FACULTY OF SCIENCE

SYLLABI

FOR

M.Sc. (TWO YEAR COURSE )

IN

PHYSICS

1ST YEAR( Semester System)
&
2ND YEAR (Annual System)

EXAMINATIONS 2011-2012

--:O:--
OUTLINE OF SYLLABI AND COURSES OF READING FOR
M.Sc. (TWO YEAR COURSE) IN PHYSICS,
FIRST YEAR (SEMESTER SYSTEM) & SECOND YEAR (ANNUAL SYSTEM)
FOR THE EXAMINATION 2011-2012

M.Sc 1st Semester

MAX MARKS (TOTAL=500)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Max Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 6001</td>
<td>MATHEMATICAL PHYSICS I</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6002</td>
<td>CLASSICAL MECHANICS</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6003</td>
<td>QUANTUM MECHANICS I</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6004</td>
<td>NUCLEAR PHYSICS</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6005</td>
<td>ELECTRONICS I</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6051</td>
<td>PHYSICS LAB I</td>
<td>125</td>
</tr>
</tbody>
</table>

M.Sc 2nd Semester

MAX MARKS (TOTAL=500)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Max Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 6011</td>
<td>MATHEMATICAL PHYSICS II</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6012</td>
<td>QUANTUM MECHANICS II</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6013</td>
<td>PARTICLE PHYSICS I</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6014</td>
<td>CLASSICAL ELECTRODYNAMICS I</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6015</td>
<td>ELECTRONICS II</td>
<td>15 + 60 = 75</td>
</tr>
<tr>
<td>PHY 6052</td>
<td>PHYSICS LAB II</td>
<td>125</td>
</tr>
</tbody>
</table>
M.Sc.- 1st Semester

PHY6001 Mathematical Physics I

Max. Marks: 15+60=75

Objectives: The aim and objective of the course on Mathematical Physics I is to equip the M.Sc student with the mathematical techniques for understanding theoretical treatment in different courses e.g. to evaluate various definite integrals, to solve various differential equations including Laplace equation, Schrodinger equation, equations used in electronic circuits, electrical circuits, nuclear decays etc. Concepts of Complex analysis, Dirac Delta function, beta, gamma functions, Special functions: Bessel, Legendre, Hermite, Lagurre functions

For developing a strong background if he chooses to pursue research in Physics as a career.

Note:

1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.

2. The question paper is expected to contain problems with a weightage of 50% of the total marks.

UNIT I

   (6.1-6.5, 7.1-7.3 of Book1)

UNIT II

II Delta and Gamma Functions: Dirac delta function. Delta sequences for one dimensional function, properties of delta function, gamma function, factorial notation and applications. Beta function.
(8.7, 10.1, 10.4 of Book 1)
UNIT III

III  **Differential Equations**: Partial differential equations of theoretical physics, separation of variables, singular points, series solutions, second solution.
(8.1, 8.3-8.6 of Book 1)

UNIT IV

IV  Special Function: Bessel function of first and second kind, Generating function, integral Representation and recurrence relations for Bessel’s functions of first kind, orthogonality. Legendre function: generating function, recurrence relations and special properties, orthogonally. Various definitions of Legendre polynomials, Associated Legendre functions: recurrence relations, parity and orthogonality. Hermite functions. Laguerre function.
(11.1, 11.2, 12.1-12.5, 13.1, 13.2, of Book 1)

TUTORIALS: **Relevant problems given at the end of each section in the text books.**

Books

PHY6002  **CLASSICAL MECHANICS**  
Max. Marks: 15+60=75

Objectives: The aim and objective of the course on Classical Mechanics is to train the students of M.Sc class in the Lagrangian and Hamiltonian formalism, conservation theorems, rigid body motion, Hamilton’s equations, Canonical Transformations to an extent that they can use these in the modern branches like Quantum Mechanics, Quantum field theory, Condensed matter Physics, Astrophysics etc.

Note: 1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the
corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.

2. The question paper is expected to contain problems with a weightage of 30 to 40% of the total marks.

UNIT I


II Hamilton Principle: Calculus of variations. Hamilton principle. Lagrange's equation from Hamilton’s principle. Extension to non-holonomic systems, advantages of variational principle formulation, symmetry properties of space and time and conservation theorems. (2.1-2.6 of Book 1)

UNIT II

III Rigid Body Motion: Independent co-ordinates of rigid body, orthogonal transformation. Eulerian Angles and Euler’s theorems. infinitesimal rotation. Rate of change of vector, Coriolis force, angular momentum and kinetic energy of a rigid body, the inertia tensor, principal axis transformation. Euler equations of motion. Torque free motion of rigid body, motion of a symmetrical top. (4.1, 4.2, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 5.3, 5.7 of Book 1)

UNIT III


UNIT IV

VI Canonical Transformation and Hamilton-Jacobi Theory: Canonical transformation and its example, Poisson brackets. Equations of motion, Angular momentum. Possion’s Bracket

(9.1, 9.2, 9.4-9.6, 10.1, 10.4, of Book 1)

**TUTORIALS: Relevant problems given at the end of each section in the text books.**

**Books**


**PHY6003 QUANTUM MECHANICS I**

**Max. Marks: 15+60=75**

**Objectives:** The aim and objective of the course on Quantum Mechanics I is to introduce the students of M.Sc to the formal structure of the subject and to equip them with techniques of linear vector space and matrix mechanics, Stationary state approximate methods, angular momentum, perturbation theory, Variational method with the application to ground states of harmonic oscillator, hydrogen atom etc., Fermi’s Golden rule so that they can use these in various branches of Physics as per requirement.

**Note:**

1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.

2. The question paper is expected to contain problems with a weightage of 30 to 40% of the total marks.


III Stationary State Approximate Methods: Non- Degenerate and degenerate perturbation theory and its application to anharmonic oscillator, Variational method with application to the ground states of harmonic oscillator, hydrogen atom, helium and other simple cases. (5.1-54, 5.6-58, of Book 2 and Ch4 of Book 1).

IV Time Dependent Perturbation: General expression for the probability of transition form one state to another. constant and harmonic perturbations. Fermi’s golden rule and its application to radiative transition in atoms. Selection rules for emission and absorption of light (Ch 6 of Book 1 and 9.5-9.8, 9.12-9.15 of Book 2).

TUTORIALS: Relevant problems given at the end of each section in the text books.

Books:

PHY6004 NUCLEAR PHYSICS I

Max. Marks: 15+60=75

Objectives: The aim and objective of the course on Nuclear Physics is to familiarize the students of M.Sc class to the basic aspects of Nuclear Physics like wave mechanical properties of nuclei, electric and magnetic moments, nuclear shapes, nuclear forces, basic properties of neutrons, detection, Nuclear reactions, types of reactions, conservation laws so that they are equipped with the techniques used in studying these things.

Note:
1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.
2. The question paper is expected to contain problems with a weightage of 30 to 40% of the total marks.

Unit-I
I Nuclear size and Shape
Scattering and electromagnetic methods for determining the nuclear radius. Wave.
Mechanical properties of nucleus and statistics, electric and magnetic moments and nuclear shapes
(Book 1,2)

Unit-II
II Nuclear Forces
(Book 1,2)
Unit-III
III Neutrons Physics
Basic properties of neutrons, Neutron production and detection. Slowing down power and moderating ratio, thermal neutron density flux. Maxwellian distribution and the diffusion of thermal neutrons, measurements of different cross section, Fission cross section and threshold, fission products, mass and energy distribution of the fission products, energy distribution of the neutron emitted in fission, energy release in fission. Liquid drop model of fission, thermal nuclear reactor- the neutron cycle. Energy production in stars.
(Book 1,2)

Unit-IV
IV Nuclear Reactions: Type of reactions, conversation laws. Q-values and its significance. Laboratory and Centre of mass coordinates and their relationship, reaction cross sections, Coulomb excitation, Breit – Wigner formula, compound nucleus.
(Book 1,2)

TUTORIALS: Relevant problems given at the end of each section in the text books.

Books:

PHY6005 Electronics I
Max. Marks: 15+60=75

Objectives: The Electronics I course covers linear wave shaping which throws light on high pass and low pass RC circuits and response to various wave forms, Clamping and clipping circuits, diode clippers, transistor clippers, clamping circuit theorem, operation of transistor as a switch, Multivibrators: Astable, Monostable and Bistable modes and their applications, Counting circuits, operational amplifier, communication systems , IC fabrication : basic ideas of integrated circuits, various steps of fabrication of Monolithic integrated circuits.

Note:
1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer
type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks.

2. The question paper is expected to contain problems with a weightage of 50% of the total marks.

**Unit I**

**Linear Wave shaping:** High pass RC circuits: Its response to STEP PLUSE, SQUARE WAVE , RAMP, EXPONENTIAL, WAVE FORMS. Its application as a Differential , Low Pass RC Circuit: Its response to STEP PULSE SQUARE WAVE, RAMP, EXPONENTIAL, wave forms , Its application as an integrator .

**Clamping and clipping circuits:** Diode Clippers , Transistor Clippers, Operation of Clamping circuits, Clamping Circuit, Theorem, Practical Clamping Circuit Theorem. Operation of Transistor as a switch.

**Unit II**

**Multivibrators:** Basic concepts of operation Astable, Monostable and Bistable multivibrator, quantitative discussion of Quasi stable state and Symmetrical and Unsymmetrical triggering, quantitative discussion of time periods, Applications of Vibrators (brief)

**Counting Circuits:** Use of Binaries as a Counter. Forward and Reverse counting, Counting to a base other than power of 2.

**Unit III**

**Operational Amplifier:** Differentials Amplifier, Transfer Characteristic Frequency Characteristic, IC Operational Amplifier, Compensation in Operational Amplifiers. Application of Op-Amp As adder, Multiplier, Differentiator, Integrator, Logarithmic and Anti-logarithmic Amplifier, Application of Operational Amplifier to Analog Computation

**Unit IV**

**Communication systems:** Generation and detection of amplitude modulated, single side band, Double Side band suppressed carrier and Frequency modulated wave.

**IC Fabrication:** Standard gate assemblies, Fabrication of integrated Circuits and Devices: Basic ideas of integrated circuits Epitaxial growth, Diffusion, Masking, Etching, Fabrication of Monolithic Integrated circuits.
TUTORIALS: Relevant problems given in the books listed below:


1st Semester

PHY6051 Physics Laboratory I  Max. Marks :125

Objectives: The aim and objective of the courses on Physics Laboratory I and Physics Laboratory II is to expose the students of M.Sc. to the experimental techniques in general Physics, electronics, nuclear Physics and condensed matter Physics so that they can co-relate the theoretical concepts with the experimental ones and develop confidence to handle sophisticated equipments wherever necessary.

Note: Students are expected to perform at least 10 experiments in one semester.

1. To study the dependence of energy transfer on the mass ration of colliding bodies. Using air track.
2. To study the dependence of frequency of normal modes and their difference in a couples oscillator on the coupling mass.
3. To verify the law of conservation of linear momentum in collision using air track.
4. To obtain the potential energy curve due to magnet-magnet interactions using air track.
5. To study oscillations in a rectangular potential well, using air track.
6. To determine Planck’s constant using photocell.
7. To find wavelength of given laser light using diffraction grating and carry out related studies.
8. To study the characteristics of given astable multivibrator.
9. To study the distributed capacity of given inductance coil.
10. To study the characteristics of Colpitts oscillator.
11. To study the characteristics of Hartley oscillator.
12. To study the characteristics of phototransistor.
13. To study the characteristics of given voltage doubler and tripler.
14. To verify the statement: Power dissipation in the side bands is directly proportional to the square of the modulation.
15. To study the characteristics of a superheterodyne receiver.
16. To study use of operational amplifier for different mathematical operations.
17. Frequency response of operational amplifier.
18. To study SR and JK flip flop circuits using logic gates.
19. To find conductivity of given semiconductor crystal using four probe method.
20. To study the seven segment display (IC) trainer.
21. To study the various aspects of frequency modulation.
22. To determine the Hall coefficient for given semi-conductor and study its field dependence.
23. To determine the velocity of ultrasonic in given liquid. Using interferometer.
24. To study non-radiative transition in LED.
25. To determine the dead time of given G. M Counter.
26. To determine the absorption coefficient of AL for gamma rays using G. M. Counter.
27. Electron Spin Resonance spectrum of DPPH.
28. To study the statistical fluctuations of background counts in a G. M. Counter.
29. To determine the absorption coefficient of AL for gamma rays using G. M. Counter.
30. To determine the energy of a pure beta-emitter using G.M. Counter and Al absorbers.
31. Design different Clipper and Clamper circuits: positive, negative & bias. (through breadboard)
32. Design of Wein bridge oscillator using IC 741. (through breadboard)
M.Sc. 2nd Semester

PHY6011 Mathematical Physics II

Max. Marks: 15+60=75

Objectives: The aim and objective of the course on Mathematical Physics II is to equip the M.Sc student with the mathematical techniques for understanding theoretical treatment in different courses. The knowledge of Fourier analysis, Laplace transforms, tensor analysis, integral equations help to solve plenty of problems in higher Physics. Numerical analysis helps to solve problems of computational physics and develop a strong background if he chooses to pursue research in Physics as a career.

Note:

1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.

2. The question paper is expected to contain problems with a weightage of 50% of the total marks.

UNIT I

I. Group Theory: Basic definitions, Multiplication table, conjugate elements and classes.
(1.1-1.7, 3.1-3.3, 3.5, 3.6, 4.1,4.3,(excluding 4.3.2 and 4.3.3), 4.5 (excluding its subsections)and based on chapters 5-8 of Book 2)

UNIT II

(14.1-14.5, 15.1-15.6, 15.8-15.10, 15.12 of Book 1)
UNIT III

III **Integral Equations:** Definitions and classifications, Neumann series, Separable kernels, Hilbert-Schmidt theory. Green’s function in one dimension. (16.1, 16.3, 16.4, 9.5 of Book 1)

IV **Tensors:** Introduction, definitions, contraction, direct product, Quotient rule. Levi-Civita symbol, Non Cartesian tensors, metric tensor. Covariant differentiation. (2.6-2.10 of Book 1)

UNIT IV

V **Elementary Numerical Analysis:** Numerical differentiation, Numerical integration by Simpson and Weddle’s rules. Numerical solution of differential equations by Euler and Runge-Kutta Method, Linear and non-linear least square fitting, generation of random numbers, Monte-Carlo technique, solution of simultaneous equations (simplex method) (Books 3, 4 and 5)

**TUTORRIALS:** Relevant problems given at the end of each section in the text books.

**Books**

PHY6012 QUANTUM MECHANICS II
Max. Marks: 15+60=75

Objectives: The aim and objective of the course on Quantum Mechanics II is to introduce the students of M.Sc to the formal structure of the subject and to equip them with scattering theory, Born approximation, Relativistic quantum mechanics: Klein Gordon equation, Dirac equation, fine structure of hydrogen atom, Lamb shift, Field Quantization, Relativistic Quantum Field Theory, the concept of Feynman diagrams helps to study various phenomena like Compton scattering etc. so that they can use these in various branches of Physics as per requirement.

Note:
1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.
2. The question paper is expected to contain problems with a weightage of 30 to 40% of the total marks.

Unit
I Scattering Theory: Scattering Cross-section and scattering amplitude, partial wave analysis. Low energy scattering. Green’s function in scattering theory. Born approximation and its application to Yukawa potential and other simple potentials. Electron scattering by an atom, Optical theorem, Scattering of identical particles. (CH 5 of Book 1 and 6.1, 6.2, 6.4-6.6, 6.8-6.13, 6.19 of Book 2)
(Chs 7, 8 of Book 1, Ch10 of Book 2. Ch. 10 of Book3 (Except Foldy Wouthuysen Transformation and 10.2B)
III  **Filed Quantization:** Resume of Lanrangian and Hamiltonian formalism of a classical field. Second quantization: Concepts and illustrations with Schroedinger field. Quantization of a real scalar field and its application to one meson exchange potential. (Ch. 9 of Book 1 and 11.2, 11.3 of Book 3)

IV  **Relativistic Quantum Field Theory:** Quantization of a complex scalar field. Dirac field and e.m. filed. Commutation relations. Covariant perturbation theory. Introduction to Feynman Diagrams. (Ch II-12 of Book 1 : 11.4, 11.5 of Book 3: 1.5, 2.1-2.3, 3.13, 4, 4.1-4.5, 5.1, 5.2, 6.1-6.3, 7.1 of Book 4)

**TUTORIALS:** Relevant problems given at the end of each section in the text books.

**Books :**

**PHY6013  PARTICLE PHYSICS I**

**Max. Marks: 15+60=75**

**Objectives:** The aim and objective of particle Physics is to familiarize with the concepts of Fermions, bosons and other particles and their interactions with fields in particle physics, Yukawa picture, Invariance principles and conservation laws: parity, Charge conjugation, CPT theorem, Hadron- Hadron Interactions: Strangeness, G-Parity, Relativistic Kinematics and Phase Space: Dalitz plots , Static Quark Model of Hadrons : Baryon decuplet, Baryon octet, spin, colour, quark-anti quark combination, Weak Interaction: Classification, Fermi theory, cabobbo theory, CP violation In K-decay and its experimental
determinations and develop a strong background if the student pursue research in particle physics.

**Note:**

1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.

2. The question paper is expected to contain problems with a weightage of 30 to 40% of the total marks.

**UNIT I**

I  **Introduction**: Fermions and Bosons, particles and antiparticles, quarks and leptons, interactions and fields in particles physics, classical and quantum pictures. Yukawa Picture, types of interactions: electromagnetic, weak, strong and gravitational, Natural unit.

(Book 1-4)

**UNIT II**

II  **Invariance Principles and Conservation Laws**: Invariance in classical mechanics and in quantum mechanics, parity, pion parity, Charge conjugation, Positronium decay, Time reversal invariance, CPT theorem.

(Book 1-4)

III  **Hadron-Hadron Interactions**: Cross section and decay rates, Pion spin, Isospin, Two nucleon system, Pion-nucleon system, Strangeness and Isospin, G-parity, Total and Elastics cross section. Particle Production at high energy.

(Book 1-4)

**UNIT III**

IV  **Relativistic Kinematics and Phase Space**: Introduction to relativistic kinematics. Dalitz K-3π decay, Dalitz plots for dissimilar particles. \(1-\theta\) puzzle. Wave optical discussion of hadron scattering, Breit –Wigner response formula, Example of baryon resonance-\(\Delta^{++}\). Mandelstem variables.

(Book 1-4)
V Static Quark Model of Hadrons: The Baryon decuplet, baryon octet, meson octet, quark spin and color, quark-antiquark combination.
(Book 1-4)

UNIT IV

VI Weak Interaction: Classification of weak interactions, Fermi theory, cabobbo theory, Parity non-conservation in ß-decay, experimental determination of parity violation. Helieity of neutrino, CP violation in K-decay and its experimental determination.
(Book 1-4)

TUTORIALS: Relevant problems given at the end of each section in the text books.

Books:

PHY6014 Classical Electrodynamics I

Max. Marks: 15+60=75

Objectives: The Classical Electrodynamics course covers Electrostatics and Magnetostatics, Multiple expansion, concepts of dielectrics: Molecular polarizability, Clasusius Mossetti equation, boundary value problems: Green's theorem, Method of images, Maxwell equations and their applications to propagation of electromagnetic waves in dielectrics, metals and plasma media, EM waves in bounded media: Fresnel amplitude relations, polarization, Total internal reflection , wave guides, radiation from localized time varying sources.

Note:
1. The question paper for the final examination will consist of five units. Unit I-IV will have TWO questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five
questions in all, selecting one each from the units I to IV and the compulsory question from unit V.

2. The question paper is expected to contain problems with a weightage of 30 to 40% of the total marks.

UNIT I

I Electrostatics in Vacuum: Coulomb’s Law, Gauss Law, Scalar potential. Laplace and poisson’s equation. Electrostatic potentials energy and energy density of the electromagnetic field. (1.1-1.4 and 1.6 of Book 1 and 1.1-1.7 of Book 2)

II Magnetostatics: the differential equations of magnetostaties, Vector potential. Magnetic field of a localized current distribution. (3.1-3.5 of Book 1, 5.1 – 5.7 of Book 2)

III Multipole Expansion: Multipole expansion of the scalar potential of a charge distribution. Dipole moment, quadrupole moment. Multipole expansion of the energy of a charge distribution in an external field. (1.5, 1.7 of Book 1: 4.1-4.2 of Book 2)

UNIT II


UNIT III

UNIT IV


(6.1-6.8, 7.1-7.3 of Book 1 ; 7.1-7.5, 7.7, 8.1-8.8 of book 2)

VIII **Radiation from Localized Time Varying Sources:** Solutions of the inhomogeneous wave equation in the absence of boundaries. Fields and Radiation of a localized oscillating source. Electric dipole and electric quadrupole fields, centre fed linear antenna.

(8.1-8.6 of Book 1: 9.1-9.4 of Book 2)

**TUTORIALS:** Relevant problems given at the end of each section in the text books.

**Books**


**PHY6015      Electronics-II**

Max. Marks: 15+60=75

**Objectives:** The Electronics II covers the logic systems : concepts of dc positive, negative systems, logic gates in DL, RTL, DTL and TTL logic families, number systems, Karnaugh map representation of logic functions, Multiplexers and Flip Flops, Registers, Analog to digital converters, digital to analog converters, Semiconductor memory devices : Organizations, operations, classification and characteristics of memories, digital display, Seven segment display, charged couple device memory and applications, Fundamentals, types and various concepts of Microprocessors
Note:
1. The question paper for the final examination will consist of five units. Unit I-IV will have two questions each from the corresponding units of the syllabus. Unit V in the paper will have one compulsory question consisting of short answer type questions covering the whole syllabus. The compulsory question will not have any choice. Each question will have a weightage of 12 marks. The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.
2. The question paper is expected to contain problems with a weightage of 30 to 40% of the total marks.

Unit I:
Logic Systems: Basic Concepts of dc positive, negative and dynamic logic systems, Logic gates (AND, OR, NOT, NOR, NAND and EX-OR gates) in DL, RTL, DTL and TTL logic families. Number systems, Binary arithmetic, Boolean algebra, de-morgan laws. Karnaugh map representation of logic functions and simplification of logic functions(up to three variables).

Unit II
Multiplexers, demultiplexers, adders, subtractors, comparators, Latch, FLIP FLOPS (SR, JK, T, D, MASTER SLAVE) Registers, shift registers (serial and parallel operations), Asynchronous counters (up, down, up-down, decade) and synchronous counter (up, down, up-down, decade). Analog-to-digital converters, digital-to-analog converters

Unit III
Semiconductor memory devices: organizations, operations, Classification and characteristics of memories, read only memory (ROM organization, PROM, EEPROM), RAM (Bipolar RAM, MOS RAM), Memory Storage Cell(both Bipolar and MOS RAM), Digital display, Seven Segment Display, Charged Couple Device Memory, Applications

Unit IV
Fundamentals of Microprocessors, ideal microprocessor, data bus, address bus, control bus, ALU, Registers, program counters, flags, timing and control sections, microprocessor based system, basic operations, Programming Languages (introduction and basic instructions)
**Books:**


**2nd Semester**

**PHY6052 Physics Laboratory II**

**Max. Marks 125**

**Objectives:** The aim and objective of the courses on Physics Laboratory I and Physics Laboratory II is to expose the students of M.Sc. to the experimental techniques in general Physics, electronics, nuclear Physics and condensed matter Physics so that they can co-relate the theoretical concepts with the experimental ones and develop confidence to handle sophisticated equipments wherever necessary.

**Note:** Students are expected to perform at least 10 experiments in one semester.

1. To study the dependence of energy transfer on the mass ration of colliding bodies. Using air track.
2. To study the dependence of frequency of normal modes and their difference in a couples oscillator on the coupling mass.
3. To verify the law of conservation of linear momentum in collision using air track.
4. To obtain the potential energy curve due to magnet-magnet interactions using air track.
5. To study oscillations in a rectangular potential well, using air track.
6. To determine Planck’s constant using photocell.
7. To find wavelength of given laser light using diffraction grating and carry out related studies.
8. To study the characteristics of given astable multivibrator.
9. To study the distributed capacity of given inductance coil.
10. To study the characteristics of Colpitts oscillator.
11. To study the characteristics of Hartley oscillator.
12. To study the characteristics of phototransistor.
13. To study the characteristics of given voltage doubler and tripler.
14. To verify the statement: Power dissipation in the side bands is directly proportional to the square of the modulation.
15. To study the characteristics of a superheterodyne receiver.
16. To study use of operational amplifier for different mathematical operations.
17. Frequency response of operational amplifier.
18. To study SR and JK flip flop circuits using logic gates.
19. To find conductivity of given semiconductor crystal using four probe method.
20. To study the seven segment display (IC) trainer.
21. To study the various aspects of frequency modulation.
22. To determine the Hall coefficient for given semi-conductor and study its field dependence.
23. To determine the velocity of ultrasonic in given liquid. Using interferometer.
24. To study non-radiative transition in LED.
25. To determine the dead time of given G. M Counter.
26. To determine the absorption coefficient of AL for gamma rays using G. M. Counter.
27. Electron Spin Resonance spectrum of DPPH.
28. To study the statistical fluctuations of background counts in a G. M. Counter.
29. To determine the absorption coefficient of AL for gamma rays using G. M. Counter.
30. To determine the energy of a pure beta-emitter using G.M. Counter and Al absorbers.
31. Design different Clipper and Clamper circuits: positive, negative & bias. (through breadboard)
32. Design of Wein Bridge Oscillator using IC 741. (through breadboard)
## SECOND YEAR

### OUTLINES OF TESTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching hours per week</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY7001</td>
<td>Classical Electrodynamics</td>
<td>4</td>
<td>125</td>
</tr>
<tr>
<td>PHY7002</td>
<td>Statistical Mechanics</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>PHY7003</td>
<td>Electronics II</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>PHY7004</td>
<td>Condensed Matter Physics II</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>PHY7005</td>
<td>Nuclear Physics II</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>PHY7006</td>
<td>Particle Physics II</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>PHY7051</td>
<td>Physics Laboratory III and Project</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>PHY7052</td>
<td>Computational Physics</td>
<td>4</td>
<td>125</td>
</tr>
</tbody>
</table>

**Special Paper**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching hours per week</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY7071</td>
<td>Experimental Techniques in Condensed Matter, Nuclear and Particle Physics</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>PHY7072</td>
<td>Fibre Optics and Non-linear Optics and Microprocessor and Computer Architecture</td>
<td>3</td>
<td>100</td>
</tr>
</tbody>
</table>

*Both the papers will be offered and the students will be allotted one of these on the basis of their option and percentage of marks in M.Sc. I examination.*
**SECOND YEAR**

**PHY7001 Classical Electrodynamics**

Max. Marks: 25+100=125

<table>
<thead>
<tr>
<th>Note</th>
<th>1</th>
<th>The question paper for the final examination will consist of five units. Units I – IV will have TWO questions each from the corresponding units of the syllabus. These eight questions will carry 19 marks each. Unit V in the paper will have one Compulsory Question consisting of 7 to 10 short answer type parts covering the whole syllabus. This question will have a weightage of 24 marks and will not have any choice. The candidates will attempt <strong>five</strong> questions in all, selecting one each from the units I to IV and the compulsory question from unit V.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>The question paper is expected to contain problems with a weightage of 30 to 40 % of the total marks.</td>
<td></td>
</tr>
</tbody>
</table>

**UNIT I**

I  **Electrostatics in Vacuum** : Coulomb's law, Gauss law, Scalar potential, Laplace and Poisson's equations, Electrostatic potentials energy and energy density of the Electromagnetic field.
   (1.1-1.4 and 1.6 of Book 1 and 1.1-1.7 of Book 2).

II **Magnetostatics** : The differential equations of magnetostatics, Vector potential, Magnetic field of a localized current distribution. Force and torque on a localized current distribution.
   (3.1-3.5 of Book 1, 5.1-5.7 of Book 2).

   (2.1-2.5 of Book 1; 4.3, 4.5-4.7 of Book 2).

IV **Boundary Value Problems** : Uniqueness Theorem, Dirichlet or Neumann Boundary conditions, Green's Theorem, Formal solution of Electrostatic Boundary value problem with Green function. Method of images with examples, Magnetostatic Boundary value problems.
   (4.1-4.3 of Book 1; 1.8-1.10, 2.1-2.7, 3.12, 5.9 - 5.12 of Book 2).

**UNIT II**

V **Multipole Expansion** : Multipole expansion of the scalar potential of a charge distribution, dipole moment, quadrupole moment, Multipole expansion of the energy of a charge distribution in an external field.
   (1.5, 1.7 of Book 1; 4.1-4.2 of Book 2)
VI **Time Varying Fields and Maxwell Equations**: Faraday’s Law of induction, displacement current, Maxwell equations, scalar and vector potentials, Gauge transformation, Lorentz and Coulomb gauges, General Expression for the electromagnetic fields energy, conservation of energy, Poynting’s Theorem, Conservation of momentum.

(5.1-5.5 of Book 1; 6.1-6.5, 6.8-6.9 of Book 2).

VII **Electromagnetic Waves**: Wave equation, plane waves in free space and isotropic dielectrics, polarization, energy transmitted by a plane wave, Poynting’s theorem for a complex vector field, waves in conducting media, skin depth, E.M. waves in rarefied plasma and their propagation in ionosphere. Reflection and Refraction of EM waves at plane interface, Fresnel’s amplitude relations. Reflection and transmission coefficients, polarization by reflection. Brewster’s angle, Total internal reflection, EM wave guides, TE and TM waves, Rectangular wave guides. Energy flow and attenuation in wave guides, Cavity resonators.

(6.1-6.8, 7.1-7.3 of Book 1; 7.1-7.5, 7.7, 8.1-8.8 of Book 2).

UNIT III

VIII **Radiation from Localised Time Varying Sources**: Solution of the inhomogeneous wave equation in the absence of boundaries. Fields and Radiation of a localized oscillating source, electric dipole and electric quadrupole fields, centre fed linear antenna.

(8.1-8.6 of Book 1; 9.1-9.4 of Book 2).

IX **Special Theory of Relativity**: Lorentz transformation as orthogonal transformation in 4-dimension, relativistic equation of motion, applications of energy momentum conservation, Disintegration of a particle, C.M. System and reaction thresholds.

(9.1-9.6 of Book 1; 11.3-11.7, 11.9-11.10 of Book 2).

X **Charged Particle Dynamics**: Non-relativistic motion in uniform constant fields and in a slowly varying magnetic field. Adiabatic invariance of flux through an orbit, magnetic mirroring, Relativistic motion of a charged particle.

(10.1-10.4 of Book 1).

UNIT IV

XI **Covariant Formulation of Electrodynamics in Vacuum**: Four vectors in Electrodynamics, 4 current density, 4-potential, covariant continuity equation, wave equation, covariance of

(11.1-11.4, 11.6-11.7 of Book 1; 12.1, 12.3-12.6 of Book 2).


(12.1-12.6, 13.1 and 13.2 of Book 1; 14.1-14.5 of Book 2).


TUTORIALS: Relevant problems given in each chapter in the text and reference books.

Books

4. Introduction to Electrodynamics: D.J. Griffiths, (Prentice Hall India, New Delhi).

PHY7002 Statistical Mechanics

Max. Marks: 20+80=100

<table>
<thead>
<tr>
<th>Note</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The question paper for the final examination will consist of five units. Units I – IV will have TWO questions each from the corresponding units of the syllabus. These eight questions will carry 19 marks each. Unit V in the paper will have one Compulsory Question consisting of 7 to 10 short answer type parts covering the whole syllabus. This question will have a weightage of 24 marks and will not have any choice. The candidates will attempt five questions in all, selecting one from the units I to IV and the compulsory question from unit V.</td>
</tr>
<tr>
<td>2</td>
<td>The question paper is expected to contain problems with a weightage of 30 to 40 % of the total marks.</td>
</tr>
</tbody>
</table>
UNIT I

I  The Statistical Basis of Thermodynamics: The macroscopic and microscopic states, contact between statistics and thermodynamics, classical ideal gas, Gibbs paradox and its solution.
   (1.1-1.6 of Book 1).

II  Elements of Ensemble Theory: Phase space and Liouville’s Theorem, The microcanonical ensemble theory and its application to ideal gas of monatomic particles, equipartition and virial theorems.
   (2.1-2.4, 2.6 of Book 1).

UNIT II

III  The Canonical Ensemble: Equilibrium between a system and a heat reservoir, a system in the canonical ensemble and physical significance of various statistical quantities, partition function, classical ideal gas in canonical ensemble theory, energy fluctuations, a system of harmonic oscillators as canonical ensemble, statistics of paramagnetism, thermodynamics of magnetic systems and negative temperatures.
   (3.1-3.9 of Book 1)

UNIT III

IV  The grand canonical ensemble: Equilibrium between a system and a particle-energy reservoir and significance of statistical quantities. Classical ideal gas in grand canonical ensemble theory. Density and energy fluctuations.
   (4.1-4.5 of Book 1).

   (2.5, 6.1-6.3 of Book 1)

   (8.1, 8.2A, 8.3 (omit sub sections A and B), 8.4 of Book 1).
UNIT IV

VII  **Ideal Bose Systems** : Basic concepts and thermodynamic behaviour of an ideal Bose gas, Bose-Einstein condensation, Discussion of gas of photons (the radiation fields) and phonons (The Debye field), Liquid helium and superfluidity. 
(7.1, 7.2, 7.3, 7.5 of Book 2).

**TUTORIALS** : Relevant problems given in the end of each chapter in the text book.

**Books**

**PHY7003 Electronics II**

**Max. Marks: 20+80=100**

| Note | 1 | The question paper for the final examination will consist of five units. Units I – IV will have TWO questions each from the corresponding units of the syllabus. These eight questions will carry 19 marks each. Unit V in the paper will have one Compulsory Question consisting of 7 to 10 short answer type parts covering the whole syllabus. This question will have a weightage of 24 marks and will not have any choice.
The candidates will attempt **five** questions in all, selecting one from the units I to IV and the compulsory question from unit V. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>The question paper is expected to contain problems with a weightage of 30 to 40 % of the total marks.</td>
</tr>
</tbody>
</table>

**UNIT I**

I  **Digital Systems I** : Review of basic concepts of logic systems and Boolean Algebra/Logic gates (OR, AND, NOR, NAND, EX-OR, etc.). Standard gate assemblies. binary address, parallel and serial operations, half adder, full adder, Decoder, Multiplexer Encoder, Read Only Memory and its applications.
UNIT II

II **Digital Systems II** : Master Slave J-K Flip-flop, Shift Register, Up and Down Counters, Synchronous and Asynchronous counters, SSI, MSI and LSI, Bipolar and MOS digital systems and their comparison, Bipolar and MOS-RAM Encoder, Random Access Memory and its applications, Digital Display, Seven Segment Display, Sequence generator. Memory Storage Cell (both bipolar and MOS RAM ), Read, Write and Address Operations (both bipolar and MOS RAM), Dot Matrix, Digital to Analog Converters, Weighted Resistor and 2R Ladder Type, Analog to Digital Converters.

UNIT III


UNIT IV


V **Fabrication of Integrated Circuits and Devices** : Basic ideas of integrated circuits, Epitaxial Growth, Diffusion, Masking, Etching, Fabrication of Monolithic Integrated Circuits.

TUTORIALS : Relevant problems given at the end of each chapter in the books listed below.

**Books**

1. Integrated Electronics : Millman and Halkias (Tata McGraw Hill, New Delhi).
Note: 1. The question paper for the final examination will consist of five units. Units I – IV will have TWO questions each from the corresponding units of the syllabus. These eight questions will carry 19 marks each. Unit V in the paper will have one Compulsory Question consisting of 7 to 10 short answer type parts covering the whole syllabus. This question will have a weightage of 24 marks and will not have any choice. The candidates will attempt five questions in all, selecting one from the units I to IV and the compulsory question from unit V.

2. The question paper is expected to contain problems with a weightage of 30 to 40 % of the total marks.

UNIT I

I Optical Properties: Resume of macroscopic theory -- generalized susceptibility, Kramers- Kronig relations, Brillouin scattering, Raman effect; interband transitions. (Books 4-7)

UNIT II

II Magnetism: Dia- and para-magnetism in materials, Pauli paramagnetism, Exchange interaction. Heisenberg Hamiltonian and resume of the results; Ferro-, ferri- and antiferro-magnetism; spin waves; specific heat - Bloch law. (Books 5-7).

III Magnetic Resonance Techniques: Principles of ESR and NMR (Book 4)

UNIT III

IV Superconductivity: Experimental Survey, Basic phenomenology, Type I and Type II superconductors; BCS pairing mechanism,; High Tc superconductors. (Books 4-7).

UNIT IV

V Defects and Disorder: Elementary ideas of point defects and dislocations; Brief introduction to nanostructures. (Book 4).
TUTORIALS: Relevant problems given at the end of each chapter in the books listed below.

Books:


PHY7005 Nuclear Physics II

Max. Marks: 20+80=100

Note: 1 The question paper for the final examination will consist of five units. Units I – IV will have TWO questions each from the corresponding units of the syllabus. These eight questions will carry 19 marks each. Unit V in the paper will have one Compulsory Question consisting of 7 to 10 short answer type parts covering the whole syllabus. This question will have a weightage of 24 marks and will not have any choice.

The candidates will attempt five questions in all, selecting one each from the units I to IV and the compulsory question from unit V.

2 The question paper is expected to contain problems with a weightage of 30 to 40% of the total marks.

UNIT I


UNIT II

II Collective Model of Nucleus I: Collective motion, parametrization of nuclear surface, Rotation of deformed nuclei, Rotation D-
matrices, Collective model Hamiltonian, nuclear wavefunction for even-even nuclei and odd-A nuclei, Rotation-vibrational coupling, Nuclear vibrational and rotational energy spectra of even nuclei, odd mass nuclei: coupling of particle to even-even core.

UNIT III

III Collective Model of Nucleus II: Nilsson model, Cranking shell model, kinematic and dynamic moment of inertia, Routhians and alignment plots, backbending behaviour.

UNIT IV

IV Nuclear reactions: Review of Statistical & Optical model for compound nucleus, Direct reactions: Kinematics and theory of stripping, pick up & reverse reactions. Fusion-evaporation & transfer reactions and various models, Heavy-ion induced nuclear reactions and various phenomena at low, intermediate and high energies.

TUTORIALS: Relevant problems given at the end of each chapter in the books listed below.

Books


PHY7006 Particle Physics II

Max. Marks: 20+80=100

Note: 1 The question paper for the final examination will consist of five units. Units I – IV will have TWO questions each from the corresponding units of the syllabus. These eight questions will carry 19 marks each. Unit V in the paper will have one Compulsory Question consisting of 7 to 10 short answer type parts covering the whole syllabus. This question will have a weightage of 24 marks and will not have any choice.

The candidates will attempt five questions in all, selecting one from the units I to IV and the compulsory question from unit V.

2 The question paper is expected to contain problems with a weightage of 30 to 40 % of the total marks.
UNIT I

I **Internal Symmetries**: Introduction to Symmetries and their relation to group theory. Symmetry groups $O(3)$, $SU(2)$, $SU(3)$ and $SU(6)$. Applications of symmetry groups to hadron spectroscopy: meson mixing, mass formulae.

UNIT II

II **Quark Model**: Introduction to constituent quark model, hadron wavefunction in terms of quarks, simple applications to hadron phenomenology.


UNIT III


UNIT IV

V **Strong Interactions**: Introduction to gauge field theories, including Non-Abelian gauge field. Elements of QCD.

VI **Unification Schemes**: Spontaneous symmetry breaking, Introduction to Glashow-Weinberg-Salam model, Standard model, etc.

TUTORIALS: Relevant problems given at the end of each chapter in the books listed below.

**Books**

2. Introduction to Unitary Symmetry: Litchtenberg (Addison Wesley, Reading).
4. Introduction to Particle Physics: M.P. Khanna (Prentice-Hall of India, New Delhi).
5. Gauge Theories of Weak, Strong and Electromagnetic Interactions: C. Quigg (Gorden & Breach, New York).
Note: Students are expected to perform at least 10 experiments distributed over all the sections. Duration of the examination will be 4 hours.

ELECTRONICS & GENERAL:
1. To study uncertainty principle using Laser
2. To study the characteristics of IC555.
3. To study the characteristics of FET/MOSFET.
4. To study (i) refractions through a prism (ii) double slit interference (iii) Fabry–Perot interferometer using Gunn diode microwave generator.
5. Use of microwaves to study (i) Michelson interferometer (ii) Brewster’s angle for polarization (iii) Bragg’s diffraction from crystal model.

NUCLEAR PHYSICS:
6. To study time resolution of a gamma-ray coincidence set-up.
7. To study anisotropy of gamma-ray for $^{60}\text{Co}$ using a coincidence set-up.
8. To study energy resolution and calibration of a gamma-ray spectrometer using multi-channel analyzer.
9. To study time resolution and calibration of a coincidence set-up using a multi-channel analyzer.
10. To study calibration of a beta-ray spectrometer.
11. To study scattering of photons from different elements.

PARTICLE PHYSICS:
12. To study p-p interaction and find the cross-section of a reaction using a bubble chamber.
13. To study n-p interaction and find the cross-section using a bubble chamber.
14. To study k-d interaction and find its multiplicity and moments using a bubble chamber.

CONDENSED MATTER PHYSICS:
15. To determine crystal structure of different materials using x-ray diffraction.
16. To measure dielectric constant of Barium titanate as function of temperature and frequency and hence study its transition.
17. To measure heat capacity of a solid at high and low temperatures.
18. To study the cooling curve for a binary alloy.
**PROJECT WORK**: Develop a new experiment or perform open-ended experiment thorough investigations using the available set-up.

(* with weightage equal to few experiments to be decided by the teachers).

**PHY7052 Computational Physics Laboratory and Project**  
**Max. Marks : 125**

I. **Introduction**: Computer hardware, software, programming languages, Fortran 77, classification of data, variables, dimension and data statement, input/output, format, branching, IF statements, DO statements, subprogrammes, operations with files.

II. **List of numerical problems to be done using Fortran language**
1. Data handling: find standard deviation, Mean, variance, moments etc.
2. Choose a set of 10 values and find the least fitted curve.
3. Generation of waves on superposition like stationary waves and beats.
4. Fourier Analysis for square waves.
6. Perform numerical integration of one-dimensional function using Simpson rule.

III. **List of Physics Problems**
1. Study the charging and discharging of a capacitor in RC circuit with a DC source using Euler method. Graphically demonstrate the variation of charge with time for two values of time step size. Modify the program to include AC source instead of D.C. Source.
2. Study the growth and decay of current in RL circuit containing (a) DC source and (b) AC source using Runge Kutta method. Draw graphs between current and time in each case. Perform power analysis in the circuit for two values of time step size for the case.
3. Write a program to study graphically the EM oscillations in a LCR Circuit (use Runge-Kutta method). Show the variations of (a) charge vs time, (b) current vs time.
4. Study graphically the motion of a falling spherical body under various effects of the medium (viscous drag, buoyancy and air drag using Euler method.
5. Study graphically the path of a projectile with and without air drag, using FN method. Find the horizontal range and maximum height in either case. Write your comments on the findings.
6. Motion of artificial satellite.
7. Study of motion of a one-dimensional harmonic-oscillator without and with damping effect (use Euler method). Draw graphs showing the relations (a) velocity vs time (b) acceleration vs time (c) position vs time.
8. Obtain the energy eigenvalues of a quantum oscillator using Runge-Kutta method.
9. Study the motion of a charged particle in (a) uniform electric field (b) in uniform magnetic field (c) in combined electric and magnetic fields (cyclotron). Draw graphs in each case.
10. Monte-Carlo technique to simulate phenomenon of Nuclear radioactivity. Modify your programme to a case when daughter nucleus is also unstable.
11. Study the motion of two coupled harmonic oscillators. Compare the numerical results with analytic results.

12. Project

PHY7071 : Experimental Techniques in Condensed Matter, Nuclear and Particle Physics

Max. Marks: 20+80=100

<table>
<thead>
<tr>
<th>Note</th>
<th>1</th>
</tr>
</thead>
</table>
| The question paper for the final examination will consist of five units. Units I – IV will have TWO questions each from the corresponding units of the syllabus. These eight questions will carry 19 marks each. Unit V in the paper will have one Compulsory Question consisting of 7 to 10 short answer type parts covering the whole syllabus. This question will have a weightage of 24 marks and will not have any choice.

The candidates will attempt five questions in all, selecting one from the units I to IV and the compulsory question from unit V. |

| 2 |
| The question paper is expected to contain problems with a weightage of 30 to 40 % of the total marks. |

UNIT I

I Material Preparation and Characterisation Techniques :
Amorphous, Ceramics, Crystal growth, Preparation thin films.

Characterization of semiconductors- mobility, depth profiling, Dielectric Spectroscopy, Luminescence/fluorescence, IR-UV/Visible absorption, Raman spectra, Phase transition by DSC techniques, Specific heat and thermal conductivity, Susceptibility, ESR, NMR, Structural properties - XRD, SEM, AFM.

UNIT II

II Radiations Detectors I : Interaction of gamma-rays, neutrons, electrons and heavy charged particles with matter, Relativistic
particle interactions.
Radiation detectors- modes of detector operation, pulse height
spectra, energy resolution, detection efficiency, dead time,
Background and detector shielding.
Counting statistics and Error propagation, statistical model and
their applications.

III Introduction to Nuclear and Particle Physics Experimentation:
Experimental methods for gamma-ray, conversion electron and
charged particle spectroscopy associated with nuclear reactions,
nuclear lifetime measurements (DSAM and RDM techniques).

Particle Physics Experiments, Kinematics, Brief account of
Particle Accelerators, Secondary beams.

UNIT III

V Detection of Radiations II : Proportion counters, Gas
multiplication factor, space charge effects, energy resolution,
time characteristics of signal pulse position-sensitive
proportional counters. Organic and inorganic scintillators and
their characteristics, light collection and coupling to
photomultiplier tubes and photodiodes, pulse shape analysis,
properties of scintillation gamma-ray spectrometers.
Semiconductor detectors, Ge and Si (Li) detectors, charge
production and collection processes, Compton-suppressed, Ge
detectors, Semiconductor detectors for charged particle
spectroscopy and particle identification; Magnetic charged
particle transport system.

Detection of fast and slow neutrons - nuclear reactions for neutron
detection.

UNIT IV

VI Electronics Associated with Detectors : Electronics for pulse
signal processing, CR, RC and CR-(RC)^n shaping, pole-zero
cancellation, preamplifiers (voltage and charge-sensitive
configurations), Linear amplifiers, pileup rejectors, single-channel
analyser, multichannel analyser. Basic considerations in time
measurements, time pick off methods, time-to amplitude
converters, fast slow coincidence, NIM and CAMAC
instrumentation standards and data acquisition system.

TUTORIALS : Relevant problems pertaining to the topics covered in the course.
Books:


**PHY7072 Fibre Optics and Non-linear Optics and Microprocessor and Computer Architecture**

Max. Marks: 20+80=100

**Note:**

1. The question paper for the final examination will consist of five units. Units I – IV will have TWO questions each from the corresponding units of the syllabus. These eight questions will carry 19 marks each. Unit V in the paper will have one Compulsory Question consisting of 7 to 10 short answer type parts covering the whole syllabus. This question will have a weightage of 24 marks and will not have any choice.

   The candidates will attempt **five** questions in all, selecting one each from the units I to IV and the compulsory question from unit V.

2. The question paper is expected to contain problems with a weightage of 30 to 40 % of the total marks.

**UNIT I**

I **Optical Fibre and its Properties**: Introduction, Basic Fibre Construction, Propagation of the Light, Modes and the Fibre, Refractive Index Profile, Types of Fibre, Dispersion, Data rate and bandwidth, Attenuation, Leaky modes. Bending losses. Cut off wavelength, Mode field diameter. Other fibre types.

(Chapter 3 of Book 1).

II **Fibre Fabrication and Laser Design**: Fibre fabrication. Mass production of fibre. Comparison of the processes. Fibre drawing process, Coatings, Cable design requirements, Typical Cable design testing.

(Chapter 4 of Book 1)
Stored Electromagnetic energy in anisotropic media. Propagation of monochromatic plane waves in anisotropic media, Two possible directions of $\mathbf{D}$ for a given wave vector are orthogonal. Angular relationships between $\mathbf{D}$, $\mathbf{E}$, $\mathbf{H}$, $\mathbf{K}$ and the Poynting’s vector, and Indicatrix, Uniaxial crystals. Index surfaces. Other surfaces related to the Uniaxial Indicatrix, Huygenian constructions. Retardation. Biaxial crystals, Intensity Transmission through Polariser/Wave Plate/Crystals. Intensity Transmission through Polariser/Wave Plate/Polariser combinations.
(18.1 to 18.14 of Book 2)

UNIT II

(19.1 to 19.10 of Book 2)

(20.1 to 20.3 & 20.6, 20.7 of Book 2; 1.1 to 1.3 and 2.1 & 2.5 of Book 3).

UNIT III

8085 Microprocessor architecture, Microprocessor initiated operations. Internal data operations, 8085 registers, externally initiated operations, memory mapping and memory classification. Simple microcomputer system, logic devices for interfacing. Microprocessor communication and bus timings. 8085 machine cycles. Memory interfacing with 8085.
Interfacing I/O devices.
Introduction to 8085 assembly language programming.
8085 instructions.
General purpose programmable peripheral devices.
Microprocessor Applications.
Recent trends in Microprocessor Technology.

UNIT IV

II. PC Computer Families :
1. PC 80286, 80386, 80486
2. Pentium Class
3. Bus Technology

TUTORIALS : Relevant problems pertaining to the topics covered in the course.

Books

1. The Elements of Fibre Optics : S. L.Wymer Meardon
   (Regents/Prentice Hall, Englewood Cliffs).
2. Lasers and Electro-Optics : C. C. Davis (Cambridge University
3. The Elements of Non-linear Optics : P.N. Butcher & D. Cotter
   (Tata McGraw-Hill, New Delhi).
5. Microprocessor Architecture, Programming and Applications :
   Gaonkar (New Age, New Delhi).
   Delhi).

******