UNIVERSITY OF MUMBAI

No.UG/280 of 2005

CIRCULAR :

A reference is invited to the Ordinances, Regulations, and Syllabi relating to the Master of Science (M.Sc.) (Part I & II) degree course *vide* Pamphlet No. 175 and to this office Circular No. UG/252 of 2001 dated 24th July, 2001 and the Head, University Department of Physics, the Principals of the affiliated colleges in the Faculty of Science and Directors/Heads of the recognised Institution concerned are hereby informed that the recommendation made by the Board of Studies in Physics at its meeting held on 18th January, 2005 has been accepted by the Academic Council at its meeting held on 5th February, 2005 *vide* item No.4.12 and that in accordance therewith, the syllabus in the subject of Physics at the M.Sc.(Part-I) course has been revised as per *Appendix* and that the same will be brought into force with effect from the academic year 2005-2006.

Mumbai 400 032,
8th July, 2005.

for REGISTRAR.

To,

The Head, University Department of Physics, the Principals of the affiliated colleges in the Faculty of Science and Directors/Heads of the recognised Institution concerned.

A.C.4.12/05.02.2005

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No.UG/ 280-A of 2005 8th July, 2005.

Copy forwarded with Compliments for information to :-

1)The Dean, Faculty of Science.
2) The Chairman, Board of Studies in Physics.

for REGISTRAR.

P.T.O.

A.C. Item No. 4.12 dt. 5/2/2005

UNIVERSITY OF MUMBAI

Revised Syllabus

for

M.Sc. Part - I (Physics)

(with effect from the academic year 2005-2006)

Revised Syllabus for M.Sc. Part-I (Physics) 2005-2006.

1. Structure of the course.

There are four theory papers each of 75 marks and a laboratory course of total 200 marks at Part-I.

A. The four theory papers, Papers I-IV, are common and compulsory in Part I for all the options. These papers are:-

Paper I
- Section I: Mathematical methods.
- Section II: Classical Mechanics

Paper II
- Section I: Quantum Mechanics I
- Section II: Nuclear Physics

Paper III
- Section I: Solid State Physics
- Section II: Quantum Mechanics II

Paper IV
- Section I: Electronics
- Section II: Solid State Electronics.

B. The four Practical Papers I-IV, are common and compulsory in Part I for all the options. These papers are:-

Practical Paper I : One Experiment from Group A or B.

Practical Paper II : One Experiment from Group C or D.

Practical PaperIII : Dissertation on Groups A,B,C,D .

Practical Paper IV: Internal Viva-voce on experiments of Groups A, B, C, D.

2 Examination Scheme:

Theory:

Each theory paper shall be of three hours duration. The student shall be required to attempt SIX questions in all. The option of choosing the question to be answered shall be from within a given unit only. Each of the four papers at Part–I has two sections of equal weightage, with three units per section. The question paper shall consist of twelve questions in all, with two questions per unit. The candidate shall have an option of answering any one of the two questions set in a given unit only, so as to make up a total of SIX questions to be answered in all.

Practicals:

The Practical examination shall consist of Four Practical Papers. These practicals are common to all optional choices. Each of the Practical Paper I and II shall consist of experiments of four-hour duration. For more details of contents see the syllabus for the laboratory course provided bèlow.

The details of the division of 200 marks for the laboratory course among various heads shown below are:-

Practical Paper I: **(50 marks)** One Experiment from Group A or B to be examined externally.

Practical Paper II: **(50 marks)** One Experiment from Group C or D to be examined externally.

Practical PaperIII: **(50 marks)** Dissertation on at least TWO EXTENDED experiments of Groups A,B,C,D experiments. to be examined externally.

Practical Paper IV: **(50 marks)** = viz.,

a). Internal examination=30Marks +**b).** Term work=20Marks.

The CERTIFIED **Dissertation** should be presented by the student at the examination of Practical PaperIII during which he will be examined on the dissertation. The CERTIFIED **Journal** shall contain the minimum number of experiments as prescribed in the syllabus. All the P.G. centers should try to arrange maximum number of experiments prescribed in the syllabus. A minimum of SIX experiments from each group (A,B,C & D) must be performed COMPULSORILY by every student and presented in CERTIFIED Journal as a pre-condition for appearing at the Practical Examination.

THEORY COURSE CONTENTS

PAPER I

Section I- Mathematical methods. [60 lectures]

Unit 1. Properties of Fourier series

Properties of Fourier series, integral transforms, development of Fourier integrals, Fourier transform of derivatives, convolution theorem.

Laplace transforms, Laplace transform of derivatives, Inverse Laplace transform, and Convolution theorem.

Matrices, Eigenvalues, Application to Physics problems. Applications to differential equations.

Unit2. Function of Complex variables.

Complex numbers, Limits, Continuity, Derivatives, Cauchy Riemann Equations, Analytic functions, Harmonic functions, Elementary functions, Exponential, Trigonometric, Hyperbolism Logarithmic, Inverse trigonometric and hyperbolic functions, Complex valued functions, Contours, Contour integrals, Cauchy Gaursat theorems of simply and multiply connected domains, .Cauchy integral formula, Derivative of analytic functions, Morera's theorem, Liouville's theorem, fundamental theorem of algebra.

Convergence of sequences and series, Taylor and Laurent series.
Residues, Residue theorem, Principal part of the functions, Residues at poles, zeroes and poles of order m. Evaluation of improper real integrals, improper integral involving Sines and Cosines, Definite integrals involving sine and cosine functions.

Unit 3. Differential equations.

First and Second order ordinary differential equation with constant and non constant coefficients, Wronskian, second solution by knowing the first solution, application of second order differential equations.
Frobenius method, series solutions, Legandre, Hermite and Lagurre polynomials, Bessel equations.
Partial differential equations, separation of variables, wave equation and heat conduction equation. Inhomogeneous differential equations. Green's functions in one dimension.

Main references:

Unit 1.
Book GGC Cha. 9, 10,.1-10.6, 10.10, 11.1-11.6
Book: Boas. Cha 3, 10.1 to 10.5

Unit 2.
Book R.V. C. and JWC 1 to 41, 43-48, 53-60.

Unit 3.
Book GGC: Cha 1,2,3,4.1,5.1, 5.26.1,7.1, 14

GGC. A.K. Ghatak, I.C. Goyal and S.J. Chua, Mathematical physics.
Boas. M.L. Boas. Mathematical methods in physical sciences
RVC: and JWC: R. V. Churchill and J.W. Brown, Complex variables and applications, V Ed. Mc Graw. Hill, 1990

Additional references.

1. G. Arfken: Mathematical methods for physicists
2. A.C. Bajpai, L.R. Mustoe and D. Walker, Advanced Engineering Mathematics.
3. E. Butkov, Mathematical Methods
4. J. Mathews and R.L. Walker, Mathematical methods of physics
5. P. Dennery and A. Krzywicki , Mathematics for physicists
6. T. Das and S.K. Sharma , Mathematical methods in classical and Quantum mechanics

Section II : CLASSICAL MECHANICS [60 lectures]

Unit 4.

Survey of the Elementary Principles : Mechanics of a particle, Mechanics of a system of particles, Constraints, D'Alembert's principle and Lagrange's equations, Velocity-dependent potentials and the dissipation function, Simple applications of the Lagrangian formulation.

Variational Principles and Lagrange's Equations : Hamilton's principle, Some techniques of the calculus of variations, Derivation of Lagrange's equations from Hamilton's principle, Extension of Hamilton's principle to nonholonomic systems, Advantages of a variational principle formulation, Conservation theorems and symmetry properties.

Unit 5.

The Two-Body Central Force Problem : Reduction to the equivalent one body problem, The equations of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, The virial theorem, The differential equation for the orbit and integrable power-law potentials, The Kepler problem : Inverse square law of force, The motion in time in the Kepler problem, Scattering in a central force field, Transformation of the scattering problem to laboratory coordinates

Small Oscillations : Formulation of the problem, The eigenvalue equation and the principal axis transformation, Frequencies of free vibration and normal coordinates,

Free vibrations of a linear triatomic molecule.

Unit 6.

The Hamilton Equations of Motion : Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Derivation of Hamilton's equations from a variational principle.

Canonical Transformations : The equations of canonical transformation, Examples of canonical transformations, The symplectic approach to canonical transformations, Poissson brackets and other canonical invariants, Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation, The angular momentum Poisson bracket relations, Symmetry groups of mechanical systems.

MAIN Reference : Classical Mechanics, H. Goldstein,. Chapter 1 and Chapter 2. Chapter 3 except sections 3.6 and 3.9; Chapter 6 except section 6.5. Chapter 8 except sections 8.3, 8.4 and 8.6; Chapter 9 except section 9.8.

Additional References :

1. Classical Mechanics, N. C. Rana and P. S. Joag.
2. Classical Mechanics , S. N. Biswas, Allied Publishers (Calcutta).
3. Classical Mechanics, V. B. Bhatia, Narosa Publishing (1997).
4. Mechanics, Landau and Lifshitz, Butterworth, Heinemann.
5. The Action Principle in Physics, R. V. Kamat, New Age International (1995).
6. Classical Mechanics, Vol I and II, E. A. Deslougue, John Wiley (1982).
7. Theory and Problems of Lagrangian Dynamics, Schaum Series, McGraw (1967).

Paper II

Section I-Quantum Mechanics I [60 lectures]

Problems form an integral part of the course.

Topics covered in different units are interlinked.

Unit 1: Theory

1. Review of concepts: Analysis of the double-slit particle diffraction experiment; the de Broglie hypothesis; Heisenberg's uncertainty principle; probability waves. Postulates of QM: Observables and operators; measurements; the state function and expectation values; the time-dependent Schrodinger equation; solution to the initial value problem. Superposition and commutation: The superposition principle; commutator relations; their connection to the uncertainty principle; degeneracy; complete sets of commuting observables.

Unit 2: Formalism

1. Time development of state functions and expectation values; conservation of energy, linear momentum and angular momentum; parity. Dirac notation; Hilbert space; Hermitian operators and their properties. Matrix mechanics: Basis and representations; matrix properties; unitary and similarity transformations; the energy representation. Schrodinger, Heisenberg and Interaction pictures.

Unit 3: One-dimensional Problems

1. General properties of one-dimensional Schrodinger equation.
2. Particle in a box.
3. Finite potential well. Harmonic oscillator.
4. Unbound states; one-dimensional barrier problems.

Texts:

2. 1. Richard Liboff, *Introductory Quantum Mechanics*, 4th ed., 2003. 2.5-2.9 3.1-3.5, 4.1-4.2, 4.3-4.6, 5.1-5.5 6.1-6.4, 7.1, 7.2-7.4,7.5-7.8, 8.1, 11.1-11.4, 11.12

2. Ajoy Ghatak and S Lokanathan, *Quantum Mechanics: Theory and Applications*, 5th ed., 2004. (GL5)

Additional References:

1. W Greiner, Quantum Mechanics: An Introduction, 4th. ed., 2004.
2. DJ Griffiths, Introduction to Quantum Mechanics, 1995.
3. R Shankar, Principles of Quantum Mechanics, 2nd ed., 1994.
4. SN Biswas, Quantum Mechanics, 1998.

Section II-Nuclear Physics (60 Lectures)
(Problems form an integral part of the course)

Unit -4(20 Lectures)

(I) Review of basic nuclear properties, Hofstadter's electron scattering experiments, Magnetic moments predicted by the shell model – Schmidt lines (2 Lectures)

Deuteron : Binding Energy, dipole moment, quadrupole moment and size. Estimate of depth and range of (assumed) square well potential. Qualitative discussion of the tensor force and its effects (3 Lectures)

Nuclear Forces : Elementary Yukawa theory – estimate of pion mass, Exchange forces – Majorana, Bartlett and Heisenberg interactions, Nucleon-Nucleon scattering – qualitative discussion of results, Existence of strong spin-orbit interaction between nucleons – double scattering experiments. (4 Lectures)

(II) Nuclear Models :

1. Review of Liquid Drop Model, stability limits against beta decay and fission (1 Lecture)
2. The Shell model (extreme single particle) – Evidence, Assumptions, Effect of including a strong spin – orbit interaction in the nuclear Hamiltonian (assuming a harmonic oscillator or square well form for the nuclear potential), Predictions of the Shell model, Limitations (3 Lectures)
3. Quadrupole moments and Nuclear deformation. Collective motion of nucleons as manifested in the observation of rotational and vibrational spectra, Nilsson's deformed oscillator nuclear potential, Qualitative treatment of the Nilsson model, Use of Nilsson diagram (4 Lectures)

Unit -5 (20 Lectures)

(1) Review of alpha decay, Geiger Nuttal law, Gamow's Theory (realistic potential barrier) and its predictions (3 Lectures)

(2) Beta Decay : Fermi's Theory of beta decay, Fermi- Curie Plots, comparative half lives (ft values), selection rules and classification of beta transistions, properties of neutrinos, Cowan and Reine's experiment, helicity of neutrinos, qualitative discussion of parity violation in beta decay (6 Lectures)

(3) Gamma Ray emission : Multipole radiations, Gamma- ray spectra, Selection rules, Natural line width for gamma emission, Mossbauer effect – Recoilless emission of gamma rays, Applications (3 Lectures)

(4) Nuclear Reactions : Conservation Laws, Centre of Mass frame, angular distribution, types of nuclear reactions, cross sections, compound nuclear reaction, Breit – Wigner dispersion formula for S- Wave Scattering, resonances, elementary theory of direct nuclear reaction (5 Lectures)

Unit -6 (20Lectures)

1. Accelerators and Detectors :

The need for accelerators, Accelerator for Nuclear Physics studies, Accelerators for Particle Physics studies, Ion Sources, Direct Current accelerators, Van de Graaff Generator, Cyclotron, Linear Accelerator, Betatron, Electron Synchrotron, Proton Synchrotron, Detectors for Nuclear Physics studies, Gas filled detectors, Semiconductor detectors, Scintillation detectors, Signal processing electronics (only an outline) Detectors for Particle Physics studies, Bubble chamber, Spark chamber, Multi-wire proportional counter

(2) Introduction to Particle Physics :

Historical Introduction to the Elementary Particles : The Photon, Mesons, Antiparticles, Neutrinos, Strange Particles, The Eightfold Way, The Quark Model, The November Revolution and its Aftermath, Intermediate Vector Bosons, The Standard Model (Brief introduction – Qualitative only).

Elementary Particle Dynamics : The Four Forces, Cross sections, Decays and Resonances, Brief Qualitative Introduction to Quantum Electrodynamics, Quantum Chromodynamics and Weak Interactions, Unification Schemes.

Relativistic Kinematics : Lorentz Transformations, Four -Vectors, Energy and Momentum, Collisions, Examples and Applications, Brief discussion of Free Particle Wave Equations.

Symmetries : Symmetries , Groups and Conservation Laws, Spin ½, Flavour Symmetries, Parity, Charge Conjugation, Time Reversal, Qualitative introduction to CP violation and TCP theorem.

References:

1. Concepts of Nuclear Physics – B. L. Cohen, 1.1- 1.6, 3.1 – 3.10, 4.1- 4.8, 6.4 – 6.7, 7.1, 7.2, 7.5, 8.2, 8.3. , 10.6 ,11.1 – 11.6;, 12.1 – 12.4

2. Nuclear Physics – An Introduction – S.B. Patel, 4.II.1 - 4.II.3, New Age International.

3. Introduction to Nuclear Physics- H. A. Enge, 11.1, 11.3 – 11.6, 11.8, 11.9;10.1 – 10.5, 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 7.5, 7.6, 7.7, 7.10, Addison Wesley.

4. Nuclei and Particles – E. Segre, 7.1 – 7.39.1 – 9.6 11.1, 11.211.1, 11.2, 11.4,11.5; W.A. Benjamin.

5. Subatomic Particles – H. Fraunfelder and E. Henley, 2.1, 2.2, 2.3, 2.5, 2.6, 4.1, 4.3, 4.4, 4.5, 4.615.1 – 15.5, 16.1 – 16.5, Prentice Hall.

6. Nuclear Physics – Experimental and Theoretical – H.S. Hans, 13.1, 13.2.1, 13.2.2, 13.2.3, Ch.13.1,13.2.1,13.2.2,13.2,3A &B, 14.1, New Age International, 2001.

7. Introduction to Elementary Particles – David Griffiths, Chapter 1, 2,3. 4.1,4.4,4,5,4.6,4.7,4.9 John Wiley and Sons.

8..Introduction to High Energy Physics, D.H.Perkins, 1.5 and 2.10 only. 4th edition, Addison Wesley

9. W. E. Burcham and M. Jobes: Nuclear and Particle Physics, Addision Wesley (1995) (India edition available) Sections: 2.2, 2.3, 2.4, 2.5

PAPER III

SECTION I-Solid State Physics (60 Lectures)

Unit 1:

1.Crystal Diffraction and Reciprocal Lattice:

Crystal Diffraction Methods for X rays- Laue, Rotating Crystal, Powder Method. Reciprocal Lattice and Brillouin Zones. Scattered wave amplitude and Structure Factor of lattices; Atomic Form Factor; Temperature dependence of reflection lines.

2. Energy Bands and Fermi Surfaces:

Zone Schemes, Construction of Fermi Surfaces, Electron Orbits, Hole Orbits and Open Orbits. Calculation of Energy Bands a) Tight Binding Approximation b) Wigner Seitz Method

Unit 2:

1. Lattice Vibrations:

Vibrations of Monoatomic Lattice, normal mode frequencies, dispersion relation. Lattice with two atoms per unit cell, normal mode frequencies, dispersion relation. Quantisation of lattice vibrations, phonon momentum, Inelastic scattering of neutrons by phonons

2. Thermal Properties:

Lattice Heat Capacity : Einstein model, Normal modes, Density of modes in one and three dimensions, Debye model of Lattice Heat Capacity, Debye T^3 law. Anharmonic Crystal Interaction. Thermal conductivity – Lattice Thermal Resistivity, Umklapp Process, Imperfections.

Unit 3:

1. Magnetism:

Quantum Theory of Paramagnetism, Rare Earth Ions, Hund's Rule, Iron Group ions, Crystal Field Splitting and Quenching of orbital angular momentum; Cooling by adiabatic demagnetisation. Paramagnetic susceptibility of conduction electrons; Ferromagnetic order- Exchange Integral, Saturation magnetisation, Magnons, Neutron Magnetic Scattering, Ferrimagnetic order – Curie Temperature and Susceptibility. Anti Ferromagnetic order. Ferromagnetic Domains – Anisotropy energy, transition region between domains, origin of domains, Coercive force and hysteresis, Magnetic bubble domains.

2. Superconductivity:

London Equation, Coherence length, AC and DC Josephson effect. BCS theory (Qualitative only) High Tc Superconductors

Main References.

1. Charles Kittel "Introduction to Solid State Physics", Chapter2, Chapter4. Chapter9. Chapters 11&12, Chapter5, Chapter14, 15, 7th edition John Wiley & sons.
2. J.Richard Christman "Fundamentals of Solid State Physics" John Wiley & sons Chapter 6 (section 6.1, 6.2, 6.3 and 6.6) Chapter 4 (section 4.1 and 4.2).
3. M.A.Wahab "Solid State Physics –Structure and properties of Materials" Narosa Publications 1999.
4. M. Ali Omar "Elementary Solid State Physics" Addison Wesley (LPE)
5. T. V. Ramakrishnan and C. N. R. Rao. "Superconductivity Today : An elementary introduction" 2nd ed. University Press

Additional References

1.S.O.Pillai "Solid State Physics" 3rd edition New Age International (P) Ltd.

2. H.Ibach and H.Luth 3rd edition "Solid State Physics – An Introduction to Principles of Materials Science" Springer International Edition (2004)

Section II-Quantum Mechanics II (60 lectures)

Problems form an integral part of the course

Topics covered in units 4-6 are interlinked.

Unit 4: Angular Momentum

1) Orbital angular momentum operators in Cartesian and spherical polar coordinates, commutation and uncertainty relations, spherical harmonics, ladder operators, eigen values and eigen functions of L^2 and L_z using spherical harmonics, angular momentum and rotations

2) Angular momentum matrices, Pauli spin matrices, spin eigenfunctions, free particle wavefunctions including spin, addition of two spins

3) Total angular momentum J, L.S coupling, eigen values of J^2 and J_z

4) Addition of angular momentum, Clebsch Gordon coefficients for $j_1=j_2=1/2$ and $j_1=1$, $j_2=1/2$ [GL] coupled and uncoupled representation of eigenfunctions

Unit 5: Approximation methods

1) Two particle problem for a spherically symmetric central potential, coordinate relative to the centre of mass, radial equation for the hydrogen atom, eigen values and radial eigenfunctions, degeneracy, probability distribution

2) Time independent perturbation theory -first order and second order corrections to non- degenerate perturbation theory, Degenerate perturbation theory - First order energies and secular equation

3) Ritz variational method: basic principles, illustration by simple examples [GL]

Unit 6: Scattering theory

1) Time dependent perturbation theory with some simple applications

2) Identical particles: symmetric / antisymmetric wavefunctions

3) Scattering cross section, scattering amplitude, partial wave phase shift - optical theorem, S wave scattering from a finite spherical attractive and repulsive potential well, centre of mass frame, Born approximation

Texts:

1.Richard Liboff, Introductory Quantum Mechanics, 4th ed., 2004, 9.1-9.3 10.5 -10.6, 11.5-11.7,11.10,12.1, 13.1- 13.2,13.5,12.3,14.1 -14.4.

2.Ajoy Ghatak & S Lokanathan, Quantum Mechanics: Theory & applns. 5th ed., 2004. GL 18.1 - 18.3 GL 21.1-21.3

Additional References:

1.W Greiner, Quantum Mechanics: An Introduction, 4th ed., 2004.

2.D.J Griffiths, Introduction to Quantum Mechanics, 1995.

3.J.L.Powell and B.Crasemann, Quantum Mechanics,1961

4.A.Goswami, Quantum Mwechanics,1991

5.R.Shankar, Principles of Quantum Mechanics, 2nd ed., 1994.

6.B.K Agarwal and Hari Prakash, Quantum Mechanics,1997

7.S.N Biswas, Quantum Mechanics,1998

PAPER IV

Section I –ELECTRONICS (60 Lectures)

(NOTE: Problems form an integral part of the course)

UNIT 1: Microprocessor & Microcontroller

1.Microprocessor

Programing the 8085, Introduction to 8085 instruction sets, programming techniques with additional instructions, counters and time delays, stack and sub-routines.

2.Microcontroller

The Architecture of the 8051 Microcontroller-The Plan of 8051 Microcontroller, The Registers in the 8051 Microcontroller, The Data Memory in the 8051 ,The multiplexed port System, The Internal and the External Memory Use, The Interrupt and the Interrupt Flags,

The Interrupt System-What Is An Interrupt? Why Do We Use Interrupts?, The Interrupt system of the 8051, Setting up an Interrupt Jump Table, Servicing the Interrupt ,Enabling and Disabling the Interrupts, Interrupt from within the Microcontroller, External Hardware Interrupt, How are the Interrupts handled?

UNIT-2 Analog Systems

1.Power Electronics :

Electrical Review-Basic Circuit Quantities, Passive Circuit Elements, Basic Series Circuit, Poly-Phase Circuit.

Power Electronics- Power Semiconductor Devices, Power Converters, Scope and Applications of Power Electronics.

Power Semiconductor Devices- Power Diodes-General Purpose Diodes, Fast Recovery Diode, Schottky Diode, MOS Diode.

Power Transistor-Power BJT, Power MOSFETs, HEXFET.

Thyristors- Shockley Diode, Thyristor LASCR, SCS, GTO, IGBT, MCT, ETO.

Multilayer Devices-RCT, DIAC, TRIAC, BENISTOR

New Trends In Power Semiconductor Devices.

2. Inverters

Principle of voltage driven inversiOn, Principle of current driven inversiOn, sine wave inverter, Square wave inverter.

3. Switching and Power Electronics:

Introduction to switching regulators, The step-down (Buck) Switching regulator, The step-up (BOOST) switching regulator, Externally driven switching regulator circuits, Monolithic switching regulator sub systems, self oscillating switching regulators, guidelines and precautions while handling regulators.

4. Solid State Switching Circuits- Static switch using Thyristor, Static switch using a Triac, DC Static switch , Solid State Relays, Light Dimmer Circuit, Electronic Timer, Alarm Circuit, Electronic Crowbar, Battery charger-Battery charging Regulator, Emergency Lighting System;

Sawtooth Regulator- Sawtooth Regulator, Sawtooth Generating Using a Shockley Diode, Sawtooth Generator Using GTO

Industrial process Control- Temp. Control, Liquid Level Control, Alarm Actuator, Ambient light Control Power Switch,

Power Supply- Linear P.S.; Switch Mode P.S.(SMPS), Uninterrupted P.S.(UPS)

Motor drive- Induction Motor drive, Synchronous Motor drive , DC Motor drive, Universal Motor drive, Stepper Motor drive, Servo Motor drive

Microprocessor Based Applications- Microprocessor Based Firing Circuit For Thyristor Converters, Microprocessor Based Motor Drives, speed control of DC Motor, Speed Control of AC Motor, Microprocessor Based Process Control System, Microcontroller Based Applications

Fuzzy Logic Control-Fuzzy Logic Control of DC Motor Drive, Fuzzy Logic Control of Induction Motor, Fuzzy Logic Control of Stepper Motor.

UNIT-3 : Data Transmission & Instrumentation

1. Data Transmission

Data Transmission systems, Advantages and disadvantages of Digital Transmission over Analog, Time Division Multiplexing, Pulse Modulation, Digital modulation, Pulse code format, Modems.

2. Fibre Optics Measurements

Introduction to optical fibres, wave propagation and total internal reflection in optical fibre, Optical fibres and fibre cables-Single and multimode fibres, attenuation and light gathering power of fibers. Fibre optic components and systems.

Sources and detectors, Fibre optic power measuring, stabilized calibrated light sources, end-to-end measurement of fibre system loss, optical time-domain reflectometer.

3: INSTRUMENTATION

Measurements and Signal Processing:

(i) Measurement Transducers

Temperature, light level, Strain and displacement, acceleration, pressure, force, velocity, Magnetic field, vacuum gauges.

(ii) Bandwidth-Narrowing Techniques

Signal-to-Noise ratio, signal averaging and multichannel averaging, Making a signal periodic, Lock-in Detection, Pulse-Height Analysis, Time-to-Amplitude converters.

Spectrum Analysis and Fourier Transformations; Spectrum analyzers, off-line spectrum analysis, Self-explanatory circuits.

Main References:

1. Microprocessor Architecture , Programming , and Applications with the 8085 – R. S. Gaonkar (4th ed. Penram International,);Ch.6,7,8,9.

2. The 8051 Microcontroller & Embedded Systems - Dr. Rajiv Kapadia .(Jaico Publishing House.). Ch.2 & 5.

3. Power Electronics & its applications, 2nd edition; Alok Jain.(Publisher-Penram International India.). Chapter:1, 2, 6(6.1-6.5), 9

4. Op-Amps and Linear Integrated Circuits - R. A. Gayakwad (3rd Ed. publ. Prentice Hall India, 1993) Ch. 10.7.3.

5. Integrated Circuits-K R Botkar(8th Ed. Khanna Publishers, 1993) 13.10,13.11.

6. The Art Of Electronics - Paul Horowitz and Winfield Hill (2nd Ed. publ. Cambridge Low Price Editions, 1995); Chapter 15.

7. Electronic Communication Systems; 4th. Ed. Kennedy & Davis, (Tata-McGraw. Hill, 2004).-Ch.18.

8. Lightwave Communication Systems; Rajappa Pappannareddy (Penram International) Ch. 2.

9. Electronic Instrumentation-H.S.Kalsi (Tata-McGraw. Hill, 1999) Ch.18.

Additional Reference books:

1. 8051 Micro-controller; K.J.Ayala., Penram International.
2. Microcontrollers, Ajay Deshmukh (Tata-McGraw. Hill, 2005).
3. Power Electronics; Rashid, (3rd. Ed. Prentice-Hall of India Pvt.Ltd.)
4. Power Electronics; Jamil Asghar(Prentice-Hall of India Pvt.Ltd.)
5. Operational Amplifiers and Linear Integrated Circuits - R . F . Coughlin and F .F . Driscoll (4th Ed. Prentice-Hall of India Pvt.Ltd.)
6. Modern electronic instrumentation & measurement techniques,- Helfrick & Cooper; 5th. Edition.Prentice-Hall of India Pvt.Ltd.
7. Measurement, instrumentation & expt. design in Physics & Engineering- Michael Sayer, Abhai Mansingh; PHI, Eastern Economy Edition.

Section II: Solid State Electronics (60 lectures)

N.B. Problems form an integral part of the course.

Unit 4: Semiconductor Physics (20 lectures)

Crystal structure of semiconductors; Classification of Semiconductors; Energy band structure of Si, Ge & GaAs; Extrinsic – and compensated Semiconductors; Temperature dependence of Fermi-energy and carrier concentration.

Drift, diffusion and injection of carriers; Carrier generation and recombination processes; Applications of continuity equation; Surface states; Hall measurement; Four – point probe resistivity measurement; Carrier life time measurement by light pulse technique; Haynes Shockley experiment.

Introduction to amorphous semiconductors, crystal growth of semiconductor materials, doping of semiconductors and oxide growth.

Unit 5: Semiconductor Devices I (20 lectures)

p-n junction : Fabrication of p-n junction by growth, alloy, diffusion and ion-implantation techniques; Abrupt and linearly graded junctions; Band diagrams; Thermal equilibrium conditions; Depletion regions; Capacitance – voltage (C-V) characteristics; Current-voltage (I-V) characteristics; Tunneling and avalanche break down mechanisms; Minority carrier storage, diffusion capacitance and transient behavior; Ideality factor and carrier concentration measurements; Carrier life time measurement by reverse recovery of junction diode; Varactor diode; p-i-n diode; Tunnel diode.

Metal – Semiconductor Contacts: Schottky barrier – Energy band relation, Capacitance-voltage (C-V) characteristics, Current-voltage (I-V) characteristics; Ideality factor, Barrier height and carrier concentration measurements; Ohmic contacts; Introduction to p-n junction solar cell and semiconductor laser diode.

Unit 6: Semiconductor Devices II (20Lectures)

Bipolar Junction Transistor (BJT): Static Characteristics; Frequency Response and Switching, Measurement of h-parameters.

Junction Field Effect Transistor (JFET): Principles of operation, Current voltage (I-V) characteristics. Metal- semiconductor field effect transistor (MESFET). Introduction to ideal MOS diode and MOSFET. Measurement of mobility, channel conductance etc. from I_{ds} vs, V_{ds} and I_{ds} vs V_g characteristics.

Semiconductor heterojunctions; Heterojunction bipolar transistors; Quantum well structures; Modulation doped field effect transistor (MODFET); Introduction to Integrated circuit technology.

Main References:

1. S.M. Sze; Semiconductor Devices : Physics and Technology, 2nd edition, John Wiley, New York, 2002.

2. Adir Bar-Lev: Semiconductors and Electronic devices, 2nd edition, Prentice Hall, Englewood Cliffs, N.J., 1984.

Additional Reference:

1. B.G. Streetman and S. Benerjee; Solid State Electronic Devices, 5th edition, Prentice Hall of India, NJ, 2000.

2. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.

3. Donald A. Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, Tata McGraw-Hill, New Delhi, 2002.

4. N. DasGupta and Amitava DasGupta; Semiconductor Devices: Modelling and Technologoy, Prentice Hall of India, New Delhi, 2004.

5. W.R. Runyan; Semiconductor Measurements and Instrumentation, McGraw Hill, Tokyo, 1975.

6. M. Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.

7. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi, 1995.

8. S.M. Sze; Physics of Semiconductor Devices, 2nd edition, Wiley Eastern Ltd., New Delhi, 1985.

M.Sc. PART - I (Physics) Practicals – (2005-2006)

LIST OF EXPERIMENTS

GROUP A

EXPERIMENT	REFERENCES
1. Michelson Interferometer	Advanced Practical Physics – Worsnop and Flint
2. Analysis of sodium spectrum	a).Atomic spectra – H.E. White b).Experiments in modern physics – Mellissinos
3. Zeeman Effect using Fabry-Perot etalon / Lummer – Gehrcke plate	a. Advance practical physics – Worsnop and Flint b. Experiments I modern physics – Mellissinos
4. h/e by vacuum photocell	a. Advance practical physics – Worsnop and Flint b. Experiments I modern physics – Mellissinos
5. Study of He-Ne laser-Measurement of divergence and wavelength	a. A course of experiments with Laser - Sirohi b. Elementary experiments with Laser - G. White
6. Susceptibility measurement by Quincke's method / Guoy"s balance method	Advance practical physics – Worsnop and Flint
7. Characteristics of a Geiger Muller counter and measurement of dead time	a. Experiments in modern physics- Mellissions b. Manual of experimental physics – E.V. Smith c. Experimental physics for students - Whittle & Yarwood
8. Ultrasonic Interferometry-Velocity measurements in different Fluids	Medical Electronics- Khandpur
9. Laser Board Experiment-Measurement of Refractive Index of Liquids using Laser	Sirohi-A course of experiments with He-Ne Laser; Wiley Eastern Ltd.

GROUP – B

1.Carrier lifetime by pulse reverse method	Semiconductor electronics – Gibson
2.Carrier mobility by conductivity	Semiconductor electronics – Gibson
3.Resistivity by four probe method	Semiconductor measurements – Ruynen
4. Measurement of dielectric constant, Curie temperature and verification of Curie–Weiss law for ferroelectric material	a) Electronic instrumentation & measurement – W. D. Cooper b) Introduction to solid state physics - C. Kittel c) Solid state physics – A. J. Dekkar
5. Barrier capacitance of a junction diode	Electronic engineering – Millman Halkias
6.Temperature dependence of avalanche and Zener breakdown diodes	a) Solid state devices – W.D. Cooper b) Electronic text lab manual – P.B. Zbar c) Electronic devices & circuits -- Millman and Halkias
7. DC Hall effect	a) Manual of experimental physics - E.V.Smith b) Semiconductor measurements - Ruynen c) Semiconductors and solid state physics -- Mackelvy d) Handbook of semiconductors – Hunter
8. Linear Voltage Differential Transformer	Electronic Instrumentation – W.D. Cooper
9.Faraday Effect-Magneto Optic Effect a) To Calibrate Electromagnet b) To determine verdet's constant for KCl & KI solutions..	1. Manual of experimental physics - E.V.Smith 2. . Experimental physics for students - Whittle & Yarwood

GROUP – C

EXPERIMENT	REFERENCES
1. Diac – Triac phase control circuit	a) Solid state devices – W.D. Cooper b) Electronic text lab manual – P.B. Zbar
2. Delayed linear sweep using IC 555	a) Electronic Principles – A.P. Malvino
3. Regulated power supply using IC LM 317 and dual power supply using fixed voltage regulator Ics	a) Opeational amplifiers and linear Integrated circuits – Coughlin & Driscoll b) Practical analysis of electronic circuits through experimentation – L.MacDonald
4. Constant current supply using IC 741 and LM 317	Integrated Circuits – K. R. Botkar
5. Active filter circuits (second order)	a) Op-amps and linear integrated circuit technology – R. Gayakwad b) Operational amplifiers and linear integrated circuits – Coughlin & Driscoll
6. Adder-subtractor circuits using ICs	a) Digital principles and applications -- Malvino and Leach b) Digital circuits practice – R.P. Jain
7. Study of Presettable counters 74190 and 74193	a) Digital circuit practice – Jain & Anand b) Digital principles and applications -- Malvino and Leach c) Experiments in digital practice -Jain & Anand
8. TTL characteristics of totem pole, open collector and tristate devices	a) Digital circuits practice – Jain & Anand b) Digital principles and applications -- Malvino and Leach
9. Switching Voltage Regulator	Integrated Circuits – K. R. Botkar

GROUP D

EXPERIMENT	REFERENCES
1. Temperature on-off controller using IC	a) Op-amps and linear integrated circuit technology -- R. Gayakwad
2. Waveform Generator using ICs	a) Operational amplifiers and linear integrated circuits – Coughlin & Driscoll b) Op-amps and linear integrated circuit technology – R. Gayakwad c) Opertional amplifiers : experimental manual – C.B. Clayton
3. Instrumentation amplifier and its applications	a) Operational amplifiers and linear integrated circuits – Coughlin & Driscoll b) Integrated Circuits – K.R. Botkar
4. Study of 8 bit DAC	a) Op-amps and linear integrated circuit technology – R. Gayakwad b) Digital principles and applications –Malvino and Leach
5. 16 channel digital multiplexer and demultiplexer	a) Digital principles and applications-- Malvino and Leach b) Digital circuits practice – R.P.Jain
6. Shift registers	a) Experiments in digital principles-D.P. Leach b) Digital principles and applications – Malvino and Leach
7. Study of 8085 microprocessor Kit and execution of simple programmes	a) Microprocessor Architecture, Programming and Applications with the 8085 – R. S. Gaonkar b) Microprocessor fundamentals, Schaum Series – Tokheim c) 8085 Kit user manual
8. Waveform generation using 8085	a) Microprocessor Architecture, Programming and Applications with the 8085 – R. S. Gaonkar b) Microprocessor fundamentals, Schaum Series – Tokheim c) 8085 Kit user manual
9. SID & SOD using 8085	a) Microprocessor Architecture, Programming and Applications with the 8085 – R. S. Gaonkar b) Microprocessor fundamentals, Schaum Series – Tokheim c) 8085 Kit user manual

Additional references:

[1] Digital theory and experimentation using integrated circuits – Morris E. Levine (Prentice Hall)

[2] Practical analysis of electronic circuits through experimentation – Lome Macronald (Technical Education Press)

[3] Logic design projects using standard integrated circuits – John F. Wakerl (John Wiley & sons)

[4] Practical applications circuits handbook – Anne Fischer Lent & Stan Miastkowski (Academic Press)

[5] Digital logic design, a text lab manual – Anala Pandit (Nandu printers and publishers pvt.ltd.)

Number of minimum experiments to be done : Group A – 6 , Group B – 6, Group C – 6 , Group D – 6.

Total marks for the practical examinations = 200

Practical I = 50 Marks, Practical II = 50 Marks, Total 100 Marks. To be assessed by the external examiner during the practical examination taking into account i) initial settings of the apparatus or circuit design and connections, ii) presentation of the data and results and iii) viva-voce on experiments of practical I & II.

Practical III = 50 Marks. To be assessed by the **external examiner** during the practical examination by conducting viva-voce examination on the extended experiments from group A&B and group C&D from the **Dissertation. The candidates will be allotted 15 minutes to make a presentation.**

Practical IV=50Marks viz.,a). Internal examination=30Marks **+b).** Term work=20Marks. **i) Internal examination=30 Marks; to be held by the college** based on total number of the experiments performed by the student from group A&B and C&D. **ii) Term Work=20 marks** based on the performance of the student throughout the year in the laboratory and maintaining a proper and neat record of the experiments in the journal containing a total no. of minimum **24** experiments [a minimum of 6 experiments from each group].

Journal should not be certified by the laboratory in-charge if the student fails to perform satisfactorily the minimum number of experiments as stipulated above. Such student will lose both the term work marks(assessed by the internal teacher) and a part of the viva-voce examination marks.

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