UNIVERSITY OF CALCUTTA

SYLLABI

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THREE YEAR B. Sc HONOURS

AND

GENERAL COURSES

IN

ELECTRONICS

2010

w.e.f.2010-2011.

HONOURS COURSE

DISTRIBUTION OF MARKS

Part-I Examination (1st year)		**Full Marks - 200**
Module I:	**Paper-I:**	**100**
	Paper IA: Mathematical Methods	50
	Paper IB: Classical and Quantum Mechanics	50
Module II:	**Paper-II:**	**100**
	Paper IIA: Electromagnetism I, Linear Circuits and Nonlinear Devices and Circuits I	50
	Paper IIB: Practical	50
Part-II Examination (2nd year)		**Full Marks - 200**
Module I:	**Paper-III:**	**100**
	Paper IIIA: Thermal, Statistical and Solid State Physics	50
	Paper IIIB: Nonlinear Devices and Circuits II	50
Module II:	**Paper-IV**:	**100**
	Paper IVA: Instrumentation and Digital Electronics I	50
	Paper IVB: Practical	50
Part-III Examination (3rd year)		**Full Marks - 400**
Module I:	**Paper-V:**	**100**
	Paper VA: Electromagnetism II and Electronic Communication	50

	Paper VB: Microwave Electronic Devices, Optics and Photonics	50
	Paper-VI:	**100**
	Paper VIA: Digital Electronics II and Introduction to Computers and C programming	50
	Paper VIB: Introduction to the 8085 Microprocessor	50
Module II:	**Paper-VII: Practical**	**100**
	Paper VII A: Experiments with Analog Integrated Circuits and on Communication Systems	50
	Paper VIIB: Experiments on Digital Electronics	50
	Paper-VIII: Practical	**100**
	Paper VIIIA: Assembly Language Programming on the 8085 Microprocessor	50
	Paper VIIIB: Computer programming in C language	50
	Total marks for Honours Course:	**800**
	Theoretical papers:	**500**
	Practical papers:	**300**

Guidelines for practical classes:

In practical classes all the data should be recorded directly in the Laboratory Note Book and signed regularly by the attending teachers. This student has to submit this Note Book at the time of final Practical Examination. No separate fair LNB needs be maintained.

Practical classes will be held in two modules but practical examination will be held in even module.

Honours Course in Electronics

Question Pattern

Part-I Examination **Full Marks-200**

Module I

Paper-IA: **Full Marks-50**

Q. No.1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions will have to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking at least one from each unit.

Setting of Questions

Unit	Topics	No. of Questions to be set
I	(i) Vector Analysis	2
	(ii)Differential Equation	1
II	(i) Fourier Series	2 ((i)-(iv))
	(ii) Fourier Transform	
	(iii) Laplace Transform	
	(iv) Special Functions, distributions	
III	(i) Numerical methods	1
	(ii)Matrix	1
	Total No. of questions:	**07**

Paper-IB: **Full Marks-50**

Q. No.1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions will have to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking one from Unit **I** and 3 from Unit **II**.

Setting of Questions

Unit	Topics	No. of Questions to be set
I	Classical Mechanics	2
II	(i) Quantum Theory	1
	(ii) Foundations of Quantum Mechanics	2
	(iii) The Schrodinger's equation and its applications	2
	Total No. of questions:	**07**

Module II

Paper-IIA: **Full Marks-50**

Q. No.1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions will have to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking one from Unit **I**, two from Unit **II** and one from Unit **III**.

Setting of Questions

Unit	Topics	No. of questions to be set
I	(i)Electrostatics	1
	(ii) Magnetostatics	1
II	(i) Loop and nodal Analysis	1 ((i) and (ii))
	(ii) Wave shaping Circuits	
	(iii) Transients	

	(iv) Alternating Currents	2 ((iii), (iv) and (v))
	(v) AC Bridges	
III	(i) Introduction to Circuit Simulation	1
	(ii) Nonlinear Devices and Circuits	1
	Total No. of questions:	**07**

Paper-IIB: Practical **Full Marks: 50**

One experiment to be performed

Marks Distribution: LNB-5, Viva-10, Experiment-35

Part-II Examination **Full Marks: 200**

Module I

Paper-IIIA: **Full Marks-50**

Q. No.1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions will have to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking two from each unit.

Setting of Questions

Unit	**Topics**	**No. of questions to be set**
I	(i) Kinetic Theory	1
	(ii) Thermodynamics	1
	(iii)Statistical Physics	2
II	(i) Crystal Physics	1
	(ii) Free Electron Theory	1((ii) and (iii))
	(iii) Energy Bands	
	(iv)Physics of Semiconductors	1
	Total No. of questions:	**07**

Paper-IIIB: **Full Marks-50**

Q. No.1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions will have to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking two from each unit.

Setting of Questions

Unit	**Topics**	**No. of questions to be set**
I	(i) Bipolar junction Transistors (BJTs) and Circuits	2
	(ii) Field Effect Transistors (FETs) and Circuits	1
	(iii) OP- AMP and OP-AMP circuit	1
II	(i) Power amplifiers	1
	(ii) Feedback in amplifiers	1
	(iii) Oscillators	1 ((iii) and (iv))
	(iv) Regulated Power Supply	
	Total No. of Questions:	**07**

Module II

Paper – IVA: **Full Marks: 50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking atleast two from Unit **I** and one from Unit **II**.

Setting of questions

Unit	Topics	No. of questions to be set
I	(i) Cathode Ray Oscilloscope	1
	(ii) Meters	1
	(iii) Signal Generators and Multivibrators	2
II	(i) Number systems and codes	1
	(ii) Boolean Algebra and gates and simplifications	1
	(iii) IC families and their characteristics	1
	Total No. of Questions:	**07**

Paper-IVB: Practical **Full Marks: 50**

One experiment to be performed.

Marks Distribution: LNB-5, Viva-10, Expt.-35

Part-III Examination **Full Marks-400**

Module I

Paper-VA **Full Marks-50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking two from each unit.

Setting of questions

Unit	Topics	No. of questions to be set
I	(i) Maxwell's equations	1
	(ii) Electromagnetic waves in	1

	different media	
	(iii) Transmission lines	1
	(iv) Wave guides	1
II	(i) Radiowave propagation	1
	(ii) Modulation	2 ((ii) and (iii))
	(iii) Noise	
	Total No. of Questions:	**07**

Paper-VB **Full Marks-50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking one from each unit.

Setting of questions

Unit	Topics	No. of questions to be set
I	(i) Basics of Microwaves	
	(ii) Two-cavity Klystron	2 ((i)-(iv))
	(iii) Reflex Klystron	
	(iv) Magnetron	
II	(i) Tunneling Wave Tube	
	(ii) Transferred Electron Mechanism	2 ((i)-(iv))
	and Gunn diode	
	(iii) Transient Time Mechanism	
	and IMPATT diode	
	(iv) Tunneling and Tunnel diode	
III	(i) Basic ideas of Physical Optics	1 ((i) and (ii))
	(ii) Interference of light	

	(iii) Diffraction of light	1 ((iii) and (iv))
	(iv) Polarization of light	
IV	(i) Laser	1 ((i) and (ii))
	(ii) Some Optoelectronic devices	
	(iii) Fiber Optics	1(iii)
	Total No. of Questions:	**08**

Paper-VIA **Full Marks-50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking two from each unit.

Setting of questions

Unit	**Topics**	**No. of questions to be set**
I	(i) Combinational Logic Circuits	2
	(ii) Sequential Circuits	2((ii) and (iii))
	(iii) DAC/ADC	
II	(i) Personal Computer	1 ((i) - (iii))
	(ii) Operating Systems	
	(iii) Networking	
	(iv)Languages and Translators	2 ((iv) and (v))
	(v) Basics of C language	
	Total No. of Questions:	**07**

Paper-VIB **Full Marks-50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking at least one from each unit.

Setting of questions

Unit	Topics	No. of questions to be set
I	Microprocessor Architecture and Organizations	2
II	Communicating with the Microprocessor	3
III	(i) Basic Concepts of Memory Interfacing	1 ((i) and (ii))
	(ii)Interfacing I/O Devices	
	(iii) Interfacing Data Converters	1 ((iii) and (iv))
	(iv) PPI Device	
	Total No. of Questions:	**07**

Module II

Paper-VIIA : Practical **Full Marks-50**

Analog Integrated Circuits and Communication Systems.

Marks Distribution: LNB- 05, Viva-10, Expt.-35

Paper-VIIB : Practical **Full Marks-50**

Digital Electronics.

Marks Distribution: LNB-05, Viva-10, Expt.-35

Paper-VIIIA : Practical **Full Marks-50**

Assembly Language Programming on 8085 Microprocessor.

Marks Distribution: LNB-05, Viva-10, Expt.-35

Paper-VIIIB : Practical **Full Marks-50**

Computer programming in C language.

Marks distribution: LNB-05, Viva-10, Expt.-35

HONOURS SYLLABUS

Part I(1st year) **Full marks 200**

Module I **Full Marks 100**

Paper IA : Mathematical and Numerical Methods **Marks-50**

Paper IB : Classical and Quantum Mechanics **Marks-50**

Paper IA : Mathematical and Numerical Methods

Total No. of lecture periods: 55

I.Mathematical Methods

Vector Analysis: Definition and classification of vectors, scalar and vector products, vector calculus-applications to simple problems. Gauss' divergence, Stokes and Green's theorems with simple applications.

Curvilinear co-ordinates: unit vectors, scale factors, their calculation in spherical and cylindrical polar coordinates. Calculation of differential operators: gradient, divergence, curl, Laplacian in spherical polar coordinates. (15)

Differential Equations: First and second order linear differential equations, equations with constant coefficients (homogeneous and inhomogeneous). Second order linear differential equations with variable coefficients: outlines of Frobenious method of power series solution. (10)

Fourier's Series: Dirichlet conditions and Fourier Theorem, analysis of simple waveforms using Fourier series. (5)

Fourier Transform: Definition, properties and simple problems. (4)

Laplace Transform: Definition, properties and simple problems (4)

Special Functions and Distributions: Beta and gamma functions , Gaussian, Poisson and Binomial distributions. (4)

Matrix : Inverse of a matrix, Adjoint of a matrix, Hermitian and unitary matrices, matrix diagonalization, eigen-values and eigen-vectors of a square matrix. (8)

II. Numerical Methods:

Solution of algebraic and transcendental equations by bisection method, Newton-Raphson method. Numerical differentiation. Numerical integration: Simpson's $1/3^{rd}$ rule, Gauss's quadrature. Solution of ordinary linear differential equations: Euler's method, Runge Kutta method.

(5)

Text and/or Reference Books:

Introduction to vector analysis, H.F. Davis and A.D. Snider, UBS, New Delhi
Vector analysis, Spiegel- TMH
Advanced Engineering Mathematics, Kreyszig, John Wiley
Mathematical methods for physicists, Weber and Arfken , Elsevier
Mathematics for Engineers & Physicists, L. A. Pipes
Mathematical Methods, Charlie Harper, PHI
Elementary Numerical Analysis, Conte and Boor, McGRAW-Hill
Elementary Numerical Analysis, Atkinson, Wiley India
Mathematical Physics, Ghatak, Goyal and Chua, Macmillan
Mathematical Methods, M.C. Potter and J. Goldberg, PHI
Numerical Methods, E. Balaguruswamy, TMH

Paper IB : Classical and Quantum Mechanics

Total No. of lecture periods: 55

I. Classical Mechanics

Tangential and normal components of velocity and acceleration of a particle in Cartesian coordinate system. Radial and transverse components of velocity and acceleration in a plane polar coordinate system. (5)

Time and path integral of force. Concepts of linear momentum, angular momentum, torque, work, power and energy. Conservative forces. Potential energy. Conservation laws. Basic concepts and simple problems.
Constraint equations and generalized forces, Lagrangian equation for conservative systems and its application to simple cases. (10)

Text and/or Reference Books:

Introduction to Classical Mechanics, Takwale and Puranik ,TMH
Classical Mechanics, Goldstein, Pearson
Theoretical Mechanics by Spiegel, TMH

Mechanics: Berkeley Physics Course, Vol-1, Berkeley, TMH
Introduction to Mechanics, Klepner, TMH

II. Quantum Mechanics

Quantum Theory: Compton effect, derivation of the Compton shift and simple problems. Blackbody radiation, Wien's law, Raleigh Jeans Law, Wien's displacement law (statement only), Derivation of Plank's formula. Wave-particle duality, de Broglie's hypothesis, phase and group velocity of a wave, concept of a wave packet. (6)

The Foundations of Quantum Mechanics: Specifications of the state of a quantum mechanical system by a wavefunction, observables, complementarity, Heisenberg's uncertainty principle, simple problems on the principle, requisite properties of admissible wave functions, probability density and Born interpretation.

Normalized and orthogonal wavefunctions. Operator, expectation value of an operator and measurement of an observable, eigenstate, eigenfunction and eigenvalues, Hermitian operators and their properties, operators associated with position, linear momentum, angular momentum, kinetic energy, potential energy and total energy, Hamiltonian operator, commutation relation between operators, basic concept of position and momentum representations of quantum mechanics. (13)

The Schrodinger's Equation: The time-dependent Schrodinger equations, obtaining the time-independent Schrodinger equation from the time-dependent one. Concept of stationary state. (5)

Application of Schrodinger Equation : Free particle moving in one dimension, Particle in a one- dimensional infinite potential well.

The rectangular potential barrier: setting up the Schrodinger's equation for the three pertinent regions and qualitative discussion, the reflection and transmission coefficients for the case where the total energy is less than the barrier height

Linear Harmonic Oscillator :setting up the Schrodinger's equation, qualitative study of the solution for the wave function in terms of the Hermite polynomials, energy levels, zero-point energy

Hydrogen and Hydrogenic atom : Schrodinger's equation, separation of the Schrodinger equation by expressing the Hamiltonian in center-of-mass and relative coordinates, separation of the Schrodinger's equation in relative coordinates into angular and radial parts, (detailed procedure for obtaining the solutions is to be omitted), analyzing the solution for the complete wave function in terms of the spherical harmonics and the radial wave function and their dependence on the quantum numbers n, l and m_l, probabilities and the radial distribution function, correlation with Bohr's theory of hydrogen atom. (16)

Text and/or Reference Books:

Quantum Physics, Eisberg and Reisnick, John Wiley
Quantum Physics of Atoms and Molecules, Eisberg and Resnick, Wiley India
Quantum Mechanics, Powell and Crasemann, Narosa
Quantum Mechanics, A. Ghatak and S. Lokanathan, Macmillan India
Basic Quantum Mechanics, A. Ghatak, Macmillan India
Quantum Mechanics, Mathews and Venkateswar, TMH
Quantum Mechanics, Gasiorowitz, Wiley India
Quantum mechanics, S. N. Ghoshal, Calcutta Book House

Quantum mechanics, G. S. Chaddha, New Age
Quantum physics: Berkeley Physics course, Berkeley,Vol-4, TMH
Quantum mechanics, J. Singh, John Wiley & sons
Concept of Modern Physics, Beiser, TMH

Module II   Full Marks 100

Paper IIA : Electromagnetism I, Linear Circuits and Non-linear Devices and Circuits I

Marks-50

Paper IIB : Practical   Marks-50

Paper IIA : Electromagnetism I, Linear Circuits and Non-linear Devices and Circuits I

Total No. of lecture periods: 60

I. Electromagnetism I :

Electrostatics: Coulomb's Law, discrete charge distribution, continuous charge distribution, electric field and electric potential, Electric Field and Electric potential due to a continuous charge distribution, energy consideration, relation between field and potential, lines of force, flux of electric field and Gauss's Law (integral and differential forms), divergence and curl of electric field, Poisson's equation, Laplace's equation, electric dipole, dipole field and potential, conductors, capacitors, energy of a capacitor and energy density in an electric field, dielectrics, polarization density, electric polarizability of atoms, polarization charge density, the relation $\mathbf{D} = \mathbf{e}\,\mathbf{E} + \mathbf{P}$, Gauss's Law in presence of a dielectric; boundary conditions on **D** and **E** (basic concepts, definitions and simple problems). (10)

Magnetostatics: Biot-Savart Law, divergence of magnetic induction vector, Ampere's Law, Lorentz force, Faraday's law of electromagnetic induction, motional EMF, mutual and self inductance (basic concepts, definitions and simple problems). (6)

Text and/or Reference Books:

Engineering Electromagnetics , Paul,TMH
Electricity and Magnetism , A S Mahajan and A . A Rangwala, TMH
Introduction to Electrodynamics, D.J. Griffiths, PHI
Physics , D. Halliday, R. Resnick and K. S. Krane, Volume II Wiley
Engineering Electromagnetics, Hayt,TMH

II. Linear Circuits:

Loop and Nodal Analysis: Kirchoff's current and voltage Laws, Examples of loop and nodal analysis, Generalized Network theorems: Superposition, Reciprocity, Thevenin's, Norton's theorem, Maximum Power transfer theorem, Bisection, Millman Theorem T-pi and to pi- T transformation. (6)

Wave shaping circuits: Frequency response of R-C networks –passive filter, integrator, differentiator, phase lead-lag circuit, passive filter (first order only). (4)

Transients: Use of Laplace transforms – theorems and application in transient analysis of different electrical circuits with and without initial conditions. Growth and decay of current in LR circuit, Charging and discharging of capacitors in CR and LCR Circuits, Oscillatory discharge, time constant. (4)

Alternating current: LR, CR and LCR circuits. Power factor, series and parallel resonant circuits, Q-factor, selectivity. magnetically coupled circuits-mutual inductance,linear transformer,ideal transformer,T and Pi equivalent circuits. (4)

A.C. Bridges: Generalized Wheatstone bridges, Anderson's bridges, Scherring bridges (3)

Introduction to Circuit Simulation using Spice/PSpice: Need for circuit-simulation, basic structure of a SPICE netlist, data statements for use with passive elements like resistor, inductor and capacitor, independent and dependent voltage and current sources, control and output statements, transient analysis, AC analysis, simple examples. (7)

Text and/or Reference Books:

Network analysis, Van Valkenburg, Pearson
Engineering Circuit Analysis, Hayt, TMH
Linear Circuit Analysis, De-Carlo-Lin , Oxford
Network Analysis, D.Roychowdhury , New Age
Electricity and Magnetism, Fewkes and Yearwood
Introduction to P-Spice, Rashid, Pearson
Electric circuits, Sitamm's outline series, J. Edminister and M. Nanvi, TMH.
Linear Integrated circuits, Nair, Wiley India
Basic Circuit Analysis, D.R. Cunningham and J.A. Stuller, Jaico
Electronic Circuits, H. N. Shivshankar and B. Basavvraj, Jaico
Network analysis and synthesis, Sudhakar, TMH
Network analysis and synthesis, Ghosh, TMH

III. Non-linear Devices and Circuits I:

Distinction between insulators, semiconductors and metals, intrinsic and extrinsic semiconductors, p and n type semiconductors, p-n junction, space-charge region in a p-n junction, expressions for the potential and field across a p-n junction, depletion width and junction capacitance, energy band diagrams of unbiased and biased p-n junctions, current-voltage characteristics of a p-n junction diode, temperature effects, reverse breakdown, avalanche and Zener breakdown, varactor diode, Schottky effect and Schottky diode, basic ideas of LED and photodiode.
(9)

Diode as a circuit element, piecewise linear model, the diode load-line, clipper, clamper, voltage doubler using diodes, half wave, full wave rectifier and bridge rectifiers using diodes, effect of filters, need for bleeder resistance, switching characteristics of a diode, load and line regulation using a Zener diode. (7)

Text and/or Reference Books:

Integrated Electronics, Millman and Halkias , TMH

Foundations of Electronics , Chattopadhyay and Rakshit , New Age
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson Education.
Electronic Devices and Circuits, Maini, Wiley India
Analog and Digital Electronics, Taraprasad Chattopadhyay, CBS Pub and Distributors
Basic Electronics , K.K.Ghosh, Platinum Publisher
Basic Electronics Engineering, J.P. Bandyopadhyay, Vikash
Electronic Devices and Circuits, T. F. Bogart, Jr. UBS, New Delhi
Semiconductor Circuit Approximation, A. P. Malvino, TMH

Paper IIB: (Practical)

Experiments on Electricity and Basic Electronics I :

1.Verification of

a) Thevenin's theorem

b) Norton's theorem

c) Maximum power transfer theorem using a resistive Wheatstone bridge, dc source, dc meters.

2. Measurement of self-inductance of a coil and measurement of mutual inductance between two coils by Anderson bridge.

3. Investigation of inductance in ac circuits:

a) To verify the current-voltage relationship characteristics for an inductance in ac circuit and hence to measure the value of the inductance.

b) To determine the phase-difference between the current and voltage in a series LR circuit at different frequencies.

c) To study the variation of the reactance of the inductive coil with frequency of the ac source and hence to measure its inductance.

d) To find the value of the loss-angle δ, the resistance of the inductor (R) and the inductance of the inductor (L) from the phasor-diagram.

4. Investigation of capacitance in an alternating current circuit:

a) To verify the current-voltage relationship for a capacitor in an ac circuit being linear and hence to measure the value of the capacitance.

b) To determine the phase-difference between the current and the voltage in a series CR circuit at different frequencies.

c) To study the variation of reactance of a capacitor with frequency of the ac source and hence to measure the capacitance.

d) To find the value of the loss-factor and loss-angle δ of a capacitor from the phasor-diagram.

5. Study of resonance in electric circuits:

(a) Series resonance

To study the variation of the voltages across the inductance, capacitance and resistance in a series LCR circuit.

To determine the current resonant frequency by noting the frequency at which the voltage across the inductance equals that of the capacitance.

To plot the graph of the current amplitude versus frequency of the source and hence determine the current resonant frequency, bandwidth and the quality factor (Q value).

(b) Parallel resonance

To study the variation of the voltages across the inductance and capacitance in a parallel resonant circuit. Also study the variation of the voltage across the resistance R connected in series with the source.

To plot the graph of the amplitude of the current delivered by the source versus its frequency and hence determine the frequency at which the current becomes minimum, say I_{min}, the bandwidth corresponding to I_{min} and the quality factor (Q value).

6. Study of p-n junction diode:

a) To draw I-V characteristics for forward-bias and to find the dc and ac resistances of a p-n junction diode.

b) To study ripple-factor of half-wave, full-wave and bridge- rectifier with and without filter Also to study the use of bleeder resistor in a π-type filter.

c) To study the load and line regulation of a full-wave unregulated power-supply using Zener diode.

7. Study of a Zener diode:

a) To study the forward and reverse bias characteristics of a Zener diode.

b) To study the load and line regulation of a Zener diode voltage regulator.

8. Circuit analysis using Spice/Pspice: **Some typical example programs are given and other programs with similar approach may be set.**

DC Analysis: Independent sources

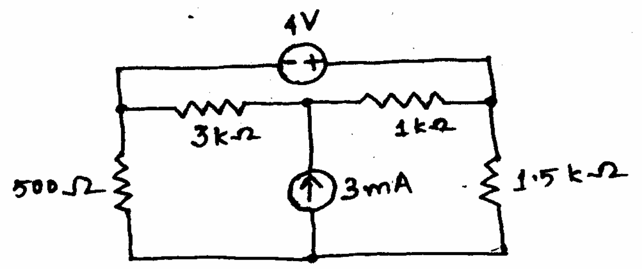
Use of data statements for passive elements.

Use of data statements for independent current and voltage sources.

Example program:

1.Write the Spice/PSpice source program for the following circuit, run PSpice for DC analysis and obtain the output on screen.

(i)



The values of the passive components and sources are for indicative purposes and may be varied.

(ii) DC Analysis: Dependent sources

Use of data statements for dependent sources:

Voltage-controlled voltage source (VCVS)

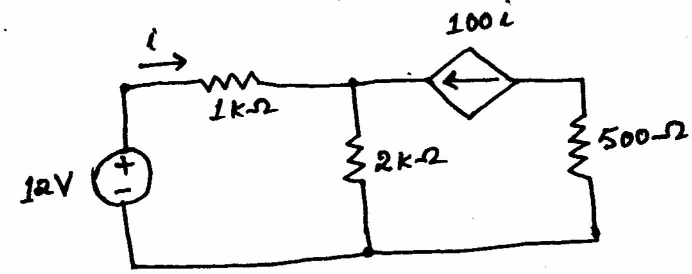
Voltage-controlled current source (VCCS)

Current-controlled voltage source (CCVS)

Current-controlled current source (CCCS)

Example program:

2. Write the Spice/PSpice source program for the following circuit, run PSpice for DC analysis and obtain the output on screen.



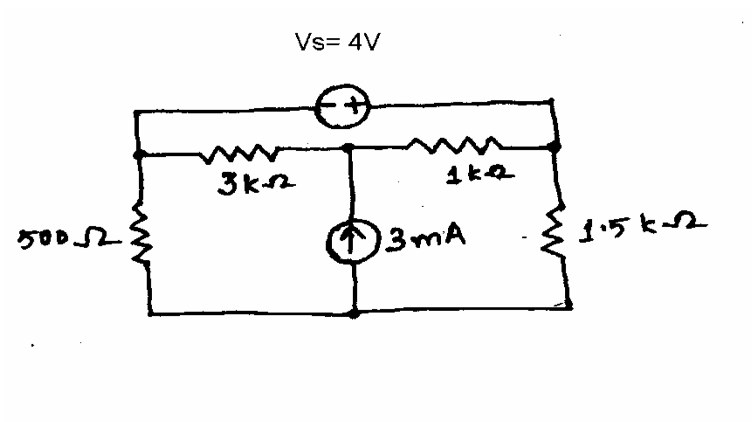
The values of the passive components and sources are for indicative purposes and may be varied.

Use of control and output statements in DC analysis

(.OP, .DC, .PRINT, .PLOT and .PROBE)

Example program:

3. Write the Spice/PSpice source program containing .DC, .PRINT, .PROBE and .PLOT statements and execute it to find the value of the source voltage V_s for which it supplies no power. Draw a graph between V_s and I from the resultant data file.



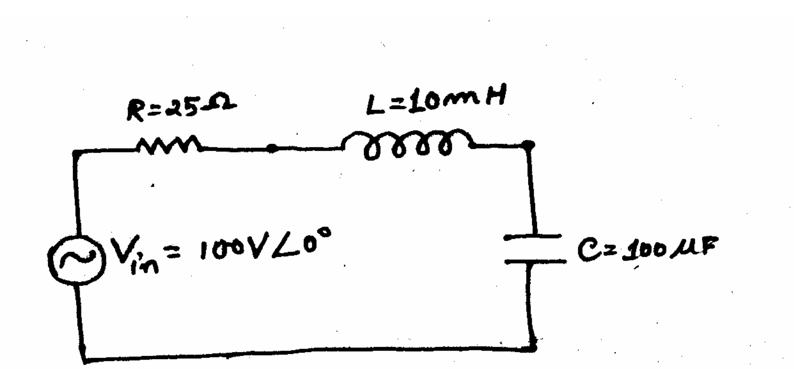
(iii) AC analysis

Use of control and output statements in AC analysis

(.AC, .PRINT AC, .PLOT AC)

Example programs:

4. Use Spice/PSpice for the given series LCR circuit; vary the frequency of the AC source from 10 to 1000 in 100 steps and use .PROBE to display the resonance graph.



•In the final practical examination, questions may be set by combining different parts of the same or different experiments listed above. However one question of Spice/PSpice of 10 marks will be compulsory.

• Free versions of Spice (both for Windows and Linux) may be downloaded from the Internet and installed in the PCs.

Reference Books:

Practical Physics , Rakshit and Chattopadhyay
Advanced Practical Physics Volume II B. Ghosh, New Central Book Agency
Laboratory Manual for Electric Circuits , Bell
Electric Circuits: Schaum's Outlines, J. Edminister and M. Nahvi, TMH.
Introduction to Pspice, Rashid, Pearson.
Circuits and Networks, Sudhakar, Shyammohan and Palli, TMH.

Part II (2^{nd} year) **Full marks 200**

Module I **Full Marks 100**

Paper IIIA : Thermal, Statistical and Solid State Physics	**Marks-50**
PaperIIIB : Non-linear Devices and Circuits II	**Marks-50**

Paper IIIA : Thermal, Statistical and Solid State Physics

Total No. of lecture periods: 60

I : Thermal Physics

Kinetic theory of gases : Evidence of molecular motion, association of heat with molecular motion. Basic assumptions of the Kinetic theory of gases. Derivation of Maxwell's law of distribution of molecular speeds from probabilistic approach. Average velocity, RMS velocity and most probable velocity. Maxwell's energy distribution, Mean free path. Expression for mean free path (elementary treatment). Survival equation.

(9)

Thermodynamics: (Qualitative idea only) Scope of Thermodynamics, State variables. Thermodynamic equilibrium. Zeroeth law of Thermodynamics.Intensive and extensive properties of a thermodynamic system.

External and internal work, quasi-static process. Work done in quasi-static isothermal expansion or compression of an ideal gas. Work and heat. Adiabatic and non- adiabatic work. Internal energy function.

1^{st} Law of thermodynamics: Mathematical formulation and differential forms of the first law of Thermodynamics. Heat capacity and molar heat capacity. Definitions of Cp and Cv for an ideal gas. Work done in a quasi-static adiabatic process.

Carnot cycle and the 2^{nd} Law: Efficiency of Carnot's cycle. Kelvin, Planck , Kelvin- Planck and Clausius statement of the second law of Thermodynamics. Equivalence of Kelvin- Planck and Clausius statements, Carnot's theorem. Reversible and irreversible processes. Condition for reversibility.

Concept of entropy : Entropy and the mathematical formulation of the second law. T-S diagram. Entropy change in an irreversible process, principle of increase of entropy. (15)

II : Statistical Physics

Classical and Quantum Statistics: Basic differences between classical and quantum statistics, basic features of Maxwell-Boltzmann (MB), Bose-Einstein (BE) and Fermi-Dirac (FD) statistics, Examples illustrating counting procedures for MB, BE and FD statistics, expressions for the partition-probability in the three statistics (derivation not required), derivation of distribution functions for the three statistics starting from the respective expressions for the partition-probabilities. Conditions under which the quantum mechanical distribution functions reduce to the classical distribution. (6)

Applications of MB, BE and FD statistics: Obtaining the MB energy distribution for a collection of ideal gas molecules, obtaining the FD distribution function for a gas of free-electrons, Fermi energy at T=0 and at a low but finite temperature. (5)

Text and/or Reference Books:

Heat and Thermodynamics, Zeemansky and Dittman, McGraw Hill
Kinetic Theory and Statistical Thermodynamics, Sears and Salinger, Narosa
Thermal Physics S. Garg, R. M. Bansal and C. K. Ghosh Tata McGraw Hill.
Heat and Thermodynamics Gupta and Roy, New Central
Fundamentals of Classical and Statistical thermodynamics, Roy, Wiley India
Statistical Mechanics, Pathria, Elsevier
Statistical Mechanics, Laud, New Age International
Fundamentals of Statistical and Thermal Physics F. Reif McGraw Hill
Statistical Mechanics, Huang, Wiley India
Thermal Physics, Kittel, W. H. Freeman

II. Solid State Physics

Crystal Physics: Lattice and basis, primitive translation vectors, primitive and unit cells, Bravais lattices, coordination number, packing fraction, calculation of packing fraction for the simple , body-centered and face-centered cubic lattices, Miller indices for designating crystal planes, concept of reciprocal lattice, Bragg's equation in direct and reciprocal lattice (no derivation required). (6)

The free electron theory: Thermionic emission, work function, Richardson-Dushman equation, electrical conductivity, main features of the Drude Lorentz theory of electrical conductivity, Mattheissen's rule, basic concepts of the thermal conductivity in metals, Widemann- Franz law, Hall effect. (conceptual study of the above sub-topics, mathematical formulations to be kept at a minimum). (7)

Energy bands in solids: Origin of energy bands in solids, classification of solids as metals, insulators and semiconductors on the basis of the band picture, Bloch's theorem in one dimension (proof not required), the Kronig-Penney model (detailed calculations not required.), E-K diagrams in different representations.

(6)

Physics of semiconductors: The band structure of semiconductors, density of states, Fermi level, equilibrium carrier concentration, law of mass-action, diffussion and drift processes in a semiconductor, current equation, recombination process, continuity equation, theory of p-n junction, energy band diagrams in unbiased and biased conditions. (6)

Text and/or Reference Books:

Elementary Solid State Physics, M. Ali Omar, Pearson Education.
Introduction to Solid State Physics, C.Kittel, John Wiley
Solid State Electronic Device, Streetman , Pearson
Solid State Physics Singhal, Kedarnath Ramnath publications
Solid State physics, A.K. Saxena, Macmillan India
Solid State Physics, D. L. Bhattacharyay, Calcutta Book House
Semiconductor Physics and Devices, Neaman, TMH

Paper IIIB : Non-linear Devices and Circuits II

Total No. of lecture periods: 55

Bipolar junction transistor (BJT) and circuits:

The junction transistor, transistor current components, input and output characteristics in CB,CE and CC modes. Biasing a transistor, self bias, fixed bias, stability factor, compensation techniques, Q point, and load line. Impedance, admittance, and hybrid parameter models for transistors, analysis of a low frequency transistor amplifier (current , voltage and power gain, input and output resistance), RC coupled amplifier, Darlington configuration, frequency response of a BJT, cut off frequencies, Bode Plot ,Gain-Bandwidth product , Miller theorem, BJT as a switch. (15)

Field Effect Transistor (FET) and circuits : Junction field effect transistor (JFET): basic structure of n-channel and p-channel JFETs, output and transfer characteristics of n-channel JFET, Shockley's equation for a JFET, FET parameters. Metal-Oxide-Semiconductor FET (MOSFET): basic structure of an n-channel depletion type MOSFET, output characteristics of n-channel depletion and enhancement types of MOSFET. Use of JFET as an AGC (Automatic Gain Control) device (concept only), use of enhancement-type MOSFET as a switch. (10)

Operational amplifier: Features of the ideal op amp, characteristics of the practical op amp (IC 741), the input differential amplifier and other stages of the IC 741 op amp, input bias current, input offset current, input offset voltage, Common Mode Rejection Ratio (CMRR), frequency response, slew rate. Op amp circuits: inverting and non-inverting amplifiers (concept of virtual ground and virtual short), adder, phase shifter, scale changer, voltage to current, current to voltage converter, differential amplifiers, comparator, Schmitt trigger, integrator and differentiator, logarithmic and anti-logarithmic amplifier. (8)

Power amplifiers: Class A, B, and AB power amplifiers, direct coupled, transformer coupled amplifiers, Push pull amplifiers , class A and B push-pull circuits, harmonic distortion and crossover distortion in power amplifiers. (6)

Feedback in amplifiers: General theory of feedback, features of negative and positive feedback, types of negative feedback in transistor amplifiers: current series , voltage series , current shunt, voltage shunt amplifier, Nyquist criteria. (6)

Oscillators: Positive feedback and oscillation, Barkhaussen criterion, Colpitt, Wien-bridge and phase shift oscillators, crystal oscillator, frequency stability and stability criterion. (5)

Regulated power supply : Design of an unregulated and regulated power supply, series and shunt regulation, idea of IC regulators, concept of SMPS. (5)

Text and/or Reference Books

Electronic Devices and Circuits, T. F. Bogart, Jr-UBS, New Delhi
Introduction to electronic circuit design, Spencer, Pearson
Basic Electronics, Ghatak and De, Pearson
Integrated Electronics, Millman and Halkias , TMH
Electronic Principles, Malvino, TMH
Electronic Devices and Circuit theory, Robert L. Boylestad, Louis Nashelsky*,* Prentice-Hall India
Electronic Circuits, Schilling and Belove, TMH
Electronic Devices and Circuits, Salivahanan , TMH
OP-Amp and Linear Integrated circuits, Gaykwad, Pearson
OP-Amp and Linear Integrated circuits, Coughlin and Driscoll, PHI
Electronic Devices and Circuits, Maini, Wiley India
Operational Amplifiers and linear Integrated circuits, Rajiv Kapadia, Jaico
Foundations of Electronics , Chattopadhyay and Rakshit New Age

Module II Full Marks 100

Paper IVA : Instrumentation and Digital Electronics I **Marks-50**

Paper IVB : Practical **Marks-50**

Paper IVA : Instrumentation and Digital Electronics I

Total No. of lecture periods: 55

I. Instrumentation

Cathode Ray Oscilloscope: Motion of charged particles in simultaneous electric and magnetic fields (cross and parallel), block diagram of CRO, cathode ray tube (CRT), construction, principles of focusing and deflection of electron beam, basic elements:CRO probes, trigger circuits, applications of CRO in measuring voltage, frequency, phase, brief ideas on dual-beam, dual trace and storage oscilloscopes. (10)

Meters: DC ammeters, voltmeters, voltmeter sensitivity, ohm meter, ammeter (series, and shunt

types), basic features of analog and digital multimeter (DMM), true RMS ac meter, Q meter, power factor meter, digital voltmeter (DVM) (block diagram, A-D conversion techniques, display). (8)

Signal Generators and Multivibrators: Basic oscillator circuits, Generation of sinusoidal, square wave and triangular waves. Pulse characteristics and terminology, function generator (block diagram), monostable, bistable and astable multivibrators using op-amp and the IC555 timer, using the IC555 timer chip as a Voltage Controlled Oscillator (VCO). (12)

Text and/or Reference Books

Modern Electronic Instrumentation and Measurement Techniques, Helfrik and Cooper, Pearson
Elements of Electronic Instrumentation and Measurement, Carr, Pearson
Electronic Instrumentation, Kalsi , TMH
Electronic Instrumentation and Measurement, Zbar, McGraw Hill

II. Digital Electronics I

Number systems and codes : Decimal, binary, octal and hexadecimal number systems and conversions between them, signed number representation, addition and subtraction of binary numbers using 1's and 2's complement method, weighted and non-weighted codes, BCD code, Gray code and the alphanumeric ASCII code. (5)

Boolean algebra and logic gates: The AND, OR, NOT, NAND, NOR, X-OR and X-NOR logic gates, active levels of a logic signal, theorems and properties of boolean algebra, canonical forms of switching functions: the SOP and POS representation, minterms and maxterms, conversions between canonical forms. (7)

Simplification of Boolean expressions: Algebric method, Karnaugh map method, SOP and POS simplification, role of don't care conditions, implementation of combinational logic circuits. Two-level AND-OR, NAND and NOR implementations. (6)

Integrated Circuit (IC) digital logic families and their characteristics: Different IC digital logic families, their characteristics, fan-out, power dissipation, propagation delay, noise margin, comparison of different IC digital logic families, working of a basic TTL inverter, need for Totem-pole output, improvement over basic TTL gates, basics of CMOS IC logic family. (7)

Text and Reference books:

Digital Logic and Computer Design, Mano , Pearson
Digital computer electronics, Malvino and Brown, TMH
Digital Principles, Leach and Malvino, TMH
Digital Circuits, Vol-I and II, D.RoyChaudhuri, Platinum publishers
Digital Electronics, Maini, Wiley India
Digital Fundamentals, T.L Floyd, UBS
Modern Digital electronics, Jain, TMH

Paper IVB (Practical) :

Experiments on Electricity and Basic Electronics II :

1. To observe waveforms and to measure amplitude, frequency and phase of different waveforms generated by a function-generator using a CRO. Study of Lissajous figures obtained by mixing different sinusoidal waveforms with a CRO.

2. To obtain the frequency response of a low-pass and a high-pass RC-network to sine and square wave inputs using a CRO.

3. To determine the Fourier spectrum of square, triangular and half-sinusoidal waveform by using a parallel resonant circuit and CRO.

4. Study of a BJT:

a) To draw the static input and output characteristics of a pnp and an npn transistor in CB and CE configurations and find the respective hybrid parameters.

(b) To construct a fixed biased transistor circuit with and without R_E in CE mode for a given dc operating point (Q point). Study the variation of the Q point by changing the values of biasing resistors.

(c) To use the above circuit to design and construct a CE amplifier for a particular mid-band frequency gain.

(i) To study the input-output voltage relationship at a fixed frequency of the source (say, 1kHz).

(ii) To study the variation of the voltage gain with frequency at a value of the input voltage for which the input-output voltage relationship is linear.

(d) To construct an R-C coupled amplifier by coupling a second stage to the above circuit and study the frequency response of the overall gain.

5. Study of a JFET and a MOSFET:

a) To obtain the drain (or output) characteristics of an n-channel JFET and to determine therefrom the drain resistance. Also obtain the transfer characteristic of the same JFET and determine the transconductance factor from the curve.

b) To obtain the drain (or output) characteristics and the transfer characteristic of an n-channel depletion type MOSFET and also of an n-channel enhancement type MOSFET.

6. Design of a power supply:

(a) To construct an unregulated power supply using a transformer, a rectifier circuit and a capacitor filter. Study the load regulation of the power supply.

(b) To convert the unregulated supply to a regulated one using

(i) a suitable zener diode (use appropriate design considerations).

(ii) a two transistor regulator circuit (apply appropriate design considerations).

(iii) a suitable IC regulator chip (for e.g. IC7805, IC7809 etc)

and study the load regulation again.

7. Use discrete components (resistors, diodes/transistors) to construct OR, AND, NOT and NAND gates on a breadboard. Verify the respective truth-tables.

8. (i) To verify De Morgan's theorems and other Boolean identities using TTL IC chips.

(ii) Show why NAND and NOR gates are called universal gates. (Use only NAND gates or NOR gates to construct AND, OR, NOT, EX-OR and EX-NOR gates)

*** In the final practical examination, questions may be set by combining different parts of the same or different experiments listed above.**

Reference Books:

1. *Basic Electronics: A Text Lab Manual*, Zbar, TMH
2. *Laboratory Manual for Electronic Devices and Circuits*, Bell, PHI
3. *Advanced Practical Physics Volume 2*, B. Ghosh.

Part III(3^{rd} year) Full Marks 400

Module I Full Marks 200

Paper VA: Electromagnetism II and Electronic Communication

Full Marks 50

Total No. of lecture periods: 60

I. Electromagnetism II

Maxwell's equations: Generalization of Ampere's Law, concept of Electric Displacement, Maxwell's equations in integral and differential forms with their derivations, Maxwell's equations in matter in terms of free charges and currents, Field discontinuities at boundaries-boundary conditions, Poynting vector and Poynting theorem, its derivation and simple problems. (7)

Electromagnetic waves in non-conducting and conducting media: Plane waves in isotropic dielectric media, reflection (and transmission) of plane waves at normal and oblique incidence at (through) the interface between two dielectrics, Snell's Law, Polarization by reflection, Fresnel's equation, Brewster's angle, Electromagnetic waves in conductors, skin depth, reflection of plane waves at a conducting surface, concept of dispersion, phase and group velocity, normal and anomalous dispersion. (8)

Transmission lines: Formulation of transmission line equations in terms of voltage and current and their solutions, characteristic impedance, propagation constant, concept of lossless and lossy lines, reflection coefficient, standing wave and standing-wave ratio, line impedance (formula, its derivation and simple problems), line impedance in terms of reflection coefficient or standing-wave ratio, measurement of characteristic impedance using a short circuited and open circuited line. (9)

Wave-guides: Basic concept of a wave guide, advantages over transmission lines, group and phase velocities inside a wave guide, TE and TM modes, qualitative study of rectangular waveguide, concept of guide-wavelength, cut-off wavelength and free-space wavelength and relation among them,concept of dominant mode, field- patterns in transverse and longitudinal cross-sections of a rectangular wave guide in TE_{10} mode. (6)

Text and/or Reference Books:

Engineering Electromagnetics, Hayt, TMH
Elements of electromagnetic, Sadiku, Pearson
Introduction to Electrodynamics, Griffith, Pearson
Electromagnetic waves and radiating systems, Jordan and Balmain
Microwave Devices and Circuits, Liao, Pearson

Electromagnetic field theory and transmission lines, Raju , Pearson
Microwaves , Sisodia and Gupta, New Age
Electromagnetic Theory, Reitz and Milford
The Physics of vibration and waves, H. J. Pain, Wiley India
Electromagnetic field, Paul, TMH

II : Electronic Communication

Radio Wave Propgation : Characteristics of electromagnetic wave, propagation of radio waves at different frequencies, structure of the atmosphere, ground wave propagation, sky wave, critical frequency and virtual height, maximum usable frequency and skip distance (qualitative discussions only). (8)

Modulation: Need for modulation, modulating signal, need for carrier signal, types of modulation.

Amplitude modulation (AM): Mathematical representation, modulation index and percentage modulation, frequency spectrum, sideband frequencies, bandwidth requirements, power carried by carrier and sidebands, case of multiple modulating signals, DSB, SSB, suppressed carrier types of AM (basic idea only). Method of generation: balanced modulator. Demodulation: diode detector.

Angle modulation: Frequency (FM) and Phase Modulation (PM) : Mathematical representation of FM and PM, conversion of FM to PM and vice-versa, maximum frequency deviation, modulation index, derivation of narrow band FM, bandwidth in narrow band FM, comparison of FM and AM.

Pulse modulation systems : Sampling theorem (statement and proof), Sampling and reconstruction of signals, tone modulation (PAM, PWM, PPM). (14)

Noise : Thermal, shot and flicker noise, calculation of noise in linear systems, noise bandwidth, Noise in two-port networks-SNR ratio, Noise figure, Noise temperature, their interrelationship, Noise in cascaded stages.

(8)

Text and/or Reference Books:

Electronic Communication Systems , Kennedy , TMH
Communication systems, Singh and Sapre, TMH
Communication systems, Haykin , John Wiley
Communication systems, Lathi, Oxford
Electronic communication Systems, Roddy and Coolen, Pearson

Paper VB : Microwave Electronic devices, Optics and Photonics

Full Marks 50

Total No. of lecture periods: 55

I: Microwave electronic devices (20)

Basics of Microwaves: Microwave domains

Two-cavity Klystron: Structure, principle of operation (concept of velocity modulation and bunching of electrons, Applegate diagram)

Reflex-Klystron: Structure and principle of operation

Magnetron: Cavity structure and principle of operation

Travelling Wave Tube (TWT): Structure and principle of operation

Transferred electron mechanism and Gunn diode (Basic ideas)

Transit time mechanism and the IMPATT diode (Basic ideas)

T**unneling and tunnel diode :** Principle of operation

In the above topics qualitative discussions without derivations are required.

Text and/or Reference Books:

Microwave Devices and Circuits, Liao, Pearson
Electronic communication , Kennedy and Davies
Microwave , Sisodia and Gupta, New Age
Microwave Engineering, Das, TMH

II: Optics and Photonics: (35)

Basic ideas in physical optics: Huygens' Principle and its application to study of reflection and refraction of a plane wave. (3)

Interference of light: Young's experiment, Interference pattern, Intensity distribution, Phase change on reflection of light , Interference from thin films, Newton's Rings. Coherence- Temporal and Spatial. (5)

Diffraction of light: Fresnel and Fraunhofer types (Qualitative), Fraunhofer diffraction of single slit, double slit and multiple slits (Qualitatve), Rayleigh criterion of limit of resolution, Resolving power of a a plane transmission grating. (5)

Polarisation of light: Polarization of light, Brewster's Law, Malus Law, Double refraction, Optic axis, Principal section of a crystal (uniaxial), Nicol Prism, Retardation plate,Production and detection of linearly, circularly and elliptically polarized light. (5)

LASER: Absorption, spontaneous and stimulated emission processes, Derivations of Einstein`s A and B coefficients, Population inversion, optical pumping and optical resonator, threshold condition for lasing, Q factor, Characteristics of Lasers. Fundamentals of He-Ne and semiconductor laser (GaAs base) (6)

Some optoelectronic devices: LED, photodiode, solar cell, phototransistor, photo resistor, optocoupler (basic idea and working principle). (3)

Fiber Optics: Passage of light through a step-index fiber, graded-index fiber, Numerical Aperture, fiber parameters, modes of propagation, signal degradation. Attenuation losses - absorption ,bending and Rayleigh scattering losses (qualitative study). Dispersion and pulse- broadening in different fibers (qualitative study) (8)

Text and/or Reference Books:

Optics, Hecht and Zajak, Pearson
Optical Electronics , Ghatak, Cambridge
Optics, Ghatak, TMH
Optoelectronics, Wilson and Hawkes, PHI.

Paper VIA: Digital Electronics II and Introduction to Computers and C programming

Marks-50

Total No. of lecture periods: 60

I : Digital Electronics II

Combinational logic circuits: Adders and subtractors, look-ahead-carry generator, design of a BCD adder using two 4-bit binary adders, 4-bit magnitude comparator, Multiplexer (MUX), designing an 8-to-1 MUX using NAND gates, using a 8-to-1 MUX as a logic function generator using truth-table and implementation table. Decoder/ Demultiplexer : Decoder as a minterm generator, design of a 2-to-4 decoder, cascading two 2-to-4 decoders to obtain a 3-to-8 decoder, designing a BCD -to-decimal decoder. Encoder: Decimal-to-BCD encoder, priority encoder. Read only memory (ROM), design of a combinational circuit using a ROM,types of ROM: PROM, EPROM and EEPROM. (13)

Sequential circuits: Synchronous and asynchronous sequential circuits, flip-flop latch and clocked flip-flop circuits, S-R, D, J-K clocked flip-flops, truth-tables, race-around condition in J-K flip flop, Master-Slave J-K flip-flop, edge triggered J-K flip-flop.

Design of clocked sequential circuits using state diagrams, state tables and excitation tables.

Asynchronous or serial counters: Asynchronous 4-bit binary ripple counter, timing diagram and count sequence, asynchronous UP/ DOWN counter, asynchronous MOD-N counter, self-stopping counter.

Synchronous or parallel counters: 4-bit binary synchronous counter, synchronous UP/ DOWN counter, synchronous MOD-N counter. Ring counter.

Shift registers: different configurations of shift registers, controlled shift register. (13)

DAC/ADC conversion: DAC: weighted resistor, R-2R ladder. ADC: counter type and successive- approximation type. (4)

Text and/or Reference Books:

Digital Circuits, D.RoyChaudhuri Volume-I and II, Platinum Publishers
Digital Logic and Computer Design, Mano , Pearson
Digital computer electronics, Malvino and Brown, Tata McGraw Hill
Digital Principles, Leach and Malvino , TMH
Micro Electronics , Millman, McGraw Hill
Digital Electronics, Maini, Wiley India
Digital Fundamentals, T.L Floyd, UBS
Modern Digital Electronics, Jain, TMH

II: Introduction to Computers and C Programming

The Personal Computer (PC): Idea of a typical PC configuration, role of motherboard, CPU, RAM, Hard-disk, DVD drive, parallel, serial and USB ports, keyboard and mouse. (4)

Operating systems (OS): Role of OS. Types of OS: multi-processor, multi-user, multi-tasking, time-sharing and real-time (brief idea only). Functions of an OS, Main features of Windows and Linux OS, Different versions of Windows: XP, Vista, Windows 7 and different flavors of Linux: Fedora, Ubuntu, and Mandrake (brief idea only). (6)

Languages and translators: Brief idea of different computer languages: assembly language, machine language, high-level languages, and concept of interpreter, compiler, loader and linker. (5)

Networking: LAN – Network topologies: Star, Mesh, Bus and Ring. Basic difference between circuit- switched and packet-switched networks. Network devices: NIC hub, repeater, switch, bridge and router (Basic working principle only). (5)

Basics of C language: Declaration of variables, data types, operators, loops, arrays and functions, printing to files.

Outline and implementation of the following numerical methods using C programming (without flowchart)

(i) Solution of algebraic equations by the Newton –Raphson method
(ii) Numerical differentiation of a given function using different difference formulae.
(iii) Numerical integration of a given function by Simpson's 1/3rd rule. (10)

Text and/or Reference Books:

Progress in ANSI C, Balaguruswamy, TMH
Introduction to Computers, Norton , TMH
Introduction to Computer Science, ITL ESL, Pearson
Computer networking, Rowe and Schuh, Pearson
Data communication and networking, Farouzan , TMH
Numerical Methods, Balagurusamy, TMH
Numerical Methods, Mathews, Pearson
Advanced Engineering Mathematics, Jeffrey, Elsevier
Programming in C, Gottfried, TMH
C programming, Balagurusamy, TMH
Computer concepts and C programming, Gupta, Wiley India
The Spirit of C, Mullish Cooper, Jaico
A Book on C, Kelly and Pohl, Pearson
Mastering C, Benugopal and Prasad, TMH

Paper VIB: Introduction to the 8085 Microprocessor: Architecture and Interfacing

Full Marks 50

Total No. of lecture periods: 50

8085 microprocessor architecture and organization: Functional block diagram and role played by different constituents: ALU, General and Special Purpose Registers, Timing and Control Unit etc.,Addressing Modes, Instruction Set, Assembly language Programming, use of Subroutine and Stacks. (12)

Communicating with the 8085 microprocessor: Address, Data and Control Buses, Control and Status Signals: RD, WR, IO/M, S1,S0 and ALE, demultiplexing the Address/Data bus, generation of Read/Write Control Signals for Memory and I/O : MEMR, MEMW, IOR and IOW. Instruction Cycle, Machine Cycle, Opcode Fetch and Memory Read Machine Cycle, Timing diagram. (12)

Basic concepts of Memory Interfacing: Memory map, Address decoding. (4)

Interfacing I/O devices: I/O mapped I/O and memory mapped I/O, microprocessor controlled I/O data transfer, Interrupts: Maskable and non-Maskable, Vectored and non-Vectored. (6)

Interfacing data converters: D/A and A/D converter devices (IC 0808 DAC and ADC), interfacing examples. (6)

General Purpose Programmable peripheral Interface (PPI) device, 8255A: Explanation of BSR Mode and I/O Mode, interfacing examples. (10)

Text and/or Reference Books:

Microprocessor achitecture with the 8085, R.S.Gaonkar, Penram International
Microprocessors,Interfacing and applications , Renu Singh and B.P.Singh, New Age
Microprocessor, Suni Mathur, PHI
Microprocessor, Uday Sankar , Pearson

Module II (Practical) **Full Marks 200**

Paper VIIA: Experiments with Analog Integrated Circuits and on Communication Systems

Full Marks 50

Experiments on Op-amp

1.To learn offset null adjustment of an Op-amp. To measure the input offset voltage, input bias currents, input offset currents of an Op-amp.

2. To use the Op-amp as the inverting, non-inverting, differential amplifier, unity gain buffer, and adder.

3. To construct and study logarithmic and antilog amplifier using Op-amp.

4. To study a simple voltage comparator using a zener diode and an Op-amp.

5 To study the performance of the Schmitt trigger using Op-amp.

6. To study the the frequency response of first order active high pass and low pass filters using Op-amp.

7. To construct and study triangular and square wave generator using Op-amp and related circuit elements.

8.i To study RC lead-lag network of the Wien-bridge to be constructed and hence to find out the frequency for zero phase-shift and maximum V_{OUT} / V_{IN} respectively.

ii. To construct a Wien-bridge oscillator on a breadboard using Op-amp and FET as amplitude stabilizer. Study the waveform of the oscillator, calibrate it using CRO and compare the frequency with the theoretical value.

9. To study the performance of the R-2R ladder D/A converter using an Op-amp.

Experiments on IC 555

10. To construct and study the output waveform of (i) a monostable , (ii) an astable multivibrator and (iii) a voltage-controlled oscillator (VCO) using IC 555.

Experiments on amplitude modulation (AM)

11.(i) To construct an amplitude modulator and demodulator and find out the value of modulation index m.

(ii) To find out the highest frequency which the envelope-detector can follow without attenuation for m=100%. Compare it with the theoretical value.

(iii) To study how m changes and the output of the detector changes with the changes in the audio level.

References:

1. *Laboratory Manual for Op-amp and Linear ICs*, Bell, PHI.
2. *Basic Electronics, A Text Lab Manual*, Zbar, TMH.
2.*Practical Physics*, Rakshit and Chattopadhyay.

Paper VIIB: Experiments on Digital Electronics **Full Marks 50**

1.(a) To construct a half adder and full adder using NAND gates.

(b) To construct a full adder using 2 half adders and an OR gate.

(c) To construct a 4-bit adder-subtractor with IC 7483 and EX-OR gates.

(d) To construct a BCD adder that adds two BCD numbers and to produce the sum in BCD code as well. To be used two 4-bit binary adder (IC 7483) chips (The sum may be less than or equal to the BCD equivalent of decimal 19).

2. To design a 2-bit magnitude comparator which compares the two 2-bit numbers $A=A_1A_0$ and $B=B_1B_0$ and shows a high at any one of the three outputs (A=B, A<B and A >B) using logic-gates.

3.(a) To design a 4:1 multiplexer using TTL NAND gates.

(b) To implement a Boolean function expressed in 'sum-of-minterms' form:

say □(0,1,2,4,8,15) with a multiplexer. Use The 8:1 IC 74151 multiplexer chip for the purpose is to be used.

4. (a) To construct a 2:4 decoder using TTL NAND gates.

(b) To study the 3:8 decoder chip IC 74138. Show how you can use two 3:8 decoders to design a 4:16 decoder. Verify the truth tables.

5. To construct SR, D and JK flip-flops using TTL NAND gates and verify their truth-tables. Convert any one type of flip-flop to another.

6. (a) To study the dual negative-edge triggered J-K flip-flop chip IC 7473.

(a) Use four such chips to design a 4-bit ripple counter which counts (i) in the up direction and (ii) in the down direction. Study the output waveforms on an oscilloscope.

(b)Modify the above circuit by including a NAND gate to construct a Mod-10 counter. Study the output waveforms on an oscilloscope.

(c)Construct a 4-bit synchronous counter with the 4 JK flipflops. Study the output waveforms on an oscilloscope.

Reference:

Digital Logic and Computer Design, M. Mano, Pearson
Digital Circuits Volumes 1 and 2, D. R. Chowdhury, Platinum Publisher
Practical Physics, Volume 2, B. Ghosh
Modern Digital Electronics, Jain, TMH

N.B. Actual questions in the final examination may be set by mixing parts from different questions from the above list.

Paper VIIIA: Assembly Language Programming on the 8085-Microprocessor

Full Marks 50

Sample problems:

To draw the flow chart and write and execute the pertinent Assembly Language Program for the 8085 microprocessor for the following problems.

All the fields (including the "comment" field) of the ALP must be explicitly shown.

1.Add two 8-bit numbers stored in two memory locations and store the result in another memory location. Keep a provision for a carry, which may or may not have been generated.

Hints: (1) Use the command ADD r (r is any general purpose register B,C,D,E,H or L).

(2)Use the command ADD M (M is a pointer to the memory location stored in the H-L register pair).

2.Subtract one 8-bit number from another, the numbers being stored in two memory locations.

Hints: (1) Use the command SUB r (r is any general purpose register B,C,D,E,H or L).

(2)Use the command SUB M (M is a pointer to the memory location stored in the H-L register pair).

3.Add two 16-bit numbers stored in two pairs of consecutive memory locations and store the result in a third pair of consecutive memory locations. Keep a provision for a carry, which may or may not have been generated.

Hint: Use the commands: LHLD xxxx, DAD rp SHLD xxxx for the purpose. (xxxx means the address of a memory location and rp represents a register pair).

4. Multiply two 8-bit numbers stored in two consecutive memory locations and store the result in a third memory location.

1)Use the repeated addition algorithm.
2) Use the shift and add algorithm.

Assume that the integers 0,1,2,…….9 are stored in 10 consecutive memory locations. Make the microprocessor fetch the numbers one by one and add them. Store the result in a memory location.

Hint: Use the commands LXI H xxxx, INX H and ADD M.

5. Place an 8-bit number in a memory location. Let the microprocessor fetch the number and after checking, place in the next memory location, 00 H if the number happens to be zero and 01 H if the number happens to be otherwise.

Hint: Use the command ANI xx (xx stands for any 8-bit data).

Store an 8-bit number in a memory location and a larger number in the next memory location. Load the smaller number from the first memory location onto the Accumulator. Go on incrementing the contents of the Accumulator till its contents equal the larger number. Use a register to keep a count of the number of times the Accumulator is incremented. Comment on the result.

Hint: Use the instruction CMP r

6. Store two 8-bit numbers in two consecutive memory locations. Compare the two numbers and place the larger number in the first memory location and the smaller in the second.

Hint: Use the instruction CMP r

7.Assume that the 8-bit number XY H is stored in a memory location. Make the Accumulator fetch the number and then store 0X H and 0Y H in the next two memory locations.

Hint: Use the instructions ANI 0F H, ANI F0 H and RLC.

8.Fetch a byte from a particular memory location and count the number of 1s and 0s. Place the results in two consecutive memory locations.

9.Given an array of ten 8-bit numbers in ten consecutive memory locations, separate the even numbers from the odd. Write the even numbers in a set of consecutive memory locations and the odd numbers in a separate set of consecutive memory locations.

10.A set of ten 8-bit signed numbers are stored in ten consecutive memory locations. Fetch the numbers from the memory, check each number to determine whether it is positive or negative. Reject all negative readings. Add all positive readings and place the 8-bit output in a memory location. If the output is of more than 8 bits then store FF H instead in the memory location.

(Hint: Use RAL and RAR instructions).

11.Clear or reset all the 5 flags.

Load 00 H in the Accumulator and demonstrate that the Zero flag is not affected.

Logically OR the Accumulator with itself to set the Zero flag and display its contents.

12.Load a 16-bit count onto the register pair BC. Write a delay-subroutine to introduce a delay in the main program. Do this by decrementing the BC pair by one till it contains zero or in other words by repeating the delay-loop N number of times where N equals the count set in the BC register pair. Call the subroutine from the main program twice.

13. Design a single decade MOD-N counter using 8255 and Common Anode (CA) type 7- segment display (without using decoder/ driver IC chip 7447).

14.Write an assembly language program to simulate the tossing of a dice using the RST 7.5 interrupt (use a BCD to 7- segment display decoder IC chip (for e.g. IC 7447) & a 7-segment display) (common- anode type).

15. Write an assembly language program to perform the following tasks:

(i)When the 8085 CPU is not interrupted, one green LED connected to the PA_0 bit of port A of a 8255A Programmable Peripheral Interface chip glows.
(ii)When the CPU is interrupted using RST 7.5, one RED LED connected to the PC_7 pin of port C of the same chip blinks.

16. Write an assembly language program to generate a square wave of ON time T1 and display it on a CRO sreen using the BSR Mode of IC 8255 Programmable Peripheral Interface chip.

References:

1. *8085 Microprocessor*, Gaonkar , Penram International
2. *Microprocessors-Interfacing and applications*, Renu Singh and B.P.Singh, New Age.
3. *Microprocessors and peripherals*, S.P. Chowdhury and Sunetra Chowdhury, Scitech.

Paper VIIIB: Computer programming in C-language Full Marks 50

Write the C program, execute it in the computer and perform additional tasks if any for the following problems:

1. Calculate the first N Fibonacci numbers where N may be read from the keyboard.

2. Calculate the factorial of an integer M where M is given. Write the program

(a) without using recursion and (b) using recursion.

3. Calculate the standard deviation of an array of N numbers which may be read from the keyboard.

4. (a) Given two m x n A and B matrices, calculate A + B and A – B. Read the individual elements from the keyboard.

(b) Given an m x k matrix A and a k x n matrix B, evaluate A*B.

5. Obtain the sum of the first N terms of (a) an A.P. series and (b) a G. P. series. Read the required variables from the keyboard.

6. Sort an array of numbers in (a) ascending and (b) descending order using the Bubble-sort algorithm. You may also use a faster sorting algorithm if you like.

7. Calculate the functions sin (x), cos (x) and exp (x) by representing each of them as an infinite series. Read in the value of the desired accuracy from the keyboard.

8. Use Least Squares Regression to fit a straight line of the form y = mx + c to a given table of data points.

x	1	2	3	4	5
y	3.0	5.0	7.0	4.5	6.6

The above set of data is for indicative purpose only.

9. Solve a given polynomial equation numerically using the Newton-Raphson method. Read in the polynomial-coefficients and the accuracy from the keyboard.

10. Given a polynomial function f(x). Calculate using Simpson's method

$\int f(x)\,dx$ within specified limits. Compare the answer with that obtained analytically

11.A capacitor of known capacitance (C) is connected to a battery of specified voltage (V) and a known resistance (R) in series. Calculate the (transient) variation of the charge q(t), with time (t), in the capacitor when the battery is switched on. Values for C, V and R are to be supplied.

Write the values for time(t) and charge q(t) in two columns and print the data onto a file. Use a graph drawing program like Excel, Origin or Gnuplot to plot the resultant transient curve for charging of the capacitor.

12. For different values of the voltage (V_d) across a forwared biased silicon diode in the range 0.0V to 0.8V, calculate the diode current (I_d) using Shockley's equation for a p-n junction diode. All pertinent constants are to be supplied.

Write the voltage and current values in two columns and print them on to a file. Use a graph drawing program like Excel, Origin or Gnuplot to plot the resultant diode characteristic curve.

The above list is by no means exhaustive. Problems other than those listed above but of similar complexity and conforming to the syllabus may also be set in the final examination.

References:

Numerical Methods for Scientists and Engineers, Rajaraman, TMH
Numerical Methods in C and Fortran, Balaguruswamy, TMH
Programming in C, Gotfried, Schaum Series, TMH
C Programming, Balaguruswamy, TMH
Computer Fundamentals and C Programming, Dey and Ghosh, Oxford
Computer concepts and C programming, Gupta , Wiley India.