OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR B. Sc. (HONS SCHOOL) IN PHYSICS – FIRST and SECOND SEMESTER EXAMINATION 20 10-11.

B.Sc. (H. S.) FIRST SEMESTER (Major)	**MARKS**	**CREDITS**
PHYS 111H Mechanics	**75**	**3**
PHYS 112H Electricity and Magetism-I	**75**	**3**
PHYS 113H Physics Laboratory	**50**	**2**

B.Sc. (H. S.) SECOND SEMESTER (Major)	**MARKS**	**CREDITS**
PHYS 121H Special Theory of Relativity	**7 5**	**3**
PHYS 122H Electricity and Magnetism-II	**75**	**3**
PHYS 123H Physics Laboratory	**50**	**2**

FIRST SEMESTER SUBSIDIARY FOR STUDENTS OF HONS. SCHOOL IN CHEMISTRY, COMPUTER SCIENCE, GEOLOGY AND MATHEMATICS

PHYS 111S Mechanics and Waves	**75**	**3**
PHYS 112S Practicals	**25**	**1**

SECOND SEMSTER SUBSIDIARY FOR STUDENTS OF HONS. SCHOOL IN CHEMISTRY, COMPUTER SCIENCE, GEOLOGY AND MATHEMATICS

PHYS 121S Optics and Thermal Physics	**75**	**3**
PHYS 122S Practicals	**25**	**1**

FIRST SEMESTER SUBSIDIARY FOR STUDENTS OF HONS. SCHOOL IN BIOCHEMISTRY, BIOPHYSICS, BIOTECHNOLOGY AND MICROBIOLOGY

PHYS 113S Electricity, Magnetism and Electronics	**75**	**3**
PHYS 114S Practicals	**25**	**1**

SECOND SEMSTER SUBSIDIARY FOR STUDENTS OF HONS. SCHOOL IN BIOCHEMISTRY, BIOPHYSICS, BIOTECHNOLOGY AND MICROBIOLOGY

PHYS 123S Optics and Modern Physics	**75**	**3**
PHYS 124S Practicals	**25**	**1**

The students of B.Sc (Hons. School) have also to study the subject of "Environment Education". This is a compulsory qualifying paper which the students are required to qualify in the $1^{st}/2^{nd}/3^{rd}$ year of the course. The examination will be conducted by the University.

Internal assessment and end semester examination will be of 20% and 80%, respectively. of the total marks.

ENVIRONMENT EDUCATION

(25 Hrs. course)

1. Environment Concept :

Introduction, concept of biosphere – lithosphere, hydrosphere, atmosphere; Natural resources – their need and types; Principles and scope of Ecology; concepts of ecosystem, population, community, biotic interactions, biomes, ecological succession.

2. Atmosphere :

Parts of atmosphere, components of air; pollution, pollutants, their sources, permissible limits, risks and possible control measures.

3. Hydrosphere :

Types of aquatic systems; Major sources (including ground water) and uses of water, problems of the hydrosphere, fresh water shortage; pollution and pollutants of water, permissible limits, risks and possible control measures.

4. Lithosphere :

Earth crust, soil – a life support system, its texture, types, components, pollution and pollutants, reasons of soil erosion and possible control measures.

5. Forests :

Concept of forests and plantations, types of vegetation and forests, factors governing vegetation, role of trees and forests in environment, various forestry programmes of the Govt. of india, Urban Forests, Chipko Andolan.

6. Conservation of Environment :

The concepts of conservation and sustainable development, why to conserve, aims and objectives of conservation, policies of conservation; conservation of life support systems – soil, water , air, wildlife, forests.

7. Management of Solid Waste :

Merits and demerits of different ways of solid waste management – open dumping, landfill, incineration, resource reduction, recycling and reuse, vermicomposting and vermiculture, organic farming.

8. Indoor Environment :

Pollutants and contaminants of the in-house environment; problems of the environment linked to urban and rural lifestyles; possible adulterants of the food; uses and harms of plastics and polythene; hazardous chemicals, solvents and cosmetics.

9. Global Environmental Issues :

Global concern, creation of UNEP; Conventions on climate change, Convention on biodiversity; Stratospheric ozone depletion, dangers associated and possible solutions.

11. Biodiversity :

What is biodiversity, levels and types of biodiversity, importance of biodiversity, causes of its loss, how to check its loss; Hotspot zones of the world and India, Biodiversity Act, 2002.

12. Noise and Microbial Pollution :

Pollution due to noise and microbes and their effects.

13. Human Population and Environment :

Population growth and family welfare programme, Human Health. HIV AIDS. Human Rights.

14. Social Issues :

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15. Local Environmental Issues :

Environmental problems in rural and urban areas. Problem of Congress Grass & other weeds, problems arising from the use of pesticides and weedicides, smoking etc.

Practicals :

Depending on the available facility in the college, a visit to vermicomposting units or any other
such non-polluting eco-friendly site or planting/caring of vegetation/trees could be taken.

Note ***Above 15 topics to be covered in 25 hour lectures in total, with 2 lectures in each topics from 2 to 11and one each for the topics 1 and 12 to 15. :***

- **Examination Pattern :**
  Fifty multiple choice questions (with one correct and three incorrect alternatives and no marks
  deduction for wrong answer or un-attempted question)

- All questions compulsory i.e. no choice.

- Qualifying marks 33 per cent i.e. 17 marks out of 50.

- Total marks : 50.

- Duration of Examination : 60 minutes.

- Spread of questions : Minimum of 2 questions from each of the topics 1 and 12 to 15.Minimum of 4 questions from topics 2 to 11.

PHYSICS SYLLABUS FOR B.SC. (HONS. SCHOOL) FIRST SEMESTER FOR STUDENTS OF PHYSICS MAJOR FOR THE EXAMINATION 2010-11

PHYS 111H MECHANICS (40 hrs.) Max. Marks: 75

Objective: This course has been so framed that the students are first exposed to the mathematical tools needed in Mechanics and Special Relativity. Students are then taught the topics of conservation laws, elastic and inelastic scattering, dynamics of rigid bodies and inverse-square law of forces in the framework of Newtonian Mechanics.

Note:

1. The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

Mathematical Tools: Differentiation : Basic ideas, the chain rule, implicit differentiation, special points of a function. Differential Equations: First degree first order equations, exact differentials, integrating factor, second order homogeneous and non-homogeneous differential equations with constant coefficients, complementary solutions and particular integral. Integration: As area under the curve and inverse of differentiation, simple examples, integration by substitution and by parts, reduction formulae, integration in plane polar coordinates. Vectors : Basics, vector addition, products of vectors (Scalar and Vector), reciprocal vectors, vector derivatives, circular motion, vectors and spherical polar coordinates, invariants. (Ch 1 & 6 of Book 1, Ch. II of Book 2, Ch. 2 and 3 of Book 3).

C**onservation Laws:** Conservation of Energy, Conservative forces, Internal forces and conservation of linear momentum, Centre of mass, systems with variable mass, Space-Vehicle Problem. Conservation of Angular Momentum, Internal torques, Angular Momentum about the Centre of mass, Rotational invariance, Shape of Galaxy. (Chs. V and VI of Book 2, Ch. 5 of Book 3).

Elastic and Inelastic Scattering : Types of scattering and conservation laws, Laboratory and centre of mass systems, collision of particles which stick together, General elastic collision of particles of different mass, Cross-section of elastic scattering, Rutherford scattering. (Ch. VI of Book 1, Ch. 7 of Book 2).

Dynamics of Rigid Bodies : Equation of motion, angular momentum and kinetic energy of a Rotating Body, Moment of Inertia and Radius of Gyration, Rotation of about fixed axes - time dependence of motion, cylinder on an accelerated rough plane, Behaviour of angular momentum vector, Principal axes and Euler's equations. Elementary Gyroscope, Symmetrical Top. (Ch.VIII of Book 2, Ch. 8 of Book 3).

Inverse-Square-Law of Forces : Force between a Point Mass and Spherical shell. Force between a Point Mass and Solid Sphere, Gravitational and Electrostatic self-energy. Gravitational energy of the Galaxy and of uniform sphere; Orbits and their eccentricity, Two-body problem - reduced mass. (Ch. IX of Book 2, Ch. 6 of Book 3).

TUTORIALS : Relevant problems given at the end of a chapter in books 1, 2 and 3.

Books :

1. Mathematical Methods for Physics and Engineering : K.F. Riley, M.P. Hobson and S.J.Bence (Cambridge University Press) (1998).
2. Mechanics (Berkeley) Physics Course I : Charles Kittle, Walter D. Knight, M. Alvin and A. Ruderman (Tata McGraw Hill) (1981).
3. Mechanics : H.S. Hans and S.P. Puri (Tata McGraw Hill) (2003).
4. Introduction to Classical Mechanics : R.G. Takwale & P.S.Puranik (Tata-McGraw-Hill) (2000)

PHYS 112H ELECTRICITY AND MAGNETISM-I (40 hrs.) Max. Marks: 75

Objective: The aim of this course is to teach the students basics of electronics and electric current after making them comfortable with the mathematical tools involved in the study of electricity and magnetism.

Note:

1. The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

Mathematical Tools : Complex Numbers : Real and imaginary parts, complex plane, polar representation, conjugation, algebraic operations, Euler's formula, power and roots of complex numbers, exponential and trigonometric functions, hyperbolic functions, logarithms, inverse functions. Vector Calculus : Differentiation of vectors, scalar and vector fields, conservative fields and potentials, line integrals, gradient of a scalar field, divergence of a vector field and divergence theorem, curl of a vector field and its physical significance, Stokes' theorem, combination of grad, div and curl. (Ch 2, 6, 8 of Book 1; Ch 1,3,5 of Book 2, Ch 1, 2 of Book 3)

Electric Charges and Fields : Conservation and quantization of charge, Coulomb's Law, Energy of a system of charges. Flux and Gauss's law. Brief review of electric fields of a spherical charge distribution, a line charge and an infinite flat charged sheet. (Ch. 1 of Book 3).

Electric Potential : Potential as line integral of field, potential difference, Gradient of a scalar function, Derivation of the field from the potential, potential of a charge distribution, Uniformly charged disc. Force on a surface charge, energy associated with an electric field, Gauss's theorem and differential form of Gauss's law, Laplacian and Laplace's equation, Poisson's equation. (Ch. 2 of Book 3).

Electric Fields Around Conductors : Conductors and insulators, General electrostatic problem. Boundary conditions, Uniqueness theorem, some simple system of conductors; capacitors and capacitance, Energy stored in a capacitor. (Ch. 3 of Book 3).

Electric Currents : Charge transport and current density, Stationary currents, Ohm's law, Electrical conduction model, Failure of Ohm's law, Circuits and circuit elements, Energy dissipation in current flow, variable currents in capacitors and resistors. (Ch. 4 of Book3).

Tutorials : Relevant problems given at the end of each chapter in books 1,2 and 3.

Books :

1. Mathematical Methods in the Physical Sciences : M.L.Boas (Wiley) (2002).
2. Introduction to Mathematical Physics : C. Harper (Prentice Hall of India) (2004).
3. Electricity and Magnetism (Berkley, Phys. Course 2) : E.M. Purcell (Tata McGraw Hill) (1981).
4. Elements of Electromagnetics : M.N.O.sadiku (Oxford University Press) (2001).
5. Electricity and Magnetism : A.S. Mahajan & A.A. Rangwala (Tata- McGraw Hill) (1988).
6. Electricity and Magnetism : A.N. Matveev (Mir) (1986).

PHYS 113H PHYSICS LABORATORY (90 hrs.) Max. Marks: 50

Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitive equipments.

Note:

1. Examination time will be 3½ hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester.

1. Analysis of experimental data by:
   (i) Fitting of given data to a straight line.
   (ii) Calculation of probable error. Use of Vernier callipers, screw gauge and spherometer.
2. To study the variation of time period with distance between centre of suspension and centre of gravity for a bar pendulum and to determine:
   (i) Radius of gyration of the bar about an axis through its C.G. and perpendicular to its length.
   (ii) The value of g in the laboratory.
3. To determine the Young's modulus by bending of beam.
4. To determine the coefficient of rigidity of a wire by static method or Maxwell's needle.
5. To study one dimensional collision using two hanging spheres of different materials.
6. Dependence of scattering angle on kinetic energy and impact parameter in Rutherford scattering (mechanical analogue).
7. To measure the coefficient of linear expansion.
8. Determination of E.C.E. of hydrogen and evaluation of Faraday and Avogadro constants.
9. To study the magnetic field produced by a current carrying solenoid using a pick-up coil and to find the value of permeability of air.
10. To determine the frequency of a.c. main using sonometer.
11. To study given source of electrical energy and verify the maximum power theorem.
12. To determine the resistance of an electrolyte for a.c current and study its concentration dependence.
13. To study the dependence of resistance on temperature.
14. To measure thermo e.m.f. using potentiometer.
15. To study C.R.O. as display and measuring device by recording sines and square waves, output from a rectifier, verification (qualitative) of law of electromagnetic induction and frequency of a.c. mains.
16. To plot the Lissajous figures and determine the phase angle by C.R.O.
17. To study B-H curves for different ferromagnetic materials using C.R.O.
18. Determination of given inductance by Anderson's bridge.
19. To determine the value of an air capacitance by de-Sauty Method and to find permittivity of air. Also to determine the dielectric constant of a liquid.
20. Study of R.C. circuit with varying e.m.f. using it as an integrating circuit.
21. Study of R.C. circuit with a low frequency a.c. source.
22. Studies based on LCR Board: Impedance of LCR circuit and the phase and between voltage and current.
23. To determine the wavelength of LASER using diffraction grating and use it for the determination of the grating element of another grating.

PHYSICS SYLLABUS FOR B.SC. (HONS. SCHOOL) SECOND SEMESTER FOR STUDENTS OF PHYSICS MAJOR FOR THE EXAMINATION 2010-11.

PHYS 121H SPECIAL THEORY OF RELATIVITY (40 hrs.) Max. Marks: 75

Objective: This course aims at exposing the students to Newton's law of motion, the Galilean transformations and Einstein's special theory of relativity in proper perspective so that they can use its formulation in later courses.

Note:

1. The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

Newton's Laws of Motion: Forces and equations of motion, Lorentz force, Motion of a charged particle in a uniform constant magnetic field, charged particle in a uniform alternating electric field. (Ch. III of Book 2, Ch. 4 of Book 3).

Galilean Transformation: Inertial reference frames, absolute and relative accelerations and velocity, Galilean Transformation, Conservation of Momentum, Fictitious Forces, Collisions, Velocity and Acceleration in Rotating coordinate systems. (Ch. IV of Book 2, Ch. 10 of Book 3).

Lorentz Transformations: Michelson-Morley Experiment, Basic postulates of special relativity, Lorentz transformations, Simultaneity and causality in relativity. Length contraction, Time dilation, Velocity Transformation, Space-like and time-like intervals, Aberration of light, Doppler effect. (Ch. XI of Book 2, Ch. 11 of Book 3).

Relativistic Dynamics: Conservation of Momentum, Relativistic momentum, Relativistic Energy, Transformation of Momentum and Energy, Equivalence of Mass and Energy. Particles with zero Rest-mass. Transformation of force, Four vectors. (Ch.XII of Book2, Ch.12 of Book 3).

Problems in Relativistic Dynamics: Acceleration of Charged Particle by constant longitudinal electric field, Acceleration by a Transverse Electric field, charged particle in a magnetic field, centre of mass system and Threshold Energy. Energy available from Moving charge, Antiproton Threshold, Photoproduction of mesons. (Ch. XIII of Book 2, Ch. 12 of Book 3).

Principle of Equivalence : Inertial and Gravitational Mass, Gravitational Mass of photons, Gravitational Red-Shift, Equivalence. (Ch. XIV of Book 2).

TUTORIALS : Relevant problems given at the end of a chapter in books 1, 2 and 3.

Books :

1. Mechanics (Berkeley) Physics Course I : Charles Kittle, Walter D. Knight, M. Alvin and A. Ruderman (Tata McGraw Hill) (1981).
2. Mechanics : H.S. Hans and S.P. Puri (Tata McGraw Hill) (2003).
3. Introduction to Classical Mechanics : R.G. Takwale & P.S.Puranik (Tata-McGraw-Hill) (2000)

PHYS 122H ELECTRICITY AND MAGNETISM-I **40 hrs.** Max. Marks: 75

Objective: The course on Electricity & Magnetism-II has been designed to make the students confident about electric fields in matter, the fields of moving charges, magnetic fields in vacuum as well as matter, the physics of electromagnetic induction and alternating currents so that they can use this knowledge in electric and condense matter physics

Note:

1. The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

Electric Fields in Matter : Dielectrics, Moments of a charge distribution, Potential and field of a dipole, Atomic and molecular dipoles, Induced dipole moments, Permanent dipole moments, electric field caused by polarized matter, field of a polarized sphere, dielectric sphere in a uniform field, Gauss's law and a dielectric medium, Electrical susceptibility and atomic polarizability, Energy changes in polarization, Polarization in changing fields. (Ch. 10 of Book 3).

The Fields of Moving Charges : Magnetic forces, Measurement of a charge in motion, invariance of charge, Electric field measured in different frames of reference, Field of a point charge moving with constant velocity, Field of a charge that starts or stops, Force on a moving charge, Interaction between a moving charge and other moving charges. (Ch. 5 of Book 3).

Magnetic Field : Definition, some properties of the magnetic field, Vector potential, Field of current carrying wire and solenoid, change in **B** at a current sheet; Transformations of electric and magnetic fields. Rowland's experiment, Hall effect. (Ch 6 of Book 3).

Electromagnetic Induction : Universal law of induction, Mutual inductance, Reciprocity theorem, Self inductance, Energy stored in a Magnetic field. A circuit containing self inductance, Displacement current and Maxwell's equations. (Ch. 7 and 9 of Book 3).

Alternating Current Circuits: A resonance circuit, Alternating current, A.C. networks, Admittance and impedance, skin effect, power and energy in A.C. circuits, Anderson's Bridge, Q factor for series resonance. (Ch. 8 of Book 3).

Magnetic Fields in Matter : Response of various substances to magnetic field, Force on a dipole in an external field, Electric currents in Atoms, Electron spin and Magnetic moment, types of magnetic materials, Magnetic susceptibility. (Ch. 11 of Book 3).

Tutorials : Relevant problems given at the end of each chapter in books 1,2 and 3.

Books :

1. Electricity and Magnetism (Berkley, Phys. Course 2): E.M. Purcell (Tata McGraw Hill) (1985) 2nd ed.
2. Elements of Electromagnetics: M.N.O.sadiku (Oxford University Press) (2001).
3. Electricity and Magnetism: A.S. Mahajan & A.A. Rangwala (Tata- McGraw Hill) (1988).
4. Electricity and Magnetism: A.N. Matveev (Mir) (1986).

PHYS 123H PHYSICS LABORATORY (90 hrs.) Max. Marks: 50

Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitive equipments.

Note:

1 Examination time will be 3½ hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.

2 Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester.

1. Analysis of experimental data by:
   (i) Fitting of given data to a straight line.
   (ii) Calculation of probable error. Use of Vernier callipers, screw gauge and spherometer.
2. To study the variation of time period with distance between centre of suspension and centre of gravity for a bar pendulum and to determine:
   (i) Radius of gyration of the bar about an axis through its C.G. and perpendicular to its length.
   (ii) The value of g in the laboratory.
3. To determine the Young's modulus by bending of beam.
4. To determine the coefficient of rigidity of a wire by static method or Maxwell's needle.
5. To study one dimensional collision using two hanging spheres of different materials.
6. Dependence of scattering angle on kinetic energy and impact parameter in Rutherford scattering (mechanical analogue).
7. To measure the coefficient of linear expansion.
8. Determination of E.C.E. of hydrogen and evaluation of Faraday and Avogadro constants.
9. To study the magnetic field produced by a current carrying solenoid using a pick-up coil and to find the value of permeability of air.
10. To determine the frequency of a.c. main using sonometer.
11. To study given source of electrical energy and verify the maximum power theorem.
12. To determine the resistance of an electrolyte for a.c current and study its concentration dependence.
13. To study the dependence of resistance on temperature.
14. To measure thermo e.m.f. using potentiometer.
15. To study C.R.O. as display and measuring device by recording sines and square waves, output from a rectifier, verification (qualitative) of law of electromagnetic induction and frequency of a.c. mains.
16. To plot the Lissajous figures and determine the phase angle by C.R.O.
17. To study B-H curves for different ferromagnetic materials using C.R.O.
18. Determination of given inductance by Anderson's bridge.
19. To determine the value of an air capacitance by de-Sauty Method and to find permittivity of air. Also to determine the dielectric constant of a liquid.
20. Study of R.C. circuit with varying e.m.f. using it as an integrating circuit.
21. Study of R.C. circuit with a low frequency a.c. source.
22. Studies based on LCR Board: Impedance of LCR circuit and the phase and between voltage and current.
23. To determine the wavelength of LASER using diffraction grating and use it for the determination of the grating element of another grating.

PHYSICS SYLLABUS FOR B.SC. (HONS. SCHOOL) FIRST SEMESTER SUBSIDIARY FOR STUDENTS OF CHEMISTRY, COMPUTER SCIENCE, GEOLOGY AND MATHEMETICS FOR THE EXAMINATION 2010-11.

PHYS 111S : MECHANICS AND WAVES (40-45 hrs.) Max. Marks: 75

Objective: This course has been framed to teach the students the elements of Newtonian mechanics, simple damped and forced oscillations and propagation of waves in physical media

Note:

1 The question paper for the final examination will consist of three sections. Sections A and B of the paper will have three questions each from the corresponding sections of the syllabi and section C will have one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 12.

2 The question paper is expected to contain problems with a weightage of 25 to 40%.

3 The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION A: MECHANICS

Vector Algebra and Co-ordinate Systems : Review of vector operations, rectangular Cartesian coordinate system, spherical polar coordinates, two dimensional displacement, velocity and acceleration. (Book I)

Particle Dynamics: Dynamical concepts- mechanics of a system of particles. (4.2,4.3 of Book I).

Conservation laws and Properties of space and time: Conservation of linear and angular momenta, homogeneity of flow of time. (Book 1)

Elastic and Inelastic Scattering : Types of scattering and conservation laws, Laboratory and centre of mass systems, collision of particles which stick together, General elastic collision of particles of different mass, Cross-section of elastic scattering, Rutherford scattering. (Book 1).

Frames of Reference and Relativity: Definitions, inertial reference frames, coordinate transformations within reference frame, Newtonian mechanics and principle of relativity, Galilean transformations, origin and significance of the special theory of relativity, search of a universal frame of reference, postulates of the special theory of relativity, Lorentz transformations and their kinematical consequences, intervals, space-like and time-like, variation of mass with velocity, mass energy equivalence, Particles with zero rest mass. (Book 1).

SECTION B: Waves

Simple Harmonic Free Vibrations: Simple harmonic motion, energy of a SHO, Compound pendulum, Electrical Oscillations, Transverse Vibrations of a mass on a string, composition of two perpendicular SHMs of same period and of periods in ratio 1:2, Anharmonic Oscillations. (Book 2)

Damped Simple Harmonic Vibrations : Decay of free Vibrations due to damping, types of damping, Determination of damping coefficients – Logarithmic decrement, relaxation time and Q-factor. Electromagnetic damping. (Book 2)

Forced Vibrations and Resonance : A forced oscillator, Transient and Steady State Oscillations, velocity versus driving force frequency, Resonance, power supplied to forced oscillator by the driving force. Q-factor of a forced oscillator, Electrical, nuclear and nuclear-magnetic resonances. (Book 2)

Waves in Physical Media : Wave motion in one dimension, Transverse and longitudinal waves, progressive harmonic waves and their energy, Transverse waves on a string, longitudinal waves on a rod, characteristic impedance of a string, waves in an absorbing medium, spherical waves. **(Book 2)**

Books

1. Mechanics: H.S. Hans and S.P.Purl (TataMcGrawHill, 1984).
2. Text Book of Vibrations and Waves : S.P. Puri (Macmillan India) (2004)

PHYS 112S PHYSICS LABORATORY (45 hrs.) Max. Marks: 25

Objective: The aim of the laboratory exercises is to train the students in handling the equipments, verifying some laws they study in theory and making them confident to perform precise measurements.

Note :

1. Examination time will be 3 hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester. Exercises (i) and (ii) are compulsory for all students in first semester.

(i) **Analysis of experimental data by** Fitting of given data to a straight line.

(ii) Calculation of probable error. Use of vernier calipers, screw gauge and spherometer and other measuring instruments, Barometer.

1. Determination of 'g' by bar pendulum.
2. Determination of 'g' by Kater's pendulum.
3. Study of rotational motion using flywheel.
4. To determine Young's modulus of material of a bar by bending method.
5. Determination of modulus of rigidity by torsional pendulum.
6. Determination of coefficient of viscosity of a given liquid by Stoke's method.
7. Determination of coefficient of linear expansion
8. Determination of thermal conductivity of a bad conductor by Lee's Disc method
9. Determination of Stefan's constant.
10. Determination of focal length of convex mirror by beam compass method.
11. Determination of magnifying power of a telescope by slit method.
12. Determination of resolving power of a telescope.
13. Determination of frequency of A.C. mains by using electrical vibrator.
14. Determination of refractive index of prism for different wave-lengths using Spectrometer.
15. To determine the wave-length of laser light using a plane diffraction grating.
16. Determination of wave-length of sodium light by Newton's rings method.
17. Determination of specific rotation of sugar using a Polarimeter.
18. Study of one dimensional collisions.
19. Determination of height (of inaccessible structure) using sextant.

PHYSICS SYLLABUS FOR B.SC. (HONS. SCHOOL) SECOND SEMESTER SUBSIDIARY FOR STUDENTS OF CHEMISTRY, COMPUTER SCIENCE, GEOLOGY AND MATHEMETICS FOR THE EXAMINATION 2010-11.

PHYS 121S : OPTICS AND THERMAL PHYSICS (40-45 hrs.) Max. Marks: 75

Objective: The syllabus has been framed keeping in mind the needs of the students of basic medical sciences in their later training.

Note:

1 The question paper for the final examination will consist of three sections. Sections A and B of the paper will have three questions each from the corresponding sections of the syllabi and section C will have one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 12.

2 The question paper is expected to contain problems with a weightage of 25 to 40%.

1. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

Section A: Optics

Interference : Young's experiment, coherent sources, phase and path differences, Theory of interference fringes, Fresnel's biprism, sheet thickness determination, interference in thin films due to reflected and transmitted lights, Maxima and minima in intensities, Colours of thin films, Newton's rings and its various aspects, Non-reflecting films. (Book 1).

Diffraction: Introduction, rectilinear propagation, Fresnel and Fraunhofer diffraction, Diffraction at a circular aperture and straight edge and their discussion. Fraunhofer diffracnon at a single slit and a double slit. Fraunhofer diffraction at N slits and its discussion. Plane diffraction grating and its theory, Dispersive power of grating, Resolving power of optical instruments, Rayleigh criterion, Resolving power telescope, microscope, prism and diffraction grating. Phase contrast microscope. (Book 1).

Polarization : Introduction, Polarization by reflection, Brewester's law,Polarization by reftaction, Malus's law, Double retraction, Nicol Prism and its use, elliptically and Circularly polarized light, quarter and half-wave plates, production and detection of plane, circularly and elliptically polarized light, optical activity, specific rotation, Half-shade polarimeter. (Book 1).

Spectrum: Mercury and sodium 1amps, spectra and their classifications, infrared and ultra-violet spectra. Zeeman effect, Stark effect, Raman effect. (Book 1).

Laser and Holography: Brief features of laser, holography and fibre optics.(Book 1**).**

Section B:Thermal Physics

Statistical Physics: Scope of statistical physics, micro and macrostates, thermodynamic probability distribution of n particles in two compartments, deviation from the state of maximum probability; equilibrium state of dynamic system, distribution of distinguishable particles in compartments and cells, phase space and its division into cells, Boltzmann statistics for ideal gas, Bose-Einstein statistics and its application to black body radiation, Fermi-Dirac statistics and its application to electron gas, comparison of the three statistics. (Book2).

Thermodynamics: Statistical basis of entropy, Change of entropy of a system, third law of thermodynamics, additive nature of entropy, law of increase of entropy, reversible and irreversible processes, increase of entropy in some natural processes, entropy of a perfect gas. Maxwell's relationships and their applications, cooling produced by adiabatic expansion, adiabatic compression, Cp-Cv, Clapeyron equation, Joule-Thomson effect and its thermodynamic treatment for Van der Waal's gas and Joule-Thomson cooling, Liquefication of helium. [Book 2]

Books :

1. A Textbook of Optics: N. Subrahmanyam and B.Lal (S. Chand & Co.,N. Delhi, 1987).
2. Statistical Physics, Thermodynamics and Kinetic Theory: V.S. Bhatia (Vishal Publ., Jalandhar, 2003)

PHYS 122S PHYSICS LABORATORY (45 hrs.) Max. Marks: 25

Objective: The aim of the laboratory exercises is to train the students in handling the equipments, verifying some laws they study in theory and making them confident to perform precise measurements.

Note :

1. Examination time will be 3 hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester. Exercises (i) and (ii) are compulsory for all students in first semester.

(i) **Analysis of experimental data by** Fitting of given data to a straight line.

(ii) Calculation of probable error. Use of vernier calipers, screw gauge and spherometer and other measuring instruments, Barometer.

1. Determination of 'g' by bar pendulum.
2. Determination of 'g' by Kater's pendulum.
3. Study of rotational motion using flywheel.
4. To determine Young's modulus of material of a bar by bending method.
5. Determination of modulus of rigidity by torsional pendulum.
6. Determination of coefficient of viscosity of a given liquid by Stoke's method.
7. Determination of coefficient of linear expansion
8. Determination of thermal conductivity of a bad conductor by Lee's Disc method
9. Determination of Stefan's constant.
10. Determination of focal length of convex mirror by beam compass method.
11. Determination of magnifying power of a telescope by slit method.
12. Determination of resolving power of a telescope.
13. Determination of frequency of A.C. mains by using electrical vibrator.
14. Determination of refractive index of prism for different wave-lengths using Spectrometer.
15. To determine the wave-length of laser light using a plane diffraction grating.
16. Determination of wave-length of sodium light by Newton's rings method.
17. Determination of specific rotation of sugar using a Polarimeter.
18. Study of one dimensional collision.
19. Determination of height (of inaccessible structure) using sextant.

PHYSICS SYLLABUS FOR B.SC. (H.S.) I SEMESTER SUBSIDIARY FOR BIOCHEMISTRY, BIOPHYSICS, BIOTECH. AND MICROBIOLOGY FOR THE EXAM. 2010-11

PHYS 113S: ELECTRICITY, MAGNETISM AND ELECTRONICS Max Marks : 75

Objective: This course has been designed for the students of basic medical sciences so that after learning the basic features of electricity and magnetism, they get sufficient exposure to the electronics that can enable them to understand the working of electronic equipment used in their fields of specialization.

Note

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have three questions each from the corresponding sections of the syllabi and section C will have one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION A: Electricity and Magnetism

Vector Analysis : Review of vector algebra, vector differentiation, vector integration, Gauss's divergence and Stoke's theorems and their physical significance. (1.1-1.5 of Book1)

Electrostatics : Coulomb's law, superposition principle, field concept, scalar potential, Energy considerations, relation between field and potential, use of Gauss's law to calculate electric field, electric field due to a uniform line charge, surface charge, spherical shell of charge, the electric dipole. (Book 1)

Dielectrics: Polarization density, polarization charge density, $\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{P}$ (Book 1)

Current Electricity: Current as moving charge, The Biot-Savart law, some properties of **B**, Ampere's law, the magnetic dipole, the solenoid, magnetic vector and scalar potential, charged particle in magnetic field, charged particle in electric and magnetic fields, Faraday's law of electromagnetic induction, different mechanisms for change of flux, motional emf, mutual inductance, self inductance. (Book 1)

Magnetic field in material media : Types of magnetic substances, magnetization, $\mathbf{B} = \mu_o (\mathbf{M} + \mathbf{H})$, Boundary conditions on **B** and **H**, Hysteresis curve. (Book 1)

Maxwell's equations : Displacement current, Maxwell's equations, Poynting vector. (Book 1)

Some applications : Electrostatic deflection in a cathode ray tube, Cathode ray oscilloscope, G M counter. (Book 1)

SECTION B: Electronics

Conduction in semiconductors: Electrons and holes in an semiconductor, carrier concentration, donor and acceptor impurities, charge densities, Fermi level in semiconductors, diffusion, carrier lifetimes, continuity equation. (Book 2)

Diode characteristics: qualitative theory of p-n junction, p-n diode, band structure of an open circuit diode, current components, quantitative theory of diode currents, V-I characteristics, transition capacitance, diffusion capacitance. (Book 2)

Transistor : Junction transistor, transistor current components, transistor as an amplifier, C B and C E configurations. (Book 2)

Low frequency transistor model : The port device and hybrid model, transistor hybrid model, transistor as amplifier using h- parameters, , comparison of transistor amplifier configurations. (Book 2)

Applications : Half wave rectifier, ripple factor, full wave rectifier, inductor and capacitor filters, regulated power supply, oscillators (introduction only), photoconductivity, photodiode. (Book 3)

Books:

1. Electricity and Magnetism : A.S. Mahajan and A.A. Rangwala (Tata McGraw Hill, 1988)
2. Electronic devices and circuits: J. Millman and C.C. Halkias (Tata McGraw Hill, 1991)
3. Basic Electronics and Linear Circuits: N.N. Bhargave, D.C. Kulshreshtha and S.C. Gupta (Tata McGraw Hill, 1984)

PHYS 114 S PHYSICS LABORATORY (45 hrs.) **Max. Marks: 25**

Objective: The exercises included in this laboratory course are aimed at training the students to handle different type of equipment for verification of some of the laws studied in theory and for carrying out precise measurements so that they develop confidence to use later the sophisticated instruments in their respective fields.

Note :

1. Examination time will be 3 hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester. Exercises (i) and (ii) are compulsory for all students in first semester.

(i) **Analysis of experimental data by** Fitting of given data to a straight line.
(ii) Calculation of probable error. Use of vernier calipers, screw gauge and spherometer and other measuring instruments, Barometer.

1. Determination of wavelength of laser light by a plane diffraction grating.
2. Determination of the wave-length of sodium light using Newton's Rings Method.
3. Determination of specific rotation of sugar by Polarimeter.
4. Determination of refractive index of prism for different wave lengths using spectrometer.
5. Self-inductance by Anderson's bridge.
6. Capacitance by de Sauty method.
7. Verification of laws of electromagnetic induction.
8. Verification of Rutherford- Soddy nuclear decay formula - mechanical analogue.
9. To find half-life period of a given radio-active substance using GM counter/ Charterctisitcs of GM Counter
10. Study of C.R.O. as display and measuring device, Study of Sine-wave, square wave signals (half wave and full wave rectification)
11. Study of power supply, ripple factor - effect of filters.
12. Study of B-H curves of various materials using C.R.O, and determination of various parameters.
13. Determination of Stefan's constant.
14. Determination of coefficient of viscosity by Stoke's method.
15. Study of one dimensional Collision.
16. Determination of ionization potential of mercury.
17. Determination of E_g in Si and Ge.
18. Study of Ge, Si, LED, diode characteristics.
19. To study the variation of the resistance of filament of bulb with its temperature.
20. Study of common base transistor characteristics.
21. Study of common emitter transistor characteristics
22. Determination of ‘e’ or ‘(e/m)’of an electron.
23. Study of Solar-Cell characterstics
24. Determination of Planck's constant using photocell.
25. Determination of velocity of ultrasonic waves in a given liquid
26. Study of vacuum triode characteristics.

PHYSICS SYLLABUS FOR B.SC. (HONS. SCHOOL) SECOND SEMESTER SUBSIDIARY FOR STUDENTS OF BIOCHEMISTRY, BIOPHYSICS, BIOTECHNO-LOGY AND MICROBIOLOGY FOR THE EXAMINATION 2010-11.

PHYS 123S : OPTICS AND MODERN PHYSICS Max Marks : 75

Objective: This course has been framed keeping in mind the requirements of the students with respect to the concepts of physical optics and quantum mechanics as used in different branches of basic medical sciences.

Note

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have three questions each from the corresponding sections of the syllabi and section C will have one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION A: Optics

Interference : Young's experiment, coherent sources, phase and path differences, Theory of interference fringes, Fresnel's biprism, sheet thickness determination, interference in thin films due to reflected and transmitted lights, Maxima and minima in intensities, Colours of thin films, Newton's rings and its various aspects. (Book 1).

Diffraction: Introduction, rectilinear propagation, Fresnel and Fraunhofer diffraction, Fraunhofer diffracnon at a double slit. Fraunhofer diffraction at N slits and its discussion. Plane diffraction grating and its theory, Dispersive power of grating, Rayleigh criterion for resolving power, Resolving power of microscope and diffraction grating. Phase contrast microscope. (Book 1).

Polarization : Introduction, Polarization by reflection and refraction, Brewester's law, Malus's law, Double retraction, Nicol Prism and its use, elliptically and circularly polarized light, quarter and half-wave plates, production and detection of plane, circularly and elliptically polarized light, optical activity, specific rotation, Half-shade polarimeter. (Book 1).

Laser and Holography: Brief features of laser, holography and fibre optics. (Book 1**).**

SECTION B: MODERN PHYSICS

Particle Properties of Waves: Quantum theory of light, X-ray diffraction, Compton effect, pair production, Photons and gravity, black holes. (Book2).

Wave Properties of Particles : de Broglie waves, waves of probability, the wave equation, phase and group velocities, particle diffraction, electron microscope, uncertainty principle. (Book2).

Quantum Mechanics: Wave function and wave equation, Schrodinger equation -time-dependent and steady state forms, expectation value. Particle in a box, Schrodinger's equation for hydrogen atom, separation of variables, quantum numbers. (Book 2).

Many Electron Atoms: Electron spin, spin-orbit coupling, identical particles, exclusion principle, total angular momentum, LS coupling, JJ coupling, one and two electron spectra. (Book2).

Statistical Mechanics: Statistical distributions, Maxwell- Boltzmann statistics, molecular energies in an ideal gas, quantum statistics, Bose-Einstein distribution function, Bose-Einstein condensation, black body radiation, Planck's law, free electron in a metal. (Book 2).

Books:

1. A Textbook of Optics: N. Subrahmanyam and B.Lal (S.Chand &Co.,N.Delhi, 1987).
2. Concepts of Modem Physics: A Beiser (McGraw Hill, 1987).

PHYS 124 S PHYSICS LABORATORY (45 hrs.) Max. Marks: 25

Objective: The exercises included in this laboratory course are aimed at training the students to handle different type of equipment for verification of some of the laws studied in theory and for carrying out precise measurements so that they develop confidence to use later the sophisticated instruments in their respective fields.

Note :

1. Examination time will be 3 hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester Exercises (i) and (ii) are compulsory for all students in first semester.

(iii) **Analysis of experimental data by** Fitting of given data to a straight line.
(iv) Calculation of probable error. Use of vernier calipers, screw gauge and spherometer and other measuring instruments, Barometer.

1. Determination of wavelength of laser light by a plane diffraction grating.
2. Determination of the wave-length of sodium light using Newton's Rings Method.
3. Determination of specific rotation of sugar by Polarimeter.
4. Determination of refractive index of prism for different wave lengths using spectrometer.
5. Self-inductance by Anderson's bridge.
6. Capacitance by de Sauty method.
7. Verification of laws of electromagnetic induction.
8. Verification of Rutherford- Soddy nuclear decay formula - mechanical analogue.
9. To find half-life period of a given radio-active substance using GM counter/ Charterctisitcs of GM Counter
10. Study of C.R.O. as display and measuring device, Study of Sine-wave, square wave signals (half wave and full wave rectification)
11. Study of power supply, ripple factor - effect of filters.
12. Study of B-H curves of various materials using C.R.O, and determination of various parameters.
13. Determination of Stefan's constant.
14. Determination of coefficient of viscosity by Stoke's method.
15. Study of one dimensional Collision.
16. Determination of ionization potential of mercury.
17. Determination of E_g in Si and Ge.
18. Study of Ge, Si, LED, diode characteristics.
19. To study the variation of the resistance of filament of bulb with its temperature.
20. Study of common base transistor characteristics.
21. Study of common emitter transistor characteristics.
22. Determination of 'e' or '(e/m)'of an electron.
23. Study of Solar-Cell characterstics
24. Determination of Planck's constant using photocell.
25. Determination of velocity of ultrasonic waves in a given liquid
26. Study of vacuum triode characteristics.

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR B. Sc. (HONS SCHOOL) IN PHYSICS – THIRD AND FOURTH SEMESTER EXAMINATION 2010-11

B.Sc. (H. S.) THIRD SEMESTER (Major)	**MARKS**	**CREDITS**
PHYS 211H Vibrations and Waves	**75**	**3**
PHYS 212H Quantum Mechanics and Statistical Physics	**75**	**3**
PHYS 213H Electronics and Network Theory -I	**75**	**3**
PHYS 214H Physics Laboratory	**75**	**3**

B.Sc. (H. S.) FOURTH SEMESTER (Major)	**MARKS**	**CREDITS**
PHYS 221H Electromagnetic Theory	**75**	**3**
PHYS 222H Thermodynamics	**75**	**3**
PHYS 223H Electronics and Network Theory -II	**75**	**3**
PHYS 224H Physics Laboratory	**75**	**3**

THIRD SEMESTER SUBSIDIARY FOR STUDENTS OF HONS. SCHOOL IN CHEMISTRY, COMPUTER SCIENCE, GEOLOGY AND MATHEMATICS

PHYS 211S Electricity, Magnetism and Electronics	**75**	**3**
PHYS 212S Physics Laboratory	**25**	**1**

FOURTH SEMSTER SUBSIDIARY FOR STUDENTS OF HONS. SCHOOL IN CHEMISTRY, COMPUTER SCIENCE, GEOLOGY AND MATHEMATICS

PHYS 221S Modern Physics	**75**	**3**
PHYS 222S Physics Laboratory	**25**	**1**

Internal assessment and end semester examination will be of 20% and 80%, respectively. of the total marks.

SYLLABUS FOR B.Sc. (HONS. SCHOOL) IN PHYSICS THIRD SEMESTER (MAJOR) FOR THE EXAMINATION 2010-11.

PHYS 211H : VIBRATIONS AND WAVES (40 hrs.)

Max. Marks: 75

Note:

1. The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

I Simple Harmonic Free Vibrations : Simple harmonic motion, energy of a SHO, Compound pendulum, Electrical Oscillations, Plasma Vibrations, Lattice Vibrations, Transverse Vibrations of a mass on a string, composition of two perpendicular SHMs of same period and of periods in ratio 1:2, Anharmonic Oscillations.

II Damped Simple Harmonic Vibrations: Decay of free Vibrations due to damping, types of damping, Determination of damping coefficients – Logarithmic decrement, relaxation time and Q-factor. Electromagnetic damping, collision damping – Ionosphere and metals.

III Forced Vibrations and Resonance: A forced oscillator, Transient and Steady State Oscillations, velocity versus driving force frequency, Resonance, power supplied to forced oscillator by the driving force. Q-factor of a forced oscillator, Electrical, nuclear and nuclear-magnetic resonances.

IV Coupled Oscillations: Stiffness coupled oscillators, Normal coordinates and modes of vibrations. Normal frequencies, Forced vibrations and resonance for coupled oscillators, Masses on string-coupled oscillators.

V Waves in Physical Media: Wave motion in one dimension, Transverse and longitudinal waves, progressive harmonic waves and their energy, Transverse waves on a string, longitudinal waves on a rod, Electrical transmission lines, characteristic impedance of a string and a transmission line, waves in an absorbing medium, spherical waves.

VI Reflection and Transmission: Reflection and transmission of transverse waves on a string at the discontinuity, Energy considerations of reflected and transmitted waves, Impedance matching, eigenfrequencies and eigenfunctions for stationary waves on a string. Normal modes in three dimensions, Planck's Law, Debye's T^3 Law, Conduction electrons in a metal, transmission of non-monochromatic waves, Bandwidth Theorem.

TUTORIALS : Relevant Problems on the topics covered in the course.

Books :

Text Book of Vibrations and Waves : S.P. Puri (Macmillan India) (2004)
The Physics of Vibrations and Waves : H.J. Pain (Wiley and ELBS, 1976)

PHYS 212H: QUANTUM MECHANICS AND STATISTICAL PHYSICS (40 hrs.)

Max. Marks: 75

Note:

1 The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.

2 The question paper is expected to contain problems with a weightage of 25 to 40%.

3 The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

I Mathematical Tools : Partial differentiation : Definition of partial derivative, total differentiation, exact and inexact differentials, useful theorems, the chain rule, change of variables, stationary values under constraints, Lagrange multipliers, differentiation of integrals.

II Origin of the Quantum Theory : Blackbody radiation, the photoelectric effect, the Franck-Hertz experiment, the correspondence principle, the Bohr atom, quantization of the phase integral, the particle in a box, the rigid rotator, the harmonic oscillator.

III Foundations of Wave Mechanics : Photons as particles: the Compton effect, particle diffraction, elements of Fourier Analysis, Parseval's formula and the Fourier integral theorem, examples of Fourier transforms, superposition of plane waves and time dependence, wavepackets and the Einstein-de Broglie relations, wave functions for a free particle and the Schrodinger equation, physical interpretation of the Schrodinger wave function.

IV Basic Ideas of Statistical Physics : Introduction, Basic ideas of probability and their applications, Macrostates and microstates, Effect of constraints on the system. Distribution of n particles in two compartments, deviation from the state of maximum probability, Equilibrium state of a dynamic system, distribution of N distinguishable particles in unequal compartments, Division into cells.

V Maxwell-Boltzmann Statistics : Phase space and its division into cells. Three kinds of statistics and their basic approach. Maxwell-Boltzmann Statistics for an ideal gas: Volume in phase space, values of α and β. Experimental verification and graphical depiction of Maxwell-Boltzmann distribution of molecular speeds.

VI Bose-Einstein and Fermi-Dirac Statistics : Need for quantum statistics, Bose-Einstein statistics and its application to photon gas, deductions from Planck's law, Fermi-Dirac statistics and its application to electron gas, Fermi energy, comparison of M.B., B.E. and F.D. statistics.

TUTORIALS : Relevant Problems given at the end of chapters in books 1 - 4.

Books

1. Mathematical Methods for Physics and Engineering : K.F. Riley, M.P. Hobson and S.J.Bence (Cambridge University Press) (1998).
2. Mathematical Methods in the Physical Sciences : M.L.Boas (Wiley) (2002)
3. Quantum Mechanics : J.L. Powell, B. Crasemann (Narosa Publishing House).
4. Statistical Physics, Thermodynamics and Kinetic Theory : V.S. Bhatia (Vishal Pub. Co., Jalandhar,) (2003).

PHYS 213H: ELECTRONICS AND NETWORK THEORY-I (40 hrs.)

Max. Marks: 75

Note:

1 The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.

2 The question paper is expected to contain problems with a weightage of 25 to 40%.

3 The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

Circuit Theory: Series and parallel addition of V-I characteristics, KCL and KVL, Mesh and Node analysis, Superposition theorem, Thevenin's and Norton's theorem, reciprocity theorem, Linear resistive 2-ports and interconnections, Z, Y, T, T', H and H' representations, T and π networks. **Semiconductor Materials and Diode Junctions:** Band diagram, Mobility and conductivity, generation and recombination of charges, Diffusion, Continuity equation Diode equation, V-I characteristics, temperature dependence, Transition and diffusion capacitance, Zener diode, Light emitting diode, various kinds of Transducers

Transistors : pnp and npn junction transistors, transistor current components, CB, CC and CE configurations, transfer characteristics, Transistor as switch and applications, Transistor biasing, fixed bias, emitter-stabilised biasing, Voltage-divider biasing, Junction FET, v-i Characteristics.

Waveshaping Circuits: Clipping and Clamping circuits, Diode and transistor clippers, Clamping circuits, Clamping circuit theorem.

Power Supplies : Characteristics, Rectifiers, Filter circuits, efficiency, Ripple factor, voltage multiplying circuits, Regulation, Shunt and Series regulators, Monolithic regulators (Introduction)

TUTORIALS: Relevant problems given at the end of chapters in the books.

Books

1. Pulse, Digital and Switching Waveforms : J. Millman and H. Taub (Tata Mcgraw Hill)
2. Integrated Electronics : J. Millman and C.C.Halkias(Tata Mcgraw Hill)
3. Linear and Non-linear Circuits : Chua, Desoer and Kuh.
4. Network lines and Fields : J.D. Ryder (Prentice Hall) (1988).
5. Electronic Devices and Circuits : A. Mottershead (Prentice Hall) (1977)

PHYS 214H PHYSICS LABORATORY (90 hrs.)

Max. Marks: 75

Note:

3. Examination time will be 4 hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
4. Seven to nine experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester.

1. To determine Cauchy's constants and resolving power of a given prism.
2. To find the refractive index of a given liquid using a prism spectrometer.
3. To determine the wavelength of sodium light using Newton's rings method.
4. To find the resolving power and magnification of a telescope.
5. To find the resolving power and magnification of a diffraction grating.
6. To study the variation of specific rotation of sugar solution with concentration.
7. Determination of mechanical equivalent of heat by Calendar and Barne's constant flow method.
8. To measure the thermal conductivity of a conductor.
9. To determine the value of Stefan's Constant.
10. To determine thermal conductivity of a bad conductor disc by Lees and Chorlton method.
11. To draw the characteristics of a given triode and to determine the tube parameters.
12. To determine energy gap of a given semiconductor.
13. Study of characteristics of a thermistor and thermocouple and to calibrate it for temperature measurements.
14. To measure low resistance by Kelvin's double bridge/ Carey Foster's bridge.
15. Forward and reverse characteristics of different diodes. Use of zener diode for voltage regulation.
16. To study ripple factor for a half-wave and a full-wave rectifier without and with different filters.
17. To study common emitter characteristics of a given transistor and to determine various parameters.
18. To study common base characteristics of a given transistor and to determine various parameters.
19. To study the induced emf as a function of the velocity of magnet and to study the phenomenon of electromagnetic damping.
20. To study the variation of magnetic field with distance along axis of a circular coil – realization of Helmholtz's coils.
21. To determine charge to mass ratio (e/m) of an electron by helical method using CRT.
22. Verification of laws of probability and radioactivity (mechanical analogue).
23. To find the first ionization potential of mercury.

Compulsory exercises on fabrication etc. utilizing workshop facility-Wood/Metal/Electronics (Students will submit the report on these exercises which are equivalent to one experiment).

SYLLABUS FOR B.Sc. (HONS. SCHOOL) IN PHYSICS FOURTH SEMESTER (MAJOR) FOR THE EXAMINATION 2010-11.

PHYS 221H : ELECTROMAGNETIC THEORY (40 hrs.)

Max. Marks: 75

Note:

1. The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

I Electromagnetic Waves: Maxwell's equations, wave equation, e.m. waves in a medium with finite ε and μ. Plane waves, Energy flux due to a plane e.m. wave, Wave-impedance of a medium to e.m. waves, e.m. waves in a conducting medium – skin depth and impedance of a conductor. Reflection and Transmission of e.m. waves at the boundary of two dielectric media - impedance and refractive index, e.m. theory of dispersion.

II Polarization: Polarization of plane harmonic waves, linear, circular and elliptical polarization, natural light, production of polarized light, Malus' law, polarization by scattering, Birefringence, quarter-wave and half-wave plates. Double refraction, Nicol prism, analysis of circularly and elliptically polarized light.

III Interference: Light vector, coherence, theory of interference. Young's double slit experiment, Fresnel's Biprism, displacement of fringes, fringes with white light, Stoke's law, interference in thin films, non-reflecting films, Newton's rings and applications, Michelson's interferometer—principle, theory and applications, Fabry-Perot interferometer and etalon, Interference filters.

IV Diffraction: Introduction: Helmholtz Kirchhoff's integral, scalar diffraction theory, Fraunhoffer diffraction: single slit, circular aperture, diffraction grating, Rayleigh's criterion for resolution, resolving power of a diffraction grating, a telescope and a microscope, Fresnel diffraction at a single slit and circular aperture, Cornu spiral, Fresnel's half period zones, zone plate. Explanation of rectilinear propagation.

TUTORIALS : Relevant Problems on the topics covered in the course.

Books :

Text Book of Vibrations and Waves : S.P. Puri (Macmillan India) (2004)
The Physics of Vibrations and Waves : H.J. Pain (Wiley and ELBS, 1976)
Optics : A.K. Ghatak (Tata-McGraw Hill, 1992)
Fundamentals of Optics : F.A. Jenkins and H.E. White (McGraw Hill, 1981)

PHYS 222H THERMODYNAMICS **(40 hrs.)**

Max. Marks: 75

Note:

1. The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

I Statistical Basis of Entropy : Definition of entropy, change of entropy of a system, third law of thermodynamics. Additive nature of entropy, law of increase of entropy, reversible and irreversible processes and their examples, work done in a reversible process, Increase of entropy in some natural processes, entropy and disorder.

II Entropy and Carnot's Engine : Review of terms used in thermodynamics and of Carnot's Heat Engine, Entropy changes in Carnot's cycle, Carnot's theorem, Thermodynamic temperature scale, Third law, Thermoelectric effect and its thermodynamical analysis, change of entropy along a reversible path in P-V diagram, entropy of a perfect gas, equation of state of an ideal gas, Heat death of Universe.

III Maxwell's Thermodynamic Relations : Perfect differentials in Thermodynamics, Maxwell Relationships, cooling produced by adiabatic expansion, adiabatic compression, adiabatic stretching of wires and thin films, change of internal energy with volume, C_p-C_v, variation of C_v with volume, Clapeyron's equation. Second-order phase transitions. Thermodynamic equilibrium of a heterogeneous system. Application of phase rule to systems with one or more components.

IV Production of Low Temperature : Joule-Thomson effect and its thermodynamic treatment, Joule-Thomson effect for a Vander Waal's gas, Production of very low temperatures by adiabatic demagnetization, Measurement of very low temperatures.

V Specific Heat of Gases : Specific Heats of monoatomic and diatomic gases, Energy due to rotation and its variation, quantization of rotational motion, contribution of rotational energy to specific heat, quantization of vibrational motion, contribution of vibrational energy to specific heat, specific heat of diatomic gases.

TUTORIALS : Relevant Problems given at the end of chapters in books 1 and 2.

Books

1. Statistical Physics, Thermodynamics and Kinetic Theory : V.S. Bhatia (Vishal Pub. Co., Jalandhar) (2003).
2. A Treatise on Heat : M.N. Saha and B.N. Srivastava (Indian Press, Allahabad, 1972).Thermal Physics : C. Kittel & H. Kroemer (CBS Pub.) (1987).
3. Thermal Physics : S.C. Garg, R.M.Bansal & C.K.Ghosh (Tata McGraw Hill) (2000).

PHYS 223H ELECTRONICS AND NETWORK THEORY-II (40 hrs.)

Max. Marks: 75

Note:

1. The question paper for the final examination will consist of 7 questions including one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all including compulsory question. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

Circuit Theory : Miller's theorem, Maximum Power Transfer Theorem, Series and parallel connection of mutually coupled coil, Equivalent circuit of transformer, Impedance transformer and power relationship.

Transistor Amplifiers and Oscillators:

Transistor hybrid model, Analysis of Transistor amplifier circuit using h-parameters, Comparison of transistor amplifier configurations, Simplified common-emitter hybrid model, Common emitter amplifier with an emitter resistance, Classification of amplifiers, distortion in amplifiers, RC-coupled amplifier, Feedback in amplifiers, different types, voltage gain, advantages, emitter follower as –ve feedback circuit, FET amplifier configurations, operational amplifier characteristics and applications.

Barkhausen criterion of sustained oscillations, LC oscillator, Hartley oscillator, RC oscillators, Phase-shift and Wein bridge oscillators.

Logic Circuits: Logic systems, Circuits for OR, AND, NOT gates, transistor switching times, Exclusive OR gate, De Morgan's laws.

Communication: Modulation and detection, AM, FM, Radio wave propagation, Radio transmitter and receiver, TV receiver, Pulse Modulation, Modem.

TUTORIALS: Relevant problems given at the end of chapters in the books.

Books

1. Pulse, Digital and Switching Waveforms : J. Millman and H. Taub (Tata Mcgraw Hill)
2. Integrated Electronics : J. Millman and C.C.Halkias(Tata Mcgraw Hill)
3. Linear and Non-linear Circuits : Chua, Desoer and Kuh.
4. Network lines and Fields : J.D. Ryder (Prentice Hall) (1988).
5. Electronic Devices and Circuits : A. Mottershead (Prentice Hall) (1977)

PHYS 224H PHYSICS LABORATORY (90 hrs.)

Max. Marks: 75

Note:

1. Examination time will be 4 hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Seven to nine experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester.

1. To determine Cauchy's constants and resolving power of a given prism.
2. To find the refractive index of a given liquid using a prism spectrometer.
3. To determine the wavelength of sodium light using Newton's rings method.
4. To find the resolving power and magnification of a telescope.
5. To find the resolving power and magnification of a diffraction grating.
6. To study the variation of specific rotation of sugar solution with concentration.
7. Determination of mechanical equivalent of heat by Calendar and Barne's constant flow method.
8. To measure the thermal conductivity of a conductor.
9. To determine the value of Stefan's Constant.
10. To determine thermal conductivity of a bad conductor disc by Lees and Chorlton method.
11. To draw the characteristics of a given triode and to determine the tube parameters.
12. To determine energy gap of a given semiconductor.
13. Study of characteristics of a thermistor and thermocouple and to calibrate it for temperature measurements.
14. To measure low resistance by Kelvin's double bridge/ Carey Foster's bridge.
15. Forward and reverse characteristics of different diodes. Use of zener diode for voltage regulation.
16. To study ripple factor for a half-wave and a full-wave rectifier without and with different filters.
17. To study common emitter characteristics of a given transistor and to determine various parameters.
18. To study common base characteristics of a given transistor and to determine various parameters.
19. To study the induced emf as a function of the velocity of magnet and to study the phenomenon of electromagnetic damping.
20. To study the variation of magnetic field with distance along axis of a circular coil – realization of Helmholtz's coils.
21. To determine charge to mass ratio (e/m) of an electron by helical method using CRT.
22. Verification of laws of probability and radioactivity (mechanical analogue).
23. To find the first ionization potential of mercury.

Compulsory exercises on fabrication etc. utilizing workshop facility-Wood/Metal/Electronics (Students will submit the report on these exercises which are equivalent to one experiment).

PHYSICS SYLLABUS FOR B.SC. (HONS. SCHOOL) THIRD SEMESTER SUBSIDIARY FOR STUDENTS OF CHEMISTRY,COMPUTER SCIENCE, GEOLOGY AND MATHEMETICS FOR THE EXAMINATION 2010-11.

PHYS 211S: ELECTRICITY, MAGNETISM AND ELECTRONICS (40 Hrs)

Max. Marks: 75

Note:

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have three questions each from the corresponding sections of the syllabi and section C will have one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

I. Vector Analysis : Review of vector algebra, vector differentiation, vector integration, Gauss's divergence and Stoke's theorems and their physical significance.

II. Electrostatics : Coulomb's law, superposition principle, field concept, scalar potential, Energy considerations, relation between field and potential, use of Gauss's law to calculate electric field, electric field due to a uniform line charge, surface charge, spherical shell of charge, the electric dipole.

III. Dielectrics : The polarization density, polarization charge density, $\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{P}$

IV. Current Electricity: Current as moving charge, The Biot-Savart law, some properties of **B**, Ampere's law, the magnetic dipole, the solenoid, magnetic vector and scalar potential, charged particle in magnetic field, charged particle in electric and magnetic fields, Faraday's law of electromagnetic induction, different mechanisms for change of flux, motional emf, mutual inductance, self inductance.

V. Magnetic field in material media : Types of magnetic substances, magnetization, $\mathbf{B} = \mu_o (\mathbf{M} + \mathbf{H})$, Boundary conditions on **B** and **H**, Hysteresis curve.

VI. Maxwell's Equations : Displacement current, Maxwell's equations, Poynting vector.

VII. Some Applications : Electrostatic deflection in a cathode ray tube, Cathode ray oscilloscope, G M Counter.

VIII. Conduction in semiconductors: Electrons and holes in an semiconductor, carrier concentration, donor and acceptor impurities, charge densities, Fermi level in semiconductors, diffusion, carrier lifetimes, continuity equation.

IX. Diode characteristics: qualitative theory of p-n junction, p-n diode, band structure of an open circuit diode, current components, quantitative theory of diode currents, V-I characteristics, transition capacitance, diffusion capacitance.

X. Transistor : Junction transistor, transistor current components, transistor as an amplifier, C B and C E configurations

XI. Low frequency transistor model : The port device and hybrid model, transistor hybrid model, transistor as amplifier using h- parameters, , comparison of transistor amplifier configurations.

XII. Applications : Half wave rectifier, ripple factor, full wave rectifier, inductor and capacitor filters, regulated power supply, oscillators (introduction only), photoconductivity, photodiode.

Books:

1. Electricity and Magnetism: A. S. Mahajan and A. A. Rangwala (Tata McGraw Hill, 1988)
2. Electronic devices and circuits: J. Millman and C.C. Halkias (Tata McGraw Hill, 1991)
3. Basic Electronics and Linear Circuits by N. N. Bhargave, D.C. Kulshreshtha and S. C. Gupta (Tata McGraw Hill, 1984)

PHYS 212S: PHYSICS LABORATORY

Max. Marks: 25

Note:

1. Examination time will be 3½ hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester.

List of experiments:

1. Verification of maximum power theorem.
2. Self-inductance by Anderson's bridge.
3. Capacitance of air capacitor and dielectric capacitor by de Sauty method.
4. To calibrate the wire of Carey Foster bridge and hence determine the resistance of two turns of a tangent galvanometer.
5. To study the concentration dependence of the resistance electrolyte
6. To study dependence of magnetic field in a solenoid on various parameters and hence to evaluate μ_0.
7. Study of common base transistor characteristics.
8. Study of common emitter transistor characteristics
9. To study the variation of the resistance of filament of bulb with its temperature
10. Determination of high resistance by substitution method.
11. Comparison of e.m.f. of two cells by Lumsden's method.
12. Study of C.R.O. as display and measuring device, Study of Sine-wave, square wave signals (half wave and full wave rectification)
13. Study of power supply, ripple factor - effect of filters.
14. Study of B-H curve of various materials using CRO.
15. Verification of Rutherford- Soddy nuclear decay formula - mechanical analogue.
16. To find half-life period of a given radio-active substance using GM counter
17. Determination of Planck's constant using photocell.
18. Study of Solar-Cell characteristics
19. Determination of ionization potential of mercury.
20. Verification of laws of electromagnetic induction.
21. To determine ECE of hydrogen
22. Determination of E_g in Si and Ge.
23. Determination of charge on an electron.
24. Study of Ge, Si, LED diode characteristics.
25. Study of vacuum triode characteristics.
26. Determination of velocity of ultrasonic waves in a given liquid

PHYSICS SYLLABUS FOR B.SC. (HONS. SCHOOL) FOURTH SEMESTER SUBSIDIARY FOR STUDENTS OF CHEMISTRY,COMPUTER SCIENCE, GEOLOGY AND MATHEMETICS FOR THE EXAMINATION 2010-11.

PHYS 221S: MODERN PHYSICS **(40 Hrs)**

Max. Marks: 75

Note:

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have three questions each from the corresponding sections of the syllabi and section C will have one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

I. Particle Properties of Waves : Quantum theory of light, X-rays and their diffraction, Compton effect, pair production. photons and gravity, black holes.

II. Wave Properties of Particles : de Broglie waves, waves of probability, the wave equation, phase and group velocities, particle diffraction, uncertainty principle and its applications.

III. Quantum Mechanics: Difference between classical and quantum mechanics, wave function and wave equations. Schrodingers equation, time dependent and steady state forms, Expectation values, particle in a box, reflection and transmission by a barrier, tunnel effect, harmonic oscillator.

IV Quantum Theory of Hydrogen Atom: Schrodinger's equation for the hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number, magnetic quantum number, electron probability density, radiative transitions, selection rules. Zeeman effect.

V. Many Electron Atoms: Electron spin, spin-orbit coupling, identical particles, exclusion principle, Symmetric and antisymmetric wave functions, electron configurations, total angular momentum, L.S. coupling, jj coupling, one electron spectra, two electron spectra, X-ray spectra.

VI. The Atomic Nucleus: Do nuclei contain electrons? The neutron, stable nuclei, nuclear sizes and shapes, binding energy, liquid drop model, shell model, meson theory of nuclear forces.

Radioactivity : Radioactive decay, Half-life, radioactive dating, radioactive series, alpha decay and its theory, beta decay, gamma-decay, radiation hazards and radiation units.

VIII. Nuclear Reactions : Reaction cross-section, neutron thermalization, nuclear reactions, c.m. system, nuclear fission, nuc1ear reactors, breeder reactors, nuclear fusion in stars, fusion reactors.

IX. Elementary Particles : Interaction of charged particles, gamma ray absorption, particle detection, leptons, hadrons, elementary particle quantum numbers, isospin, symmetries and conservation principles, Quarks, fundamental interactions. .

Book:

1. Concepts of Modem Physics: A Beiser (McGraw Hill, 1987).

PHYS 222S: PHYSICS LABORATORY

Max. Marks: 25

Note:

1. Examination time will be 3½ hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester.

List of experiments:

1. Verification of maximum power theorem.
2. Self-inductance by Anderson's bridge.
3. Capacitance of air capacitor and dielectric capacitor by de Sauty method.
4. To calibrate the wire of Carey Foster bridge and hence determine the resistance of two turns of a tangent galvanometer.
5. To study the concentration dependence of the resistance electrolyte
6. To study dependence of magnetic field in a solenoid on various parameters and hence to evaluate μ_0.
7. Study of common base transistor characteristics.
8. Study of common emitter transistor characteristics
9. To study the variation of the resistance of filament of bulb with its temperature
10. Determination of high resistance by substitution method.
11. Comparison of e.m.f. of two cells by Lumsden's method.
12. Study of C.R.O. as display and measuring device, Study of Sine-wave, square wave signals (half wave and full wave rectification)
13. Study of power supply, ripple factor - effect of filters.
14. Study of B-H curve of various materials using CRO.
15. Verification of Rutherford- Soddy nuclear decay formula - mechanical analogue.
16. To find half-life period of a given radio-active substance using GM counter
17. Determination of Planck's constant using photocell.
18. Study of Solar-Cell characteristics
19. Determination of ionization potential of mercury.
20. Verification of laws of electromagnetic induction.
21. To determine ECE of hydrogen
22. Determination of E_g in Si and Ge.
23. Determination of charge on an electron.
24. Study of Ge, Si, LED diode characteristics.
25. Study of vacuum triode characteristics.
26. Determination of velocity of ultrasonic waves in a given liquid

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR B. Sc. (HONS SCHOOL) IN PHYSICS – THIRD YEAR (ANNUAL SYSTEM) EXAMINATION 2010-11.

B.Sc. (H. S.) THIRD YEA		*MARKS*	*CREDITS*
PHYS 301H	Quantum Mechanics and Mathematical Physics	150	6
PHYS 302H	Laser Physics and Atomic-Molecular Physics	150	6
PHYS 303H	Condensed Matter Physics and Materials science	150	6
PHYS 304H	Nuclear Physics and Particle Physics	150	6
PHYS 305H	Physics of Vacuum, Low Temperature and Resonance Techniques	150	6
PHYS 306H	Physics Laboratory-I	125	5
PHYS 307H	Physics Laboratory-II	125	5

SYLLABUS FOR B.Sc. (HONS. SCHOOL) IN PHYSICS THIRD YEAR (MAJOR) FOR EXAMINATION 2010-11.

PHYS 301H QUANTUM MECHANICS AND MATHEMATICAL PHYSICS

(92+32=124 hrs.)
Max. Marks: 30+120=150

Note:

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have four questions each from the corresponding sections of the syllabus and section C will have one compulsory question consisting of 7 to 10 parts covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 24.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION-A

I Wavepackets and the uncertaintly principle: Uncertainty of position and momentum, exact statement and proof, Energy time uncertainty, Gaussian wave-packet and its spread with time, General solution for time dependence of ψ, causality.
(3.1-3.4, 3.6-3.8 of Book 1).

II The Schrodinger Equation: Interaction among particles, Analogy between optics and mechanics, Superposition principle, Probability current, Motion of wave packets, Ehrenfest's Theorem.
(4.1, 4.3-4.6 of Book 1).

III Problems in one dimension: Potential step, potential barrier, Rectangular potential well, Degeneracy, Linear independence, Sturm's theorem, Bound states, Orthogonality, Linear Harmonic oscillator, Oscillator wave function, Parity.
(5.1-5.9, 5.11, 5.12 of Book 1)

IV Operators and Eigenfunctions: Linear operators, Operator formalism in quantum mechanics, orthogonal systems, expansion in eigenfunctions, Hermitian operators, commutation rule and uncertainty principle, Equation of motion, Parity operator.
(6.1-6.12 of Book 1).

XI Spherically Symmetric System: Series solutions for Hermite, Lagguerre and associated Lagguerre equations, Schrodinger equation for spherically symmetric potentials, Spherical harmonics, Degeneracy, Angular momentum, Eigenvalves of L_z and L^2. Three dimensional harmonic oscillator, Hydrogen atom.
(8.5 of Book 5; 7.1-7.4, 7.6, 7.7 of Book 1)

SECTION-B

I Determinants and Matrices: Determinants for linear algebraic equations, Laplace development, Cramer's rule, antisymmetry, Gauss elimination. Matrices, basic definitions and

operations, orthogonal matrices, Hermitian matrices, unitary matrices, diagonalization of matrices, normal matrices.
(Ch. 3 of Book 5; Ch. 3 of Book 6)

II Differential Equations: Review of differential equations, self-adjoint differential equations, eigenfunctions, eigenvalues, boundary conditions, Hermitian operators and their properties.
(8.5, 9.1 & 9.2 of Book 5)

III Statistics and Probability: Statistical distributions, second moments and standard deviations, definition of probability, fundamental laws of probability, discrete probability distributions, combinations and permutations, continuous distributions; expectation, moments and standard deviation; Binomial, Poisson and Gaussian distributions, applications to experimental measurement.
(Ch. 16 of Book 7, Ch. 24 of Book 8)

IV Multiple Integrals: Double and triple integrals, application of multiple integrals, change of variables in integrals, general properties of Jacobians, surface and volume integrals.
(Ch. 5 of Book 6, Ch. 5 of Book 8)

V Infinite Series: Fundamental concepts, convergence tests, alternating series, algebra of series, power series, Taylor series.
(Ch. 5 of Book 5, Ch. 3 of Book 8)

TUTORIALS: Relevant Problems given at the end of chapters in books 1, 5 – 8.

Books:

1. Quantum Mechanics: J.L. Powell and B. Crasemann (Narosa, 1995)
2. Quantum Mechanics: E. Merzbacher (Wiley, 1970)
3. .Quantum Physics: S. Gasiorowicz (Wiley, 2000)
4. Quantum Mechanics : F. Schwabl (Narosa, 1995)
5. Mathematical Methods for Physicists : G.B. Arfken & H.J.Weber (Academic Press, 1995)
6. Mathematical Methods in the Physical Sciences : M.L. Boas (Wiley, 2002)
7. Applied Mathematics for Engineers and Physicists : L.A. Pipes & L.R.Harvill (McGraw-Hill, 1971)
8. Mathematical Methods for Physics and Engineering : K.F. Riley, M.P. Hobson and S.J. Bence (Cambridge University Press, 1998)

PHYS 302H LASER PHYSICS AND ATOMIC-MOLECULAR PHYSICS

(92+32=124 hrs.)
Max. Marks: 30+120=150

Note:

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have four questions each from the corresponding sections of the syllabus and section C will have one compulsory question consisting of 7 to 10 parts covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 24.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION-A

I **Introduction:** Introduction, Directionality, Monochromaticity, Temporal and spatial coherence, Einstein's coefficients, momentum transfer, possibility of light amplification, kinetics of optical absorption, shape and width of spectral lines, line broadening mechanism, natural, collision and Doppler broadening.

II **Laser Pumping and Resonators:** Resonators, modes of a resonator, number of modes per unit volume, open resonators, confocal resonator (qualitative), quality factor, losses inside the cavity, threshold condition, quantum yield.

III **Dynamics of the Laser Processes:** Rate equations for two, three and four level systems, **p**roduction of a giant pulse – Q switching, giant pulse dynamics, Laser amplifiers, mode-locking, hole burning, distributed feedback lasers.

IV **Types of Lasers:** He-Ne laser, Nitrogen Laser, CO_2 laser, Ruby laser, features of semiconductor lasers, intrinsic semiconductor lasers, doped semiconductors, condition for laser action, Advances in semiconductor lasers, injection lasers and their threshold current, dye lasers.

V **Applications:** Holography, Non-linear optics: harmonic generation, second harmonic generation,phase matching and optical mixing, Brief qualitative description of some experiments of fundamental importance.

SECTION-B

I **Hydrogen and Hydrogen-like ions:** Series in hydrogen, circular motion, nuclear mass effect, elliptical orbits, energy levels, quantum numbers and angular momenta. Fine structure: basic facts and Sommerfeld theory, electron spin and spin-orbit coupling, elativistic correction and Lamb shift (qualitative).

II **Alkali-like Spectra:** General features, quantitative relations, doublet structure, Larmor's heorem and magnetic levels, elementary theory of weak and strong magnetic fields, eeman effect in Doublet spectra: anomalous Zeeman effect and the anomalous g-value.

III **Pauli's principle and shell structure:** Systems with several electrons and spin unctions.

IV **Complex Spectra:** LS-Coupling Scheme, Normal triplets, basic assumptions of the theory, dentification of terms, selection rules, jj- coupling (Qualitative).

V **Infrared and Raman Spectra:** Rigid rotator, energy levels, spectrum (no derivation of selection rules), Harmonic oscillator: energy levels eigenfunctions, spectrum, comparison with observed spectrum, Raman effect, Quantum theory of Raman effect, Rotational and Vibrational Raman spectrum. Anharmonic oscillator: energy levels, eignenfunctions, Infrared and Raman Spectrum, Vibrational frequency and force constants. Non-rigid rotator: energy levels, spectrum, Vibrating-rotator energy levels, Infrared and Raman spectrum (no derivation of e,e and Dunham coefficients), Symmetry properties of rotational levels, influence of nuclear spin .

VI **Electronic Spectra:** Electronic energy and potential curves, resolution of total energy, Vibrational Structure of Electronic transitions. General formulae, Deslandre's table, absorption sequences (qualitative) and Vibrational analysis, Rotational Structure of Electronic bands: General relations, branches of a band, band-head formation, Intensity distribution in a vibrational band system. Franck-Condon Principle and its wave mechanical formulation. Classification of electronic states: Orbital angular momentum, Spin, total angular momentum of electrons, Symmetry properties of electronic eigen-functions.

TUTORIALS: Problems pertaining to the topics covered in the course.

Books:

1. Lasers and Non-linear Optics: B.B. Laud. (Wiley Eastern).
2. Principles of Lasers: O. Svelto (Plenum Press).
3. An Introduction to Lasers and their applications: D.C.O'Shea, W. Russell and W.T. Rhodes (Addition – Wesley).
4. Laser Theory and Applications : Thyagarajan and A. Ghatak (MacMillan)
5. Atomic Spectra: H Kuhn (Academic Press)
6. Molecular Spectra and Molecular Structure I: G. Herzberg (Van-Nostrand Rein-hold, 1950)
7. Atomic Spectra: H.E. White(McGraw Hill).

PHYS 303H CONDENSED MATTER PHYSICS AND MATERIAL SCIENCE

(92+32=124 hrs.)
Max. Marks: 30+120=150

Note:

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have four questions each from the corresponding sections of the syllabus and section C will have one compulsory question consisting of 7 to 10 parts covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 24.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION-A

I **Solids and Crystal Structure** : General definitions of Lattice, basis and primitive cell, Symmetry operations, Bravais lattices in two and three dimensions, Index system for crystal planes, resume of common lattice types (sc, fcc, bcc, hcp, diamond, NaCl, CsCl & Zns structures), fcc & hcp structures as stacking*, Structures of insulators and metals*, radius ratio rules and Pauling's principles*
(Book1; * from Book 2)

II **Reciprocal Lattice and X-ray Diffraction** : Reciprocal Lattice, *Miller indices*, Brillouin one of sc, fcc and bcc lattices, Experimental diffraction methods, Bragg diffraction, cattered wave amplitude: atomic form factor, structure factor of simple structures (sc, fcc, cc, hcp, diamond, NaCl, CsCl & Zns), Neutron and electron diffraction methods, emperature dependence of reflection lines.
(Book 1)

III **Crystal Binding** : Cohesive energy and bulk modulus in inert gas and ionic crystal, inding in metallic, covalent and H-bonded crystals (basic ideas only).
(Book1)

IV **Lattice Vibrations** : Dynamics of monatoic and diatomic linear chains, optical and acoustic modes, concept of phonons, inelastic scattering of photons and neutrons by phonons, density of states (one & three dimensions) Einstein and Debye models of heat capacity, thermal expansion.
(Book 1)

V **Free Electron Fermi Gas** : Review of statistical mechanics of Fermi Gas of non-interacting electrons, heat capacity of electron gas, electrical conductivity, Ohm's Law, Hall effect, thermal conductivity and Pauli Paramagnetism.
(Book 1)

VI **Band Theory** : Bloch functions, Kronig-Penney model, Qualitative ideas of bands in metals, semi-metals, semiconductors and insulators, Fermi surface-basic idea with square lattice as an example.
(Books 1 and 6)

SECTION-B

VII **Internal Structure of Materials:** Atomic basis of structure – ionic bonding, Covalent bonding, Metallic bonding, Secondary bonding. Crystalline and non-crystalline states, Crystal symmetry, Metal Structures, Ionic and Covalent Structures, *Silica and silicates*, Polymers, Fullerenes, Experimental methods for *structural determination:* x-ray and *neutron* diffraction.

VIII **Crystal Imperfections:** Point, line, surface and volume imperfections, dislocations and t heir geometry, Disorder in polymers and non-crystalline materials.

IX **Phase Diagrams:** Phase rule, Single component systems, Binary phase diagrams, *Lever rule*, phases in polymers, non-crystalline and crystalline phases. Non-equilibrium in phase diagrams, Cu-Zn system, Fe- C alloys, Ceramic Systems, Other applications of phase diagrams.

X **Phase Transformations:** Time scale for phase changes, Nucleation kinetics, Growth of nuclei and solidification of alloys, Transformations in steel, Precipitation processes, Glass Transition; Recovery, recrystallization and grain growth.

XI **Elastic Properties:** Elastic behaviour and its atomic model, Rubber like elasticity, Anelastic behaviour, Relaxation processes, Viscoelastic behaviour, spring dash pot model, Plastic deformation.

XII **Fracture:** Ductile fracture, Brittle fracture, Fracture toughness, Ductile-brittle transition, Protection against fracture, Fatigue fracture.

TUTORIALS: Relevant problems on the topics covered in the course.

Books:

1. Introduction to Solid State Physics : C. Kittel (Wiley, VII ed.)
2. Introduction to Solids : L.V. Azaroff (Tata McGraw Hill)
3. Solid State Physics : A.J. Dekker (Prentice-Hall)
4. Essentials of Materials Science: A.G. Guy (McGraw Hill)
5. Materials Science and Engineering: V. Raghvan (Prentice Hall)
6. Elements of Materials Science and Engineering: L.H. Van Vlack (Addison-Wesley).

PHYS 304H NUCLEAR PHYSICS AND PARTICLE PHYSICS

(92+32=124 hrs.)
Max. Marks: 30+120=150

Note:

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have four questions each from the corresponding sections of the syllabus and section C will have one compulsory question consisting of 7 to 10 parts covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 24.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION-A

I Nuclear properties : Constituents of nucleus, non-existence of electrons in nucleus, Nuclear mass and binding energy, features of binding energy versus mass number curve, nuclear radius, angular momentum and parity, qualitative discussion of two-body nuclear forces, nuclear moments, magnetic dipole moment and electric quadrupole moment.

II Radioactive decays : Modes of decay of radioactive nuclides and decay Laws, chart of nuclides and domain of instabilities, Radioactive dating, constituents of Cosmic rays.
Beta decays : β^- , β^+ and electron capture decays, allowed and forbidden transitions (selection rules), parity violation in β-decay.
Alpha decay : Stability of heavy nuclei against break up, Geiger-Nuttal law, barrier penetration as applied to alpha decay, reduced widths, deducing nuclear energy levels.
Gamma transitions : Excited levels, isomeric levels, gamma transitions, multipole moments, selection rules, transition probabilities, internal conversion (IC), determination of multipolrity from $\gamma\gamma$-correlation and IC measurements.

III Nuclear reactions : Types of nuclear reactions, reactions cross section, conservation laws, Kinematics of nuclear reaction, Q-value and its physical significance, compound nucleus.

IV Nuclear Models : Liquid drop model, semi-empirical mass formula, condition of stability, Fermi gas model,, evidence for nuclear magic numbers, Shell model, energy level scheme, angular momenta of nuclear ground states.

SECTION-B

V Interaction of radiation and charged particles with matter : Energy loss of electrons and positrons, Positron annihilation in condensed media, Stopping power and range of heavier charged particles, derivation of Bethe-Bloch formula, interaction of gamma rays with matter.

VI Nuclear radiation detection : Gas-filled detectors, proportional and Geiger-Muller counters, Scintillation detectors, solid-state detectors, Cherenkov effect, calorimeter-electromagnetic and hadron, specialized detectors, solid state nuclear track detectors, bubble chambers, nuclear emulsions.

VII Accelerators : Accelerators, linear accelerators, cyclic accelerators, ion sources, focussing, stability, electron synchrotron, colliding beam machines, particle beams for fixed target experiments, CERN Super Proton Synchrotron (SPS) and Fermilab Tevatron.

VIII Elementary Particles : Historical introduction, fermions and bosons, particles and antiparticles, Classification of particles, types of interactions, electromagnetic, weak, strong interactions, gravitational interactions, Quantum numbers and conservation laws, isospin, charge conjugation, Yukawa theory, Introduction to quarks and qualitative discussion of the quark model, high energy physics units.

IX Particle Propertis and their reactions: Properties and life time of muon, pions: Determination of mass, spin and parity. Lifetime of neutral pion and isotopic spin. Strange particles: V particles, charged K-mesons, mass and life time for charged K- mesons. Observations of different strange particles (Λ°, Σ°, $\Sigma^\pm$, Ξ°, $\Xi^{+,}$ Ω), strange particle production and decay. Strangeness and Hypercharge.

TUTORIALS: Relevant problems on the topics covered in the course.

Books:

1. Basic ideas and Concepts in Nuclear Physics by K. Hyde
2. Introduction to Nuclear Physics : H.A. Enge
3. Nuclear Physics : I. Kaplan (Addison Wesley)
4. Nuclei and Particles by E. Segre
5. Introduction to High energy Physics by D.H. Perkins
6. Elementary Particles by I.S. Hughes.

PHYS 305H PHYSICS OF VACUUM, LOW TEMPERATURE AND RESONANCE TECHNIQUES

(92+32=124 hrs.)
Max. Marks: 30+120=150

Note:

1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have four questions each from the corresponding sections of the syllabus and section C will have one compulsory question consisting of 7 to 10 parts covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt **five** questions in all, selecting **two** questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 24.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION-A

I **Basics of Vacuum Techniques:** Introduction, classification of vacuum ranges, throughput, Pump speed, speed of exhaust, conductance, ultimate pressure, viscous flow, molecular flow.

II **Production of Low Pressures:** Pump types, Gaede oil-sealed rotating vane pump, Diffusion pump, sputter-ion pumps, Gettering, types of getters, Cryogenic pumps.

III **Measurement of Low Pressures:** Types of gauges, Mcleod gauge, Pirani gauge, Measurement of ultra-high vacuum.

IV **Methodology of Vacuum systems:** Materials for vacuum system, cleaning and sealing of vacuum system, Leak detection and its location.

V **Production and Measurement of Low Temperatures:** Adiabatic throttling of gases, liquefaction of H_2 and He, Solidification of He. Liquid He II, Thermodynamics of λ-transition, Adiabatic demagnetization, Temperatures below 0.01K, Low temperature thermometry.

VI **Some Systems at Low Temperatures:** Low temperature technique, Use of liquid air and other liquified gases, Superfluidity in He II, Bose-Einstein Condensation in atomic clouds. Trapping and cooling of atoms, Superconductivity.

SECTION-B

I **Hyperfine Interactions**: Electrostatic hyperfine interaction, Monopole and quadrupole interactions. Magnetic hyperfine interaction, Origin of magnetic hyperfine flux density, Combined electric and magnetic hyperfine interactions.

II **Mossbauer Spectroscopy:** Spectral line-shape of γ-rays, Recoilless emission of γ-rays, Resonance fluorescence and nuclear gamma resonance, Mossbauer spectrum – Isomer shift, Quadrupole splitting, Magnetic hyperfine structure, Combined electric and magnetic hyperfine splitting, line intensity, line width. Mossbauer spectrometer, Applications.

III **Electron Spin Resonance:** Basic resonance condition, absorption of electromagnetic energy and relaxation, ESR spectrometer, Spin Hamiltonian, Hyperfine structure, The ESR spectrum – line position, line intensity, line width. Applications.

IV **Nuclear Magnetic Resonance:** Quantum mechanical description of NMR; The Bloch equation and its solutions – free precession; steady state in weak r.f. field, in-phase and out-of-phase susceptibilities, power absorption; Saturation effects at high radio-frequency power; intense r.f. pulses. Fourier Transform NMR. The NMR spectrum – Chemical shift, spin-spin coupling. NMR spectrometer. Applications.

V **Other Resonance Phenomena:** Nuclear quadrupole resonance and its applications, Ferromagnetic resonance – shape effects and applications.

TUTORIALS: Relevant problems on the topics covered in the course.

Books

1 Vacuum Technology: A. Roth (North Holland)

2 Handbook of High Vacuum Techniques: H.A. Steinherz (Reinhold Pub.)

3 A Treatise on Heat: M.N. Saha and B.N. Srivastava (Indian Press)

4 Low Temperature Physics: C. Dewitt, B. Dreyfus and P.G. de Gennes (Gordon & Breach)

5 Bose-Einstein Condensation in Dilute Gases: C.J. Pethick and H. Smith (Cambridge Univ. Press).

6. Spectroscopy (Vol. I) eds.: B.P. Straughan and S. Walker (Chapman & Hall).

7. Hyperfine Interactions: A.J. Freeman and R.B. Frankel (Academic Press).

8. Chemical Applications of Mossbauer Spectroscopy: V.I. Goldanskii and R.H. Herber (Academic Press).

9. Principles of Magnetic Resonance: C.P. Slichter (Springer – Verlag).

10. Introduction to Solid State Physics: C. Kittel (John Wiley).

PHYS 306H Physics Laboratory-I
PHYS 307H Physics Laboratory-II

270 hours for each
Max. Marks: 125 each

Note 1. Examination time will be 4 hours for each course.
2 . The students are expected to perform at least 20 experiments for the two papers.

1. Design of constant current supply. This is a compulsory exercise for all students.
2. To study the dependence of energy transfer on the mass ratio of the colliding bodies, using air track.
3. To verify the law of conservation of linear momentum in collision with initial momentum zero, using air track.
4. To measure the coupling factor between two pendulums and study its dependence on coupling mass and distance of coupling threads from the axes of oscillation.
5. To study the dependence of frequency of normal modes and their difference in a coupled oscillator on coupling mass.
6. To study the given L.C.R. circuit and find its Q factor for different resistances.
7. To study the characteristics of given voltage doubler and tripler.
8. To study the clipping and clamping circuits.
9. To study the frequency response of given RC coupled transistor amplifier and determine its band width.
10. To determine the distributed capacity of given inductance coil.
11. To determine the given capacitance using flashing and quenching of a neon bulb.
12. To determine the operating plateau and dead time of a given G.M. Counter.
13. To measure magnetic susceptibility of $FeCl_2$ solution by Quincke's method.
14. To find conductivity of given semiconductor crystal using four probe method.
15. To study the characteristics of silicon and GaAs solar cells.
16. To study astable multivibrator.
17. Study of excitations of a given atom by Franck Hertz set up.
18. To study attenuation coefficient of an optical fibre.
19. To study intensity response of a photo resistor.
20. To study cooling curve of a binary alloy.
21. To determine the velocity of ultrasonic waves in liquids, using diffraction of light method.

22. To study the amplitude modulation.
23. To study high energy interactions in nuclear emulsion. Energy of a star.
24. Random sampling of an alternating current source, simulation and probilistic observations.
25. To study the characteristics of LED and photodiode.
26. To study of magneto-resistance of a given sample.
27. Determination of dissociation limit of iodine molecule by constant deviation spectrograph
28. Study of emission spectrum of given samples (Fe, Cu etc).
29. To determine the Hall coefficient and mobility of given semiconductors.
30. To determine the heat capacity of given materials
31. Characteristics of UJT and its application as a relaxation oscillator.