register.
d) Study of PAM and demodulation.
e) Study of PCM and demodulation.
f) Study of line coders: polar/unipolar/bipolar NRZ, RZ and Manchester.
g) Study of delta modulator and demodulator.
h) Study of adaptive delta modulator and demodulator.
i) Study of BPSK modulator and demodulator.
j) Study of BFSK modulator and demodulator.
k) Study of ASK modulator and demodulator.
l) Study of QPSK modulator and demodulator.
m) Simulation study of probability of symbol error for BPSK modulation.
n) Simulation study of probability of symbol error for BFSK modulation.

Digital Signal Processing Lab
Code: EC692
Contact: 3P
Credits: 2

Simulation Laboratory using standard Simulator:
1. Sampled sinusoidal signal, various sequences and different arithmetic operations.
2. Convolution of two sequences using graphical methods and using commands - verification of the properties of convolution.
3. Z-transform of various sequences - verification of the properties of Z-transform.
4. Twiddle factors - verification of the properties.
5. DFTs / IDFTs using matrix multiplication and also using commands.
7. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.
8. Butterworth filter design with different set of parameters.
9. FIR filter design using rectangular, Hamming and Blackman windows.

Hardware Laboratory using either 5416 or 6713 Processor and Xilinx FPGA:
1. Writing & execution of small programs related to arithmetic operations and convolution using Assembly Language of TMS320C 5416/6713 Processor, study of MAC instruction.
2. Writing of small programs in VHDL and downloading onto Xilinx FPGA.
3. Mapping of some DSP algorithms onto FPGA.

Object Oriented Programming Laboratory
EC695A
L-0, T-0, P-3;
Cr 2

1. Assignments on class, constructor, overloading, inheritance, overriding
2. Assignments on wrapper class, arrays
3. Assignments on developing interfaces - multiple inheritance, extending interfaces
4. Assignments on creating and accessing packages
5. Assignments on multithreaded programming
6. Assignments on applet programming

Note: Use Java for programming
Preferably download "java_ee_sdk-6u4-jdk7-windows.exe" from http://www.oracle.com/technetwork/java/javaee/downloads/java-ee-sdk-6u3-jdk-7u1-downloads-523391.html

Programming Language Laboratory:
EC695B
L-0, T-0, P-3
Cr 3

To be uploaded later.

ELECTRONIC MEASUREMENT AND INSTRUMENTATION
Code: EC695C
Contact: 3P
Credits: 2

1. Study of Static Characteristics of a Measuring Instrument
2. Study of Dynamic Characteristics of a Measuring Instrument
3. Acquaintance with basic structure of DMM and measurement of different electrical parameters
4. Realization of Data Acquisition system
5. Wave and spectrum analysis using Q meter
7. Statistical analysis of errors in measurement.
8. Study of VCO (Voltage controlled oscillator) & PLL (Phase Locked Loop).
Syllabus for B.Tech(ECE) Second Year

Revised Syllabus of B.Tech ECE (for the students who were admitted in Academic Session 2010-2011)

Wireless Communication and Networks

EC701
Contacts: 3L
Credits: 3

Module – I:

Cellular Mobile Wireless Networks: Systems and Design Fundamentals:

Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes – Fixed channel, Dynamic channel and Hybrid channel, mobility management – location management and handoff management, handoff process, different types of handoff.

Characteristics of wireless channel and propagation path loss models:
Different Multi-path propagation mechanisms, Multi-path effects on mobile communication, Fading, different types of fading, small and large scale fading, slow and fast fading, narrowband and wideband fading. Inter symbol interference, fast fading model, Doppler effect due to velocity of mobiles, Rayleigh envelope, free space propagation model, two ray ground reflection model, log distance path loss model, log normal shadowing model, macro and micro cell propagation models, types of base stations and mobile station antennas.

Module – II:

Modern Mobile Wireless Communication Systems

Evolution strategies – First Generation (1G) to Fourth Generation (4G), Personal Area Networks :PAN, Low Tier Wireless System: Cordless Telephone, Second Generation (CT2), Digital European Cordless Telecommunications (DECT), Public wide-area Wireless Networks: 1 G to 3G cellular networks

Multiple Access Technologies in cellular communication
Time division multiple access (TDMA), narrowband and wideband TDMA, synchronous and asynchronous TDMA, Frequency division multiple access (FDMA), Code Division Multiple Access (CDMA), Direct-sequence CDMA, spread spectrum technique, spectral efficiency of different wireless access technologies:
Spectral Efficiency in FDMA system, Spectral Efficiency in TDMA system, Spectral Efficiency for DS-CDMA system

Cellular Communication Networks and Systems
Second generation (2G) Network: Global system for mobile communication (GSM): Architecture and Protocols Air Interface, GSM spectrum, GSM Multiple Access Scheme, GSM Channel Organization, Traffic Channel multi-frame, Control (Signaling) Channel Multi-frame, Frames, Multi-frames, Super-frames and Hyper-frames, GSM Call Set up Procedure, Location Update Procedure, Routing of a call to a Mobile Subscriber

The concept of packet data services The 2.5 G General Packet Radio Services: GPRS Networks Architecture, GPRS Interfaces and Reference Points, GPRS Mobility Management Procedures, GPRS Attachment and Detachment Procedures, Session Management and PDP Context, Data Transfer through GPRS Network and Routing, The IP Internetworking Model

Overview of CDMA systems: IS-95 Networks and 3G – The Universal Mobile Telecommunication System (UMTS)
CDMA based IS-95 Systems, forward link and reverse link for IS-95, handoff process in CDMA based IS-95 network, UMTS Network Architecture –Release 99, UMTS Interfaces, UMTS Network Evolution UMTS Release 4 and 5, UMTS FDD and TDD, UMTS Channels, Logical Channels, UMTS Time Slots
Syllabus for B.Tech (ECE) Second Year

Revised Syllabus of B.Tech ECE (for the students who were admitted in Academic Session 2010-2011)

MODULE – III:

Wireless Local Area Networks (WLAN): IEEE 802.11 Standards and Protocols
IEEE 802.11 standards, WLAN family, WLAN transmission technology, WLAN system architecture, Collision Sense Multiple Access with Collision Detection (CSMA/CD) and CSMA collision avoidance (CSMA/CA), Frequency Hopping Spread Spectra, 802.11 PHY and MAC layers, IEEE 802.11 Distributed Coordination function (DCF) and Point coordination function (PCF), Back off algorithm, Virtual carrier sense, MAC frame format. Security and QoS issues, WLAN applications 4L

Wireless Broadband Networks and Access
Evolution of broadband wireless, IEEE 802.16 standards: WiMAX, Spectrum Allocation, IEEE 802.16 Standard Architecture, Overview of WiMAX PHY, IEEE 802.16 MAC Layer, IEEE 802.16 Scheduling Services, Unsolicited Grant Service (UGS), Real-time Polling Service (rtPS), Non-real-time Polling Service (nrtPS), Best Effort (BE) Overview of 3G Long Term Evolution (3G LTE) for broadband wireless communication, Orthogonal Frequency Division Multiple Access (OFDMA) 3L

MODULE – IV:

Mobile Internet Protocol
Basic Mobile IP, Mobile IP Type-MIPv4 and MIPv6, Mobile IP: Concept, Four basic entities for MIPv4, Mobile IPv4 Operations, Registration, Tunneling, MIPv4 Reverse Tunneling, MIPv4 Triangular Routing, Configuring PDP Addresses on Mobile Station, Mobility Classification, Seamless Terminal Mobility Management, Limitations of current TCP/IP networks for mobility support, Mobility solution, Accessing External PDN through GPRS/UMTS PS Domain, Transparent Access, Use of Mobile IP for Non-transparent access, Dynamically accesses IP address from External Network. 3L

TEXT BOOKS:
2. Wireless Communication and Networks: 3G and Beyond, I. Saha Misra, TMH Education.

REFERENCE BOOKS:
1. Lee’s Essentials of Wireless Communications, MH Prof. Med/Tech
3. Wireless Communications and Networking, J.W.Mark and W. Zhuang, PHI.

Microelectronics & VLSI Designs
EC702
Contacts: 3L
Credits: 3

Pre-requisite: Knowledge about MOS, MOS-Characteristics, MOS Capacitors, Short Channel MOS, CMOS inverters, MOS Gates etc done in ES201 (Basic Electronics of second semester), EC302 (solid state devices of third semester), Analog Circuit Theory and Digital Circuits done in semesters 3 & 4 respectively.

Module I : Introduction to VLSI Design: [6L]
VLSI Design Concepts, Moor’s Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA)(2L), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioral, Structu12L);
Module 2: Micro-electronic Processes for VLSI Fabrication: [10]
Silicon Semiconductor Technology- An
Overview, Wafer processing (1L), Oxidation, Epitaxial deposition, Ion-implantation & Diffusion (1L),
Cleaning, Etching (1L), Photo-lithography – Positive & Negative photo-resist
(1L); Basic CMOS Technology – (Steps in fabricating CMOS (1L)), Basic n-well CMOS process, p-well CMOS process, Twin tub process (1L), Silicon on insulator
(1L); Layout Design Rule: Stick diagram with examples (2L), Layout rules (1L).

Module – 3: CMOS for Digital VLSI Circuits: [10]
Recapitulation of MOS (2L); CMOS, CMOS inverter characteristics (1L); CMOS logic circuits, NAND & NOR Gates (1L),
Complex logic circuits (1L), CMOS Full Adder (1L), CMOS Transmission GATE (1L), Advanced CMOS Logic circuits; Sequential
CMOS logic circuits (1L); SR Latch circuit, clocked JK Latch/ Master-Slave JK (1L), CMOS D-latch & Edge triggered flip-flop
(1L);

Module – 4: Analog VLSI Circuits: [8L]
Analog VLSI design steps (1L); Basic building blocks of Analog VLSI chips (1L); MOS switch (1L); Active load / resistors; Voltage dividers (1L); CMOS Current source & sink; CMOS Voltage references/voltage dividers [Basic circuits only] (1L); CMOS Differential amplifier; Output amplifiers [Basic circuits only] (1L); CMOS OPAMP (1L); Switched capacitor filter (1L)

Text Books:
2. CMOS Digital Integrated Circuit, S.M.Kang & Y.Leblebici, TMH.
4. VHDL, Bhaskar, PHI.
5. Advance Digital Design Using Verilog , Michel D. Celliti, PHI

References:
2. Modern VLSI Design: system on silicon, Wayne Wolf; Addison Wesley Longman Publisher
5. CMOS Analog Circuit Design by P.E. Allen & D.R. Holberg; OUP

RF & Microwave Engg
EC703A
Contacts: 3L
Credits: 3

Total Lectures: 39 periods (minimum):

<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>26</td>
<td><strong>Introduction</strong></td>
<td>1</td>
</tr>
<tr>
<td>27</td>
<td><strong>Microwave Waveguide and Waveguide Resonator</strong></td>
<td>6</td>
</tr>
<tr>
<td>28</td>
<td><strong>Planar Transmission line</strong></td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td><strong>High frequency Circuit Elements:</strong></td>
<td>4</td>
</tr>
</tbody>
</table>

- **26. Introduction**
  - RF & Microwave Spectrum, Typical applications of RF and Microwave, Safety considerations.

- **27. Microwave Waveguide and Waveguide Resonator**
  - Rectangular Waveguide- Design consideration, TE & TM modes, TE_{10} mode analysis, cut-off frequency, propagation constant, intrinsic wave impedance, phase and group velocity, power transmission, attenuation, waveguide excitation, wall current; Introduction of circular waveguide; Rectangular waveguide resonator- Design consideration, resonant frequency, Q-factor, excitation.

- **28. Planar Transmission line**
  - Micro-strip lines, Coplanar waveguide, Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the above mentioned lines.

- **4. High frequency Circuit Elements:**
  - Difference in High frequency and relatively low frequency behavior of Lumped circuit components. Miniaturization and Design of Lumped components at High RF. Realization of reactive elements as Waveguide and Planar Circuit components.
### Syllabus for B.Tech(ECE) Second Year

Revised Syllabus of B.Tech ECE (for the students who were admitted in Academic Session 2010-2011)

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Waveguide Passive Components and their S-matrix Representation</td>
<td>8</td>
</tr>
<tr>
<td>N-port networks - Properties of S matrix, Transmission matrix &amp; their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magic tee, hybrid ring, Circulators, Isolators; Design procedure of filter (maximally flat and equal ripple) using insertion loss method-specification, low-pass prototype design, scaling and conversion, implementation.</td>
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<tr>
<td>6. Microwave Tubes</td>
<td>4</td>
</tr>
<tr>
<td>Electron beam &amp; Field interaction for energy exchange in resonant (two cavity klystron, Reflex Klystron, Magnetron) and non-resonant (TWT &amp; BWO) microwave active devices: Typical characteristics &amp; applications (only physical explanation is required, no mathematical derivation required).</td>
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<tr>
<td>7. Semiconductor Microwave devices</td>
<td>5</td>
</tr>
<tr>
<td>TED (Gunn diode) &amp; Avalanche Transit Time (IMPATT) device, Schottky diode, PIN diode-characteristics &amp; applications; Microwave bipolar transistor, Microwave field effect transistor (MESFET).</td>
<td></td>
</tr>
<tr>
<td>8. Microwave Amplifier Design</td>
<td>4</td>
</tr>
<tr>
<td>Basic consideration in the design of RF amplifier- Transistor S-parameter, Stability, matching network, noise figure; Matching network design using lumped elements and L-Section. Brief introduction to NBA, LNA.</td>
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</tr>
<tr>
<td>9. Typical Microwave Test Bench &amp; measurement</td>
<td>4</td>
</tr>
<tr>
<td>VSWR meter, Tunable detector, Slotted line and Probe detector, Frequency meter, Network analyzer, Measurement of VSWR – low, medium and high, Measurement of power: low, medium and high, Frequency measurement.</td>
<td></td>
</tr>
</tbody>
</table>

**Text Books:**
1. Microwave Engineering, 3rd Ed David M. Pozar, Willey & Sons Inc.
3. Microwave Engineering, A Das & S Das, TMH.
4. Microwave Devices & Circuits, SY Liao, Pearson Education / PHI

**References Books:**
(5) Microwave Engineering-Passive Circuits, PA Rizzi, Pearson Education.
(7) Microwave Devices & Circuit Design, GP Srivastava & VL Gupta, PHI

**Optical Communication & N/W**
EC703B
Credits: 3

**Introduction to communication systems:**
Principles, components; Different forms of communications in brief, advantages of optical fibre communication, spectral characteristics. [2]

**Optical Fibre wave guide:**
Structure, Single and Multimode operation; Attenuation, Material and wave guide dispersion. [2]

**Optical Sources:**
Light Emitting Diode; principle, structures, power and efficiency, coupling to fibres. [5]
Quantum Well Lasers; Modes and narrow linewidth lasers.
Laser diodes, principle, double heterostructure, gain and index guiding, distributed lasers.

**Modulation:**
Bandwidth for modulation, Optical transmitters: components.

**Optical Detectors:**
Device types, optical detection principles, efficiency, responsivity, bandwidth, Preamplifiers; noise sources, signal to noise ratio. [2]

**Point-to-point link and Wavelength Division Multiplexing:**
Building blocks; Multiplexing; Intensity Modulation/Direct Detection system; Principle of Regeneration; WDM link, Optical amplifiers; EDFA, SOA, Raman amplifier, Fabry-Perot filters. Dispersion compensation and management, Link analysis and Bit-Error-Rate calculation. [11]

**Optical Network:**
LAN, MAN, WAN; Topologies: bus, star, ring; Ethernet; FDDI; Telecom networking:SDH/SONET. Different forms of access networks: [4]
Telephony; ISDN; Cable TV; Broadcast and Switched Networks; HFC networks; FTTC and FTTH
networks; All optical networks.

Books:
1. Optical Networks – A practical perspective : Rajiv Ramaswami, K. N. Sivarajan, Galen H. Sasaki (Morgan-Kaufman)
2. Optical Fibre Communication : John M. Senior (Pearson)
3. Optical Fibre Communication : Gerd Kaiser (TMH)
4. Optical Communication Systems : John Gawar (PHI)

### Computer Networks

**EC703C**

**Contacts:** 3L  
**Credits:** 3

**Module I**  
**Overview of Data Communication and Networking:** [4L]  
Introduction; Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

**Physical Level:** [6L]  
Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network;

**Module II**  
**Data link Layer:** [5L]  
Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, HDLC;

**Medium Access sub layer:** [5L]  
Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA; Traditional Ethernet, fast Ethernet (in brief);

**Network layer:** [8L]  
Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing: techniques, static vs. dynamic routing, Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, IP, ICMP, IPv6;

**Transport layer:** [4L]  
Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm,

**Module III**  
**Application Layer** [5L]  
Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls.

**Modern topics:** [5L]  
ISDN services & ATM, DSL technology, Cable Modem: Architecture & Operation in brief Wireless LAN: IEEE 802.11, Introduction to blue-tooth.

**Text Books:**
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Miller, data Communication & Network, Vikas
7. Miller, Digital & Data Communication, Jaico
8. Shay, Understanding Data Communication & Network, Vikas

**Reference Books:**
2. Leon, Garica, Widjaja – “Communication Networks” – TMH
3. Walrand – “Communication Networks” – TMH

### FPGA & Reconfigurable Computing

**EC703D**

**Contacts:** 3L  
**Credits:** 3

**Module –I:** Introduction to Reconfigurable Computing (RC)  

**Module-II:** Reconfigurable Logic Devices:  
FPGA and its internal architecture, computing elements, LUT, BRAM, interconnects, I/O Blocks, programming of FPGA and
interfacing case study, ALU design, designing with embedded processors, introduction to Power PC and ARM processors.

6L

Module III: Hardware Description Language for RC:
Design cycle, algorithms, Hardware Description Language, VHDL, different design styles: data flow, structural and behavioral and practical logic circuit implementation example on FPGA, debugging, writing test bench, High level synthesis and Low level synthesis.

Module IV: RC Configuration:
Application segmentation and Resource partitioning, spatial and temporal configuration, systolic architectures and algorithms, Bit serial, on the fly, multiplexing vs. run-time reconfiguration

Module V: RC Implementation:
Virtual Hardware Components (VHC) design process, high level synthesis of VHC and optimization, VHC data-path and control unit design, simulation and verification of VHC, determination of reconfigurable scheme and associated loading mechanisms (temporal and spatial partitioning) for RC.

Module VI: RC applications:
RC for DSP, DSP application building blocks, RC for Image processing, Bioinformatics and Network Security

Text Books:
2. C. Maxfield; The design Warrior’s Guide to FPGAs: Devices, Tools and Flows, Newnes, 2004

Reference Books:
1. W. Wolf, FPGA Based Systems Design, PHI, 2004

Radar Engineering
EC704A
Contacts: 3L
Credits: 3

Module –I: Introduction to Radar
Historical background, radar terminology, radar band designations, Radar block diagram, radar equation: detection of signals in noise and signal-to-noise ratio, Probabilities of detection & False alarm, integration of radar pulses, radar cross section, distributed targets, Transmitted power, pulse-repetition frequency, antenna parameters & system losses, introduction to radar clutter.

Module – II: Radar Types
Pulse radars and CW radars, Advantages of coherent radar, Doppler radar and MTI: Doppler effect, delay-line cancellers, blind speeds, staggered PRFs, Digital filter bank, Moving Target Detector, limitations of MTI, tracking with radar, monopulse tracking, conical scan, limitation to tracking accuracy.

Module –III: Radar signals & clutter
Basic radar measurement, theoretical accuracy of radar measurements, Range and velocity ambiguities, the ambiguity diagram, pulse compression-principles, the matched filter, chirp waveforms, Waveform design: nonlinear FM, phase codes, waveform generation and compression
Descriptions of land & sea clutter, statistical models for surface clutter, detection of targets in clutter.

Module –IV: Devices and Radar Systems
Radar transmitter: Solid-state RF power source, Magnetron, other RF power sources, Radar receiver: Super heterodyne receiver, receiver noise figure, duplexers & diplexers, Receiver protectors, Applications: Electronic Warfare: ESM, ECM, ECCM; super resolution, IFM, types of jammers, Stealth and counter-stealth: stealth techniques for aircraft and other target types, low frequency and UWB radar, System design examples

Text Books:
1. Introduction to Radar Systems-3/E, M. I. Skolnik, Tata McGrawhill
2. Principles of Modern radar system, M. H. Carpentier, Artech House

Reference Books:
1. Fundamentals of radar signal processing, M. I. Richards, McGraw-Hill
2. Handbook of radar measurement, Barton, David & Ward, H. R, Artech House
3. Radar Technology, Brookner, Eli, Artech House

Embedded Systems
EC704B
Contacts: 3L
Credits: 3

Introduction to Embedded System: Embedded system Vs General computing systems, History of Embedded systems, Purpose of Embedded systems, Microprocessor and Microcontroller, Hardware architecture of the real time systems.

[5]

Devices and Communication Buses: I/o types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth.

[10]

Program Modelling Concepts: Fundamental issues in Hardware software co-design, Unified Modelling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.

[5]

Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS.

[8]

Examples of Embedded System: Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc. Popular microcontrollers used in embedded systems, sensors, actuators.

[6]

Programming concepts and embedded programming in C, C++, JAVA.

[4]

Ref:
1. Introduction to Embedded Systems : Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)
3. Embedded Systems : Rajkamal (TMH)
5. Embedded System design : S. Heath (Elsevier)
6. Embedded microcontroller and processor design: G. Osborn (Pearson)

Biomedical Instrumentation
EC704C
Contacts: 3L
Credits: 3

Module - 1 (Fundamentals)
1.1 Introduction to Physiological Systems –Organism, Cardiovascular, Respiratory, Renal, Hepatic, Gastrointestinal, Endocrinial, Nervous, Muscular, Cellular
[2]
[2]
1.3 Fundamentals of Electrophysiology – EKG, EEG, EMG. Evoked potentials. Quantification of Biological Signals[2]

Module 2 (Measurement & Analysis)
2.1 Biological Sensors- Bio-electrodes, Biosensors and Transducers for Cardiology, Neurology, Pulmonary, Oxygen saturation & gaseous exchange, flow measurement, goniometry, Endoscopy, Impedance Plethysmography.
[3]
2.2 Biological Amplifiers –Instrumentation Amplifiers for Electrophysiology ( ECG, EMG, EEG, EOG), Filters, Power Supplies.
[3]
2.3 Recording and Display systems, Digital Conversion for storage, Electrical Hazards in measurements, Isolation Circuits, calibration, alarms & Multi-channel re-constitution
[2]
2.4 Hospital requirements – Multi-parameter bed-side monitors, Central Nursing Stations, Defibrillators, Ventilators, Catheters, Incubators.
[2]

Module - 3 (Life-Support & Treatment)
3.1 Cardiac Support: Implantable & programmable Pacemakers, External & Internal Defibrillators, Coronary Angiography.
[2]
3.2 Electro-physiotherapy : Shortwave & ultrasonic diathermy, Transcutaneous Nerve Stimulators in pain relief, Traction Systems,
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Ultrasound in bone fracture regeneration, hypothermia & hyperthermia systems. [3]

3.3 Lasers in treatment and surgery : Ophthalmic, Ablators, Endoscopic [2]

3.4 Assists and Artificial limbs- Orthoses , passive and powered Prostheses [2]

Module-4 (Imaging)

4.1 Fundamentals of X-Rays, Radiological Imaging, Digital Radiology, DSA. [3]

4.2 Computer Tomography, Image Processing, solid state sensors, whole-body scans. [3]

4.3 Gamma camera & radio- isotope imaging. [1]

4.5 Ultrasonography- Transducers, Signal Conditioners, 2D & 3D scans, Doppler & Colour Doppler [3]

4.6 Fundamentals of Magnetic Resonance Imaging and PET - scans [2]

Text Books:-

2) R S Khandpur:- Handbook of Biomedical Instrumentation (Tata –Mcgraw Hill Education) [Partly Downloadable]

3) M E Valentiniuzzi:- Understanding the Human Machine- A Primer for Bioengineering [Freely Downloadable in PDF]

(World Scientific Publishing Co. Pte. Ltd, Singapore)

4) L Cornwell, F.J. Weibell & E.A. Pfeiffer:- Biomedical Instrumentation and Measurements(Prentice Hall/Medical)

5) J G Webster & J W. Clark:- Medical Instrumentation – Application & Design (Houghton Miffin Pub)

6) J J Carr & JM Brown:- Introduction to Bio-medical Equipment Technology(Regents / Prentice Hall)

7) J Tompkins & J G Webster :-Design of Micro- controller based Medical Instrumentation (Prentice Hall Inc)

Reference Books:

1. W.B. Blesser :- A systems approach to Biomedicine (McGraw Hill.,NY)

2. J H U Brown, J E Jacobs & L Stark:- Biomedical Engineering (Davis Co, Philadelphia, USA)


5. R Plonsey:- Bioelectric Phenomena (McGraw-Hill Co, NY)

Artificial Intelligence
EC705A

Contacts: 3L

Credits: 3

Introduction [2]

Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem.

Intelligent Agents [2]

Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

Problem Solving [2]

Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Search techniques [5]

Solving problems by searching :problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies.

Heuristic search strategies [5]


Adversarial search [3]

Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Knowledge & reasoning [3]

Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge
representation.

Using predicate logic [2]
Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction.

Representing knowledge using rules [3]
Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

Probabilistic reasoning [4]
Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.

Planning [2]
Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

Natural Language processing [2]
Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Learning [2]
Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning.

Expert Systems [2]
Representing and using domain knowledge, expert system shells, knowledge acquisition.

Basic knowledge of programming language like Prolog & Lisp. [6]

Books:
1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
7. Artificial Intelligence, Russel, Pearson

Robotics
EC705B
Contacts: 3L
Credits: 3

Robot Anatomy Arm Geometry-Direct & Inverse Kinematics Problem,Arm Dynamics,D Alembert Equations of Motion, Synthesis of elements with movulity constraints,manipulations-trajectory planning,joint interpolated trajectories. [15L]

Control of Robot Manipulation-computed torque technique sequencing & adaptive control, resolved motion control Moluie Robots. [6L]

Robot sensing-Range & Proximity & Higher-Level vision, illumination techniques,Imaging Geometry, Segmentation Recognition & Interpretation. [8L]

Robot Programming Language Characteristics of Robot Level & Task Level languages.Robot intelligence-State Space search, Robot
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learning,Robot Task Planning,Knowledge Engineering. [10L]

References:
1. K.S Fu R.C . CSG Lee-Robotics Control,Sensing, Vision & Intelligence,McGraw-Hill.
3. Andrew C.Strautgard-Robotics & AI,PHI

Database Management System
EC705C
Contacts: 3L
Credits: 3

Introduction [4L]
Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Entity-Relationship Model [6L]
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Relational Model [5L]
Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.

SQL and Integrity Constraints [8L]
Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Relational Database Design [9L]
Functional Dependency, Different anomalies in designing a Database, Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued dependencies, 4NF, 5NF

Internals of RDBMS [7L]
Physical data structures, Query optimization : join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management : transaction model properties, state serializability, lock base protocols, two phase locking.

File Organization & Index Structures [6L]
File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree .

Text Books:
12. Jain: Advanced Database Management System CyberTech

Reference:

Power Electronics
EC705D
Contacts: 3L
Credits: 3

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Hrs</th>
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</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>Advances in Power Electronics</td>
<td>6</td>
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</tbody>
</table>

| Power Semiconductor Switches: Rectifier diodes, fast recovery diodes, Schottky barrier diode, Power | 6 |
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Revised Syllabus of B.Tech ECE (for the students who were admitted in Academic Session 2010-2011)

<table>
<thead>
<tr>
<th>Module</th>
<th>Course Content</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Module I</td>
<td>BJT, Power MOSFET, SCR, TRIAC, IGBT and GTO. Ratings, Static and Dynamic Characteristics, Trigger, driver and switching-aid circuits and cooling. SCR turn-on and turn-off methods, Triggering circuits, SCR Commutation circuits, SCR Series and Parallel operation, Snubber Circuit.</td>
<td>6</td>
</tr>
<tr>
<td>Module II</td>
<td>Rectifiers Single phase and three phase controlled Rectifiers with inductive loads, RL load Effect of source inductance- performance parameters, Dual Converters.</td>
<td>4</td>
</tr>
<tr>
<td>Module III</td>
<td>Step up and Step down choppers Time ratio control and current limit control, Buck, Boost, Buck Boost and Cuk Converters, Concept of Resonant Switching.</td>
<td>4</td>
</tr>
<tr>
<td>Module IV</td>
<td>Single phase and three phase inverters – PWM techniques, Sinusoidal PWM, modified Sinusoidal PWM - multiple PWM Voltage and harmonic Control – Series resonant inverter-Current Sources Inverter.</td>
<td>6</td>
</tr>
<tr>
<td>Module V</td>
<td>AC Voltage Controllers, Single phase and three phase Cycloconverters – Power factor control and Matrix Converters.</td>
<td>4</td>
</tr>
<tr>
<td>Module VI</td>
<td>DC and AC Drives DC Motor Speed control Induction Motor Speed Control Synchronous Motor Speed Control</td>
<td>8</td>
</tr>
</tbody>
</table>

**Total Lecture Hours** 34

**Books:**

- b) P.C. Sen, Power Electronics
- c) M.H. Rashid, Power Electronics, PHI/ Pearson Education
- d) C.W. Lander, Power Electronics, McGraw Hill
- e) B.K.Bose, Modern Power Electronics, JAICO
- f) Mohan, N Undeland, TM & Robbins, WP- Power Electronics, John Wiley & Sons

**Practical**

**Group Discussion**

HU781

Contacts: 3  
Credits: 2  

**To be incorporated**

**VLSI Design Lab**

EC792

Contacts: 3  
Credits: 2  

- Laboratory 1. Familiarity with Spice simulation tool (3 Hrs.)
- Laboratory 2. Splice Simulation of Inverter, NAND, NOR Gates. (3 Hrs.)
- Laboratory 3. Familiarity with EDA tools for VLSI design /FPGA based system design (6 Hrs.)
- Laboratory 4. Layouts, Transistors and tools. (3 Hrs.)
- Laboratory 5. Standars cell Design (3 Hrs.)
- Laboratory 6. Design of CMOS XOR/XNOR Gates. (3 Hrs.)
- Laboratory 7. Design of CMOS Full adder (3 Hrs.)
- Laboratory 8. Design of CMOS Flip flops (R-S, D, J-K) (3 Hrs.)
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Laboratory 10. Design of 8 bit synchronous Counter (3 Hrs.)

Laboratory 11. Design of 8 bit bi-directional register with tri-stated input/output bus (3 Hrs.)

Laboratory 12. Design of a 12 bit CPU with few instructions and implementation and validation on FPGA (15 Hrs.)


References:
1. http://www-ee.eng.hawaii.edu/~msmith/ASIC/HTML/ASIC.htm#anchor935203
2. J.Bhasker ,A VHDL Primer , BS Publications/Pearson Education.

RF & Microwave Engg Lab
EC793A
Contacts: 3
Credits: 2

Experiments
1. Determination of phase and group velocities in a waveguide carrying TE\textsubscript{10} Wave from Dispersion diagram [\omega-\beta Plot].
3. Study of the characteristics of a Reflex Klystron oscillator.
5. Measurement of coupling factor, Directivity, Insertion loss and Isolation of a Directional coupler using X-band waveguide test bench set up.
7. Experimental/Simulation Study of filter (LPF, HPF, BPF) response.
8. Measuring of dielectric constant of a material using waveguide test bench at X-band.

Reference Books
1. ML Sisodia & GS Raghuvanshi Basic Microwave Techniques and Laboratory Manual; Wiley Eastern Limited 1987
2. EL Gintzton Microwave Measurements, McGraw-Hill Book Co.

Optical Communication & N/W Lab
EC793B
Contacts: 3
Credits: 2

Experiment with Optical fibre:
To calculate attenuation constant, bending loss and numerical aperture of optical fibre.

Experiments using LED module:
Study of DC characteristics.
I-V characteristics of LED (i) using optical fibre between LED and power meter and (ii) without using optical fibre.
P-I characteristics of LED (i) using optical fibre between LED and power meter and (ii) without using optical fibre.

Experiment with fibre Optic analog link:
Input-output characteristics using long optical fibre. Calculation of attenuation per unit length of optical fibre.

Computer Networks lab
EC793C
Contacts: 3
Credits: 2

8) IPC (Message queue)
9) NIC Installation & Configuration (Windows/Linux)
10) Familiarization with
11) Networking cables (CAT5, UTP)
12) Connectors (RJ45, T-connector)
Syllabus for B.Tech(ECE) Second Year

Revised Syllabus of B.Tech ECE (for the students who were admitted in Academic Session 2010-2011)

13) Hubs, Switches
14) TCP/UDP Socket Programming
15) Multicast & Broadcast Sockets
16) Implementation of a Prototype Multithreaded Server
17) Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
18) Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
19) Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)

FPGA & Reconfigurable Computing
EC793D
Contacts: 3
Credits: 2

1. Implementation of basic logic gates with VHDL on FPGA using different design styles.
2. Implementation of Multiplexers, Priority Encoder, decoder, counters etc. with VHDL on FPGA using different design styles.
3. Design and implementation of 16-bit ALU with VHDL on FPGA and verification by writing a test bench.
4. a) Generation of Filter co-efficient of a LPF using Simulink FDA tool.
b) Generation of VHDL codes for the LPF by coupling the co-efficient in “a” with Xilinx.
c) Implementation of the LPF in FPGA using the code in “b”.
d) Testing of the LPF by using the hardware-in-the loop configuration.
5. Design and implementation of a real time user defined Traffic Light Controller using FSM method on an FPGA.
6. Interfacing of LCD display with FPGA and configuration for the scrolling display.

Artificial Intelligence Lab
EC795A
Contacts: 3
Credits: 2

Programming Languages such as PROLOG & LISP

Robotics Lab
EC795B
Contacts: 3
Credits: 2

2. Inverse kinematic approach to determine required angular displacements for translation of link-end-points
3. Adaptive position control of a single/two-link robotic manipulator
4. Characterization of an ultrasonic transducer for range measurement applications
5. Segmentation of an image by histogram thresholding
6. Task-planning using pick-up and placement operations
7. Developing motion plan of a robot-cart using real-time A* algorithm

Database management System Lab
EC795C
Contacts: 3
Credits: 2

Structured Query Language
1. Creating Database
   4. Creating a Database
   5. Creating a Table
   6. Specifying Relational Data Types
   7. Specifying Constraints
   8. Creating Indexes
2. Table and Record Handling
   10. INSERT statement
Syllabus for B.Tech(ECE) Second Year

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11. Using SELECT and INSERT together
12. DELETE, UPDATE, TRUNCATE statements
13. DROP, ALTER statements

3. Retrieving Data from a Database
   7. The SELECT statement
   8. Using the WHERE clause
   9. Using Logical Operators in the WHERE clause
10. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
11. Using Aggregate Functions
12. Combining Tables Using JOINS
13. Subqueries

4. Database Management
   6. Creating Views
   7. Creating Column Aliases
   8. Creating Database Users
   9. Using GRANT and REVOKE

5. Cursors in Oracle PL / SQL
   Writing Oracle PL / SQL Stored Procedures

Power Electronics Lb
EC795D
Contacts: 3
Credits: 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 an SCR
4. Study of firing circuits suitable for triggering SCR in a single phase full controlled bridge.
5. Study of the operation of a single phase full controlled bridge converter with R and R-L load.
8. Study of performance of single phase controlled converter with and without source inductance (simulation)
10. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converter (simulation).
14. Study of performance of a Dual converter. (simulation)
15. Study of performance of a Cycloconverter (simulation)

Institute may develop experiments based on the theory taught in addition to experiments mentioned.

Reference books:
2. SPICE for Power electronics and electric power, M.H. Rashid & H.M. Rashid, Taylor & Francis.
3. Power Electronics: Principles and application, Jacob, Cengage Learning
5. Modeling & Simulation using MATLAB-SIMULINK, S. Jain, Wiley India

VIII Semester
Theory

Organisational Behaviour
Syllabus for B.Tech(ECE) Second Year

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HU801A
Contacts: 2L
Credits: 2

1. Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. [2]
2. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction. [2]
7. Leadership: Definition, Importance, Theories of Leadership Styles. [2]
8. Organizational Politics: Definition, Factors contributing to Political Behaviour. [2]

References:
3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI

Smart Antenna
EC801A
Contacts: 3L
Credits: 3

MODULE –I:
INTRODUCTION:
Antenna Basics, Phased array antenna, power pattern, beam steering, degree of freedom, adaptive antennas, smart antennas - key benefits of smart antenna technology, wide band smart antennas, Propagation Channels

MODULE –II:
SMART ANTENNAS FOR WIRELESS COMMUNICATIONS:

MODULE –III:
ADAPTIVE PROCESSING:
Sample matrix inversion algorithm, unconstrained LMS algorithm, normalized LMS algorithm, Constrained LMS algorithm, Perturbation algorithms, Neural network approach, Adaptive beam space processing, Implementation issues.

MODULE –IV:
DIRECTION OF ARRIVAL ESTIMATION (DOA) METHODS:
Spectral estimation methods, linear prediction method, Maximum entropy method, Maximum likelihood method, Eigen structure methods, MUSIC algorithm – root music and cyclic music algorithm, the ESPRIT algorithm.

**MODULE –V:**

**IMPLEMENTATION OF SMART ANTENNA SYSTEM:**


**6L**

**TEXT BOOKS:**

2. Smart Antennas, L.C.Godra, CRC Press, 2004
4. Introduction to Smart Antennas, C.A.Balanis, Morgan and Claypool, 2007

**Digital Image Processing**

EC801B

**Contacts:** 3L

**Credits:** 3

**Objective:** The course provides grounding in digital filter and transforms techniques for image processing and feature extraction, and an overview of common heuristic algorithms for Image Processing. The different representations of digital images, the importance of adequate sampling frequencies and the appearance of artifacts. Also how the important features in an image may be related to significant abstractions from the raw image. Prerequisite: Digital Signal Processing, Signals and Systems.

**Module 1**

Digital Image Processing Systems:


**Module 2**

Image Transforms (implementation):

Introduction to Fourier transform, DFT and 2-D DFT. Properties of 2-D DFT, FFT, IFFT. Walsh transform, Hadamard transform, Discrete cosine transform, Slant transform, Optimum transform: Karhunen – Loeve (Hotelling) transform. [7].

**Module 3**

Image Enhancement in the Spatial and Frequency Domain:


**Module 4**

Image Data Compression:


**Module 5**

Morphological Image Processing:

Introduction, Dilation, Erosion, Opening, closing, Hit-or-miss transformation, Morphological algorithm operations on binary Images, Morphological algorithm operations on gray-scale Images. [6]

**Module 6**

Image Segmentation, Representation and Description: Detection of discontinuities, Edge linking and Boundary detection. Thresholding Region based segmentation, Image Representation schemes, Boundary descriptors, and Regional descriptors. [7]

**Text Books:**

2. Anil K. Jain:- Digital Image Processing (Prentice-Hall, India)

**Reference Books:**

2. B. Chanda & D. Dutta Majumder, Digital Image Processing and Analysis, (Prentice-Hall, India)
Satellite Communication & Remote Sensing

EC801C

Contacts: 3L
Credits: 3

Module-1
Introduction to neural networks: Human brain and models of a neuron, artificial neurons and activation functions; Learning processes: Introduction to Supervised, Unsupervised and Reinforcement Learning, Hebbian learning, competitive learning, Boltzmann learning, Adaptive Linear Neuron (Adaline); [8L]

Module-2

Module-3
Radial Basis function networks: Theorems on separability of patterns, interpolation problem, regularization theory and regularization networks, generalized RBF, approximation properties of RBF, Wavelet Neural Network, comparison of RBF and back-propagation; [6L]

Module-4
Associative Memory Networks: Training Algorithm for Pattern Association-Hebb Rule, Bidirectional Associative Memory, Hopfield Networks- Continuous and Discrete, Hamming Network; Self- Organizing maps: Feature mapping models, SOM algorithm, learning vector quantization, adaptive vector quantization; Stochastic machines: Statistical mechanics, Markov chains, Simulated annealing, Gibbs sampling, Boltzmann machine, Sigmoid belief networks; [10L]

Module-5
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Applications: Applications on Digital Image Processing and other related areas, Image Restoration based on Associative Memory, Data Visualization with self organizing feature MAP, Support Vector machines (SVM), SVM based learning. Introduction to MATLAB Programming. [4L]

Text Books:
1) S. N. Sivanandam, S.N. Deepa: Principles of Soft Computing (Wiley India)
2) Satish Kumar: Neural Networks – A Classroom Approach (Mc Graw Hill Ed.)
3) Mohamad H. Hassoun: Fundamentals of Artificial Neural Networks (PHI)
4) James A. Freeman, David M. Skapura: Neural Networks (Pearson)
5) Simon Haykin: Neural Networks – A Comprehensive Foundation (PHI)
7) S. Rajsekaran, G.A. Vijaylakshmi Pai: Neural Networks, Fuzzy Logic and Genetic Algorithm

Reference Books:
2) Cloete, Zarunda: Knowledge based Neurocomputing (University Press)
3) Duda, Hart, Stork: Pattern Classification (Wiley)
5) Bart Kosko: Neural Network and Fuzzy Systems (PHI)
6) N. K. Bose, P. Liang: Neural Network Fundamentals with Graphs, Algorithms and Applications (TMG)
7) Dan W Patterson, PHI: Introduction to Artificial Intelligence and Expert Systems (PHI)

Material Science & Engineering
EC802B
Contacts: 3L
Credits: 3

Structure of Solids: Atoms and their binding, Bonds, Crystal Systems, Bravais Lattice Miller Indices, Crystalline, Polycrystalline and Amorphous Materials; Metals, Semiconductors and Insulators, Lattice defects-Qualitative ideas of point, line, surface and volume defects. [5]

Dielectric Properties: Dielectric Polarization and Mechanism- Internal or local field, Dielectric Loss, Temperature and Frequency dependence of dielectric constant, Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric Materials and its Applications. [4]


Superconductors: Basic concepts of superconductivity, Transition temperature, Meissner effect High-T superconductors, Haed and Soft Materials, SQUID. [3]


Materials for Display Devices: CRT, LED, LCD, TFT, Plasma Display. [3]

Advanced Materials: Metallic Glasses, Nanomaterials, etc. [2]

Books:
4. An Introduction to Solid State Physics - Charles Kittel (John Wiley & sons)
5. An Introduction to Electronic Materials for Engineers – W. Kao, Z. Lee and N. Sannes (World Scientific)

Renewable Energy
EC802C
Contacts: 3L
Credits: 3

Classification of Energy Sources
Advantages of Non Conventional Energy Sources over Conventional Sources
Economics, Impact on Environment
Electricity Generation from Non Conventional Energy Sources:
Solar Energy: (12)
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: (7)
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: (2)
Electricity generation from micro hydel plants, location, auxiliaries and associated problems.
Bio Energy: (4)
Sources and conversion process: bio gas conversion, bio gas plant, bio mass gasifier, co generation
Bio diesel: (2)

Wind Energy: (2)

Tidal Energy: Principle, selection of site, Economics and future prospect (2)
Wave Energy: Principle, selection of site and future prospect (2)
Geo thermal Energy: Principle, location, economics and prospect (2)
Fuel Cells: (5)
Principle of fuel cells, Different types of fuel cells, advantages and limitations
Magneto hydrodynamics energy conversion: (2)
Principle, Economics and environmental aspect of MHD generation

Audio & Speech Processing
EC802D
Contacts: 3L
Credits: 3

Objective: The course provides fundamentals in human speech and music analysis, modeling and processing using digital filters and Pattern Recognition techniques, and an overview of Hidden Markov Models for speech encoding. The different representations of digitized human speech, the importance of adequate voiced and unvoiced speech sounds grouped into phonemes, are used along with spectrograms for speech recognition, articulation and understanding. Also covered are - how the dominant features of speech may be analyzed to form significant abstractions for speaker identification and speaker-independent linguistic comprehension. Prerequisites: Audio Systems, Analog Filters, Digital Signal Processing.

Module -1

Module -2

Module -3

Module -4
Physiology of the ear and hearing mechanism, the Auditory System modeled as a Filter-bank, Gamma-tone and Roex filters, Spectrum and Complex Cepstrum analysis of speech as perceived by detectors, Automatic Speech Recognition (ASR), Linear Prediction analysis [7]

Module -5
Phonetic and phonemic alphabets, phonological models of ASR, Linear and Dynamic Time-warping, connected word recognition, Statistical sequence recognition and model training in speech pattern recognition, HMM training, Viterbi training, MLP architecture and training. [8]

Module -6
Speech Synthesis and coding, Formant synthesizers, Vocoders, Speech transformation, Speaker verification, Music synthesizers, speech-assisted applications in industry, defence and medicine. [5]

Text Books:
16. B.Plannerer : An Introduction to Speech Recognition [Freely downloadable e-Book]
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17. F.Mihelic & J.Zibert : Speech Recognition (InTech) [Freely downloadable e-Book]

Reference Books :

viii) G. Young :- The Application of Hidden Markov Models in Speech Recognition [freely downloadable e-Book]
ix) M. Grimm & K. Kroschel :- Robust Speech Recognition & Understanding (Intech)[Freely downloadable]
xii) C. Schmandt :- Voice Communication with Computers- Conversational Systems (Van Norstrand Reinhold Computers Series)
xii) SOUND FORGE software package (SONY) for practice sessions [freely downloadable]

Practical

Design Lab
Contacts: 6L
Credits: 4

Objective: To impart the essential knowledge of electronic circuit design and fault analysis, to enhance hands on experience and to encourage innovativeness.

Modus operandi: The subject will be a sessional subject so that students can employ all their resources in order to excel.

Total 18 designs have been indicated in the syllabus classified in 4 groups. Each student has to complete at least 8 designs in a semester taking two from each group.

At the end of the semester, the student will be interviewed by a panel of examiners, constituted by the head of the department/institution.

Guidelines: Each design given in the syllabus indicates the basis. On this basis, the teacher will prepare an exact design problem with specified parameters and assign to the student.

Objective of the job in brief is also given in the syllabus. As such the teacher can further elaborate or specialize the problem creating enough room for the student to learn and innovate.

If same job is assigned to more than one student/group, it must be with different parameter values.

The students will find their own design solutions with minimum input from the teacher. Of course there can be more than one solution but the student should ultimately know their comparative merits/demerits.

The hardware assembly and testing has to be done only during assigned class hours under general supervision of a teacher. The student must always make a comparative study between the theoretical and measured performance parameters and analyze their causes.

At the end of each job, the student will prepare a report including detail technical specification of his design, circuit diagram, design calculations, theoretical & measured values, graphs, references etc.

Scoring: The total score of 100 will be in two parts, e.g. a) continuous evaluation-60 and b) semester end viva-40.

A full mark of 10 is allotted to each job. At the end of each job, the teacher will evaluate the performance on the basis of initiative, innovativeness, speed and insight. The sum of 6 such evaluations will make the total for continuous evaluation.

At end semester, each student will be interviewed to assess his expertise in various facets of electronic design, and a score out of 40 will be allotted.
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A. DISCRETE ANALOG CIRCUITS.
1. Rectifiers.
   (To design a rectifier for a given average output dc voltage and a given load resistance, compare between the theoretical values of $V_{dc}$, $V_{rms}$, RF, HD, output regulation, transformer utility factor etc. with the measured values, and thus comprehend the relevance/effect of these various parameters.)
2. DC power supplies regulation and protection circuits.
   (To learn designing a series transistor based output regulation circuit, an output current limiting circuit, fold back circuit needed for a given output parameters.)
3. Single stage audio frequency voltage amplifier with BJT for a given $A_v$, $Z_{in}$ and $Z_{out}$ and maximum symmetrical output swing.
   (To learn basic design principles, different methods of biasing, bias stability, selection of transistor from data manuals and effect of ac coupling on bandwidth.)
4. Single stage audio frequency emitter follower with JFET for a given $A_v$, $Z_{in}$ and $Z_{out}$ and maximum symmetrical output swing.
   (To learn the design principles and applications of an emitter follower.)
5. Complimentary symmetry power amplifier with pre amplifier, if necessary, for a given output power to a given load with single ended power supply.
   (To learn the distinction of a power amplifier over and above a voltage or current amplifier, its design principles, issues like, efficiency, cross over distortion etc.)
6. RC phase shift Oscillator, Wien Bridge oscillator, Hartley and Colpitt oscillator
   (To learn the design of oscillators and measuring the frequency and amplitude of oscillations)

B. OPAMP BASED ANALOG CIRCUITS
1. Inverting and non-inverting amplifier of given dc gain, input impedance and output impedance.
   (To learn the basic design, inter relation between the dc gain and input/output impedances, offset balance and the relation between feedback and GBW.)
2. Adder and subtractor.
   (To learn the basic design and function of a multi input adder/subtractor (with ac and dc inputs present simultaneously).
3. Comparator/voltage level detector for a given upper threshold level and a given lower threshold level with facility of independent adjustment of hysteresis and center point.
   (To learn the design and the technique of independent adjustment of both hysteresis and center point.)
4. Active filters: LP, BP, HP, 1st order, 2nd order.
   (To learn the design of a filter and it's inherent phase shifting characteristics.)
5. 555 based monostable and astable of duty cycle below and above 50%.
   (To learn designing 555 based timer circuits.)

DIGITAL LOGIC CIRCUITS
1. Design and implement a BCD to 7-segment decoder with basic and universal gates.
   (To understand clearly the method of writing a truth table, use of K-map, simplifying a logic function and optimum design with minimum number of ICs and inputs.)
2. Design and implement a 4-digit frequency counter with a clock generator.
(To learn designing a digital circuit using available standard gate, FF, counter and display Ics.)

3. Designing logic circuits using multiplexers, demultiplexers and gates to implement logic functions.
(To learn the use multiplexers and demultiplexers)

4. Design and implement a sequence detector.
(To learn designing a sequential circuit, whose output is 1 or 0 when any input bit is preceded or succeeded by a predefined binary sequence. To define the input & output sequence from a given physical problem, to prepare a state diagram, derive a minimal state table, to find the simplified state equation, to implement the same & verify the result)

5. To design and implement a combination of a logic circuit and a RAM in order to generate a 4-bit data after simplifying a logic expression, to store the output data at a predefined location in the RAM, to retrieve the same and verify.
(To comprehend the structure and operating principle of memory devices.)

D. Power Electronics

1. Design a Single-phase full & shaft controlled converter.
2. Design of Microprocessor based Triggering socket.