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THE UNIVERSITY OF AZAD JAMMU AND KASHMIR

Syllabus for BSc (Part-wise)

Physics

Item No. 31: Revesion of Curriculum of Physics for two year B.Sc. programme

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Keeping in view that the curriculum would improve the quality of education, the existing curriculum of Bs.c. two year programme is revised. Few essential steps are taken to eliminate the partial coverage of course by the students. This may includes the adoption of annual mode of examination and revised pattern of question papers. The approval may please be granted.

1. Revised Scheme of Study

Existing		
Paper	Title	Marks
A	Mechanics, Wave & Oscillation and optics	50
B	Thermodynamics and Kinetic theory of gases, Electricity & Magnetism	50
C	Electronics, SolidState Physics & Modern Physics	50
Practical		
A	Mechanics, optics and Electricity & Magnetism	25
B	Electronics & Modern Physics	25
Grand Total		200

Revised		
B.Sc. Part-I		
Paper	Title	Marks
A	Vector Analysis, Mechanics and Theory of Relativity	40
B	Wave and Oscillation, Heat and Thermodynamics	40
Practical (B.Sc. Part-I)		
P- A	Mechanics	10
P - B	Sound, Optics, and Heat & Thermodynamic	10
B.Sc. Part-II		
C	Electricity and Magnetism	40
D	Electronics and Modern Physics	40
Practical		
P - C	Electricity and Magnetism	10
P - D	Electronics & Modern Physics	10
Grand Total		200

2. DETAIL OF COURSES

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PAPER-A: VECTOR ANALYSIS, MECHANICS, AND THEORY OF RELATIVITY

40 Marks

(To Be covered in about 70 lectures)

1. **Vector Analysis**:

   Review of Vector in dimensions and Op0erations; Direction; Cosines; Spherical polar coordinates; Vector and Scalar triple product, gradient of scalar, Divergence and curl of a vector field, curl and line integral (metal relation). Vector identities, Divergence Theorem, Stokes Theorem, Derivation, Physical importance and applications to specific cases, converting from differential to integral forms.

2. **Particle Dynamics:**

   Dynamics of Uniform, circular motion the banked curve. Equations of motion, Deriving kinematic equations x(v), V(t) using integrations, Constant and variable forces and special examples, Time dependent forces, Obtaining x(t), v(t) for this case using integration method, Effect of drag force son motion, Applying Newton's Laws to obtain V(t) for the case of motion with time dependent(integration approach) drag (viscous) forces, Terminal velocity, Projectile motion with and without air resistance, Non inertial frames and Pseudo forces, Qualitative discussion to develop understanding, Calculation of pseudo forces for simple cases (linearly accelerated reference frame), Centrifugal force as an example of pseudo force, Coriolis force.

3. **Work, Power and Energy:**

   Work done by constant force, Work done by variable force(1-2 dimension). (Essentially a review of grade-XII concepts use of integration technique to calculate work done (e.g. in vibration of a spring obeying Hooks Law), Obtaining general expression force(2-dimensional case) and applying to simple cases e.g. pulling a mass at the end of a fixed string against gravity, Qualitative Review of work energy theorem, Derivation using integral calculus, Basic formula; and applications. Power, Energy changes with respect to observers in different inertial frames, Conservation of Energy in 1,2 and 3 dimensional Conservative systems, Conservative and non Conservative forces, Conservation of energy in a system of particles, Law of conservation of total energy of an isolated system.

4. **Systems Of Particles:**

   Two particle systems and generalization too many particle systems, Centre of mass, its position velocity and equation of motion. Centre of mass of solid objects, Calculation of centre of mass of solid objects using integral calculus, Calculating C.M. of, Uniform Road, Cylinder and Sphere
   Momentum Changes in system of variable mass, Derivation of basic equation, Application to motion of a rocket (determination of its mass as a function of time).

5. **Collisions:**

   Elastic Collisions, Conservation of momentum during Collision
   - One dimensions. (Concept)
   - Two dimensions (Oblique Collisions)
   - (Mathematical treatment)

   Inelastic collision, Collisions in centre of mass reference frame, One and two dimensions, Simple applications, obtaining, Velocities in c.m. frame.

6. **Rotational Dynamics**:

   Relationships between linear & angular variables, scalar and vector form, Kinetic energy of rotation, Moment of Inertia, Parallel axis theorem, Perpendicular axis theorem Prove and illustrate Apply to simple cases, Determination of moment of inertia of various shapes i.e. disc, bar and solid sphere, Rotational dynamics of rigid bodies, Equations of rotational motion and effects of applications of torques, Combined translation and translational motion, Rolling without slipping.

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7. **Angular Momentum**

   Angular velocity, Conservation of angular momentum, Effects of torques and its relation with angular momentum, Stability of spinning objects, Discussion with examples,The spinning Top, Effects of torque on the angular momentum, processional motion.

8. **Gravitation:**

   Gravitational effect of spherical mass distribution, Mathematical treatment, Gravitational Potential Energy, Develop using integration techniques, Calculation escape velocity, Gravitational field & Potential, Universal Gravitational Law, Radial and transversal velocity and acceleration, Motion of Planets and Keplers' Laws. (Derivation & explanation) Motion of Satellites, Energy considerations in planetary and satellite motion, Qualitative discussion on application of gravitational law to the Galaxy.

9. **Bulk Properties of Matters**:

   Elastic Properties of Matter, Physical basis of elasticity, Tension, Compression & shearing, Elastic Modulus, Elastic limit, Poisson's ratio, Relation between three types of elasticity, Fluid Statics, Variation of Pressure in fluid at rest and with height in the atmosphere, Surface Tension, Physical basis, role in formation of drops and bubbles, Viscosity, Physical basis, obtaining the Coefficient of viscosity, Practical example of viscosity, fluid flow through a cylindrical pipe(Poisenille's law).

10. **Special Theory of Relativity:**

    Inertial and non Inertial frame, Postulates of Relativity, The Lorenz Transformation, Derivation, Assumptions on which inverse transformation derived, Consequences of Lorentz transformation, Relativity of time, Relativity of length, Relativity of mass, Transfer mission of velocity, variation of mass with velocity, mass energy relation and its importance, relativistic momentum and Relativistic energy, (Lorentz invariants) $E2 = c2p2 + m2\ c4$

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PAPER-B: WAVE & OSCILLATIONS, THERMODYNAMICS AND STATISTICAL MECHANICS 40 Marks

(To be covered in 70 lectures)

1. **Harmonic Oscillations:**
   Simple Harmonic Oscillation (SHM), Obtaining and solving the basic equations of motion x(t), v(t), a(t), Longitudinal and transverse Oscillations, Energy considerations in S.H.M. Application of SHM. Tensional Oscillator, Phy6sical pendulum, simple pendulum, SHM and uniform circular motion, combinations of Harmonic motions, Lissaajous patterns, Damped Harmonic Motion, Equation of damped harmonic motion, Quality factor, discussion of its solution, Forced Oscillations and resonances, Equation of forced oscillation, discussion of its solution, Examples of resonance.
2. **Waves in Physical Media:**
   Mechanical waves, Traveling waves, Phase velocity of traveling waves, Sinusoidal waves, Group speed and dispersion, Waves speed, Mechanical analysis, Transfer wave equation, Discussion of solution. Power and intensity in wave motion, Derivation & discussion, Principle of superposition (basic ideas), Interference of wave, standing waves, Phase changes on reflection, Natural frequency, resonance,
3. **Sound:**
   Beats Phenomenon, Analytical treatment,
4. **Light:**
   Nature of light visible light (physical characteristics), Light as and Electro-magnetic wave, Speed of light in matter, Physical aspects, Path difference, Phase difference etc.
5. **Interference:**
   Coherence of sources, double slit interference, Analytical treatment, Adding of Electromagnetic waves using pharos, Interference from thin films, Newton's rings (analytical treatment). Febry-perot, Interferometer, Working and analytical treatment, Fresnels Biprism and its use.
6. **Diffraction:**
   Diffraction at single slit, Intensity in single slit diffraction using phasor treatment and analytical treatment using addition of waves, Double slit interference & diffraction combined, Diffraction at circular aperture, Diffraction from multiple slits, Discussion to include width of the maxima, Diffraction grating, Discussion, Use in spectrographs, Dispersion and resolving power of gratings, Introduction to Holography.
7. **Polarization:**
   Basic definition, Production of polarization by polarizing sheets, by reflection, by double refraction and double scattering, Description of polarization states, Linear, Circular, Elliptic polarization, Specific rotation of plane of Polarization, Use of Polarimeter.
8. **Statstical Mechanics:**
   Statistical Distribution and Mean values, Mean free path and microscopic calculations of mean free path, Distribution of Molecular speeds, Distribution of energies, Maxwell distribution, Maxwell-Boltzmann energy distribution, Internal energy of an ideal gas, Brownian motion, Qualitative description, Diffusion, Conduction and Viscosity.
9. **Heat and Temperature:**
   Temperature, Kinetic Theory of the ideal gas, Work done an and ideal gas, Review of pervious concepts, Internal energy of an ideal gas, To include the Equipartition of energy, Intermolecular forces, Qualitative discussion, Van der Waals equation of state.
10. **Thermodynamics:**
    Review of previous concepts, First law of Thermodynamics, and its applications to adiabatic, Isothermal, Cyclic and free expansion, Reversible and irreversible processes, Second Law of thermodynamics, Carnot theorem, Carnot engines, Heat engine, Refrigerators, Calculation of efficiency of heat engines, Thermodynamic temperature scale, Absolute zero, Entropy, Entropy in reversible process Entropy in irreversible process, Entropy & Second Law, Entropy & probability , Thermodynamic functions, Thermodynamic functions(Internal energy, Enthalphy, Gibb's functions, Entropy, Helmholtz functions), Maxwell's relations, Tds equations, Energy equations and their applications. Low Temperature Physics, Liquidation of gases, Joule-Thomson effect and its equations. Thermoelectricity, Thermocouple, Seabeck's effect, Peltier's effect, Thomson effect.

PAPER-C: ELECTRICITY AND MAGNETISM 40 Marks

(To be covered in 70 lectures)

1. **Electric Field:**
   Field due to a point charge; due to several point charges, Electric dipole. Electric field of continuous charge distribution e.g. Ring of charge; disc of charge; infinite line of charge. Point charge in an electric field. Dipole in an electric field; Torque on, and energy of, a dipole in uniform field. Electric flux; Gauss's law; (integral and differential forms) and its application. (Integral forms). Charged isolated conductors; conductor with a cavity, field near a charged conducting sheet. Field of infinite line of charge; Field of infinite sheet of charge. Field of spherical shell. Field of spherical shell. Field of spherical charge distribution.
2. **Electric Potential:**
   Potential due to point charge. Potential due to collection of point charges. Potential due to dipole, electric potential of continuous charge distribution. Poisson's and Laplace equation without solution. Field as the gradient or derivative of potential, Potential and field inside and outside an isolated conductor.
3. **Capacitors and dielectrics:**
   Capacitance; calculating the electric field in a capacitor. Capacitors of various shapes, cylindrical, spherical etc. and calculation of their capacitance. Energy stored in and electric field. Energy per unit volume, capacitor with dielectric; Electric field of dielectric; An atomic view, Application of Gauss' Law to capacitor with dielectric.
4. **D C Circuits:**
   Electric Current, current density J, resistance, receptivity, and conductivity, Ohm's Law, energy transfer in and electric circuit. Equation of continuity. Calculating the current in a single loop, multiple loops, Voltages at various elements of a loop. Use of Kirchoff's 1st & 2nd Law. Thevenin theorem, Norton theorem and Superposition theorem, Growth and Decay of current in and RC circuit, Analytical treatment.
5. **Magnetic Field Effects and Magnetic Properties of Matter:**
   Magnetic force on a charged particle, Magnetic force on a current, recall the previous results. Do not derive, Torque on a current loop, Magnetic dipole, Energy of magnetic dipole in field, Discuss quantitatively, Lorentz Force with its applications i.e. CRO. Biot-Savart Law, Analytical treatment and applications to a current loop, Force on two parallel current changing conductors, Ampere's Law, Integral and differential forms, Application to solenoids and toroids. (Integral form), Gauses' Law for Magnetism, Discussing and developing concepts of conservation of magnetic flux, Differential form of Gauses Law, Origin of Atomic and Nuclear magnetism, Basic ideas, Bohr Magneton, Magnetization, Defining M, B, H. Magnetic Materials, Paramagnetism, Diamagnetism, Ferromagnetism Discussion, Hysteresis in Ferromagnetic materials.
6. **Inductance:**
   Faraday's Law of Electromagnetic induction, Review of emf, Faraday Law and Lenz's Law, Induced electric fields, Calculation and application using dirrerential and integral form, Inductance, " Basic definition". Inductance of a Solenoid, Toroid, LR Circuits, Growth and Decay of current, Analytical treatment, Energy stored in a magnetic field, Derive, Energy Density and the magnetic field, Electromagnetic Oscillation, Qualitative discussion, Quantitative analysis using dirrerential equations, Forced electromagnetic oscillations and resonance.
7. **Alternating Current Circuits:**
   Alternating current AC current in resistive, Inductive and capacitative elements, Single loop RLC circuit, Series and parallel circuits i.e. acceptor and rejector, Analytical expression for time dependent solution, Graphical analysis, Phase angles, Power in A.C circuits, Phase angles, RMS values power factor.
8. **Electromagnetic Waves (Maxwell's Equations):**
   Summarizing the electro magnetic equations (Gauss's Law for electromagnetism, Faradays Law, Ampere's Law), Induced magnetic fields & displacement current , Development of concepts, applications. Maxwell's equations: (Integral & Differential forms) Discussion and implications. Generating and electro magnetic wave, Traveling waves and Maxwell's equations; obtaining the

velocity of light from Maxwell's equations. Energy transport and the Poynting Vector. Analytical treatment and discussion of physical concepts.

PAPER-D: ELECTRONICS AND MODERN PHYSICS(Written) 40 Marks

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(To be covered in about 70 lectures)

1. **Electronics**:
   Basic crystal structure, Free electron model, Energy band in solid and energy gapes p-type semiconductor materials, P-N junction diode its structure, Characteristics and application as rectifiers, Transistor, its basic structure and operation, Transistor biasing for amplifiers, Characteristics of common base, Common emitter, Common collector, Load line, Operating point Hybrid parameters (common emitter). Transistor as an amplifier (common emitter mode). Positive & negative feed back R.C. Oscillators, Monostable Multivibrator (basic). Logic gates OR, AND, NOT, NAND, NOR and their basic applications.
2. **Origin of Quantum Theory**:
   Black body radiation, Stefan Boltzmann, wien and Planck's law consequences, The quantization of energy, quantum numbers, correspondence principle, Einstein's photon theory the Compton effect, Line spectra Explanation using quantum theory.
3. **Wave Nature of Matter:**
   Wave behavior of particle, Wave function(its definition and relation t probability of particle), De. Broglie hypothesis and its testing. Davison Germer Experiment and J.P Thomson exp. Wave packets and particles, Localizing a wave in space and time.
4. **Quantum Mechanics:**
   Postulates of Quantum Mechanics, Quantum operators, Linear operators & their properties i.e. Momentum operator, Energy operator, Eigen value equation, Eigen operators and eigen function, Schrödinger equation (time dependent and time independent without derivation) and its application to step potential, Free particle, Barrier tunneling(basic idea) particles in a well, probability density using wave function of states.
5. **Atomic Physics:**
   Bohr's theory (review) Frank Hertz experiment , Energy level of electrons, Atomic spectrum, Angular momentum of electrons, Vector atom model, Orbital angular momentum, Spin quantization, Bohr's Magnetron, X-Ray spectrum, ()Continuous and discrete) Moseley's Law pauli exclusion principle table and its use in developing the periodic table.
6. **Nuclear Physics:**
   Basic properties of a nucleus, Mass No Atomic No. Isotopes Nuclear force (Basic idea) Nuclear Radii, Nuclear Masses, Binding energies, Mass defect. Nuclear Spin and Magnetism.
7. **Natural Radioactivity:**
   Laws of radioactive dacay, Half life, Mean life, Chain disintegration, Alpha, Beta decay (basic idea) Measuring ionizing radiation (units i.e. curies, Rad etc.)
8. **Nuclear Reactions:**
   Basic Nuclear reactions, Q-value, Exothermic, Endothermic Nuclear fission, Liquid drop model, Nuclear Reactors (Basic). Thermonuclear Fission T.N.F. in Stars.
9. **Introduction to Quantum Optics (Laser) and Plasma Physics:**
   Basic concept of plasma and its applications, controlled thermonuclear fusion, and its requirements for T.N. reactor, Basic concepts an characteristics of LASER, different types of laser, Working of He-Ne Laser.

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Text Book for B.Sc. (General Physics)

1. Fundamental of Physics by **Halliday, Resnic and Krane**. John wiley & sons

Books Recmended:

1) College Physics by Sears, Zemansky and Young.
2) Physics (5th Edition) by Giancoli.
3) Physics by Serway.
4) Vector Analysis by Spiegel, Schaum Publishing Co.
5) Concepts of Modern Physics by A. Beiser.
6) Modern Physics by H.C. Ohanian.
7) Basic electronic by Grobe.
8) Electronic Device by Floyd.
9) Introduction to electromagnetic field and Wave by Corson and Loran.
10) Introduction to electromagnetic field and Wave by Reitz and Milford.
11) Mechanics by Dr. M.Rafique Available at standard Book House Urdu Bazar, Lahore
12) Essential of Modern Physics by Acosta, Cown and Graham.

3. WEITAGE OF PAPESRS

PAPER –A: **Mechanics and Theory of Relativity**

Estimated lectures:

1. Theory 53
2. Problem solving 17

PAPER-B: **Waves and Oscillation, Thermodynamics and Statistical Mechanics**

Estimated lecturer

1. Theory 49
2. Problem solving 21

PAPER-C: **Electricity and Magnetism**

Estimated lectures

1. Theory 53
2. Problem solving 17

PAPER-D: **Modern Physics and Elecronics**

Estimated Lectures

1. Theory 54
2. Problem solving 16

4. Details/Format of each Paper

Each paper would have 3 Sections: Section I,II&III

Section I:

Comprising short conceptual questions

No. of questions: 1

No. of Parts in question: 5

(Attempt 4 Parts out of 5, each part carries 2 marks) 2x4 = 8 Marks

Section II:

Theoretical questions: (To include mathematical derivation and qualitative e explanation of phenomenon based on the particular law or relationship

Total No. of questions: 3

No. of questions to be attempted =2

(Each questing carries 8 Marks) 2x8 =16 marks

Section III

Problems

Problems related to text of the type and style in Halliday, Resnick & karne. (Exact reproduction is not necessary.) Problems should be suitably chosen to require application of the physics taught, as well as being a test of comprehension and quantitative skills.

Total No. of questions: 4

No of questions to be attempted 2

(each question carries 8 marks) 2x8 = 16 markss

Total: 40 Marks

Thus a total of 5 questions out of 8 have to be attempted, as specified above viz. 1 from Section-I, 2 from Section-II and 2 from Section-III.

5. Practicals for B.Sc. (General Physics)

The following practicals are recommended for both B.Sc. part-I & II. Minimum number of practicals to be performed is 6 and each practical paper carries 10 marks. Teachers are requested to emphasize on graphical analysis, error calculation and on system of S.I. units in the beginning of session. Each student shall pass the practical and written examination independently. Keeping in view the existing conditions of the laboratories of the degree colleges, it is recommended that maximum number of candidates in a group should no exceed five.

B.Sc. Part-I — *Practical.*

PAPER-A: MECHANICS

1. Modulus of Rigidity by Static & Dynamic method (Maxwell's meedle, Barton's Apparatus)
2. To study the damping features of an Oscillating, system using simple pendulum of variable mass.
3. Measurement of viscosity of liquid by Stoke's / Poiseulli's method.
4. Ssurface tension of water by capillary tube method.
5. To determine the value of "g" by compound pendulum/Kater's Pendulum.
6. To study the dependence of Centripetal force on mass, radius, nd angular velocity of a body in circular motion.
7. Investigation of phase change with position in traveling wave and measure he velocity of sound by C.R.O.
8. Determination of moment of inertia of a solid/ hollow cylinder and a sphere etc.

PAPER-B: WAVE &OSCILLAITON AND HEAT THERMODYNAMICS

1. To determine internal emf and plot temperature diagram.
2. Determinaton of temperature coefficient of resistance of a given wire.
3. Determinaton of "J" by Callender Barnis method.
4. The determination of Sefan's constant.
5. Calibration of thermocouple by potentiometer.
6. To determine frequency of AC supply.
7. To determine Horizontal/ Vertical distance by Sextant.
8. The determination of wave length of Sodium – D lines by Newton's Ring.
9. The determination of wave length of light / laser by Diffraction grating.
10. Determination of Wave length of sodium light by Fresnel's bi-prism.
11. The determination of Resolving power of a diffraction grating.
12. To study the characteristics of Photo emission and determination of Planck's constant using a Photo cell.
13. The measurement of Specific rotation of sugar by Polarimeter and determination of sugar concentration in a given solution.
14. Determination of his radius of lycopodium particles.\

B.Sc. Part-II — *Practicals*

PAPER-C ELECTRICITY AND MAGNETISM

1. Measurement of the resistance using a Neon flash bulb and condenser.
2. Conversion of galvanometer into Voltmeter into Voltmeter & and Ammeter.
3. Calibration of an Ammeter and a Voltmeter by potentiometer.
4. Charge sensitivity of a ballistic galvanometer.
5. Comparison of capacities by ballistic galvanometer.
6. to study the B.H. curve & measuring the magnetic parameters.
7. Measurement of low resistance coil by a CareyFosterBridge.
8. Resonance frequency of an acceptor circuit.
9. Resonance frequency of a Rejecter Circuit.
10. Study of the parameter of wave i.e. Amplitude, phase and time period of a complex signal by CRO.
11. Measurement of self/mutual inductance.
12. Study of electric circuits by black box.

PAPER-B WAVES & OSCILLATION AND HEAT & THERMODYNAMICS

1. Determination of e/m of and electron.
2. Conversion of and Ammeter and a Voltmeter into Voltmeter & an Ammeter.
3. Calibration of an Ammeter and a Voltmeter by potentiometer.
4. Charge sensitivity of a ballistic galvanometer.
5. Comparison of capacities by ballistic galvanometer.
6. To study the B.H. curve & measuring ht magnetic parameters.
7. Measurement of low resistance coil by a CareyFosterBridge.
8. Resonance frequency of an acceptor circuit.
9. Resonance frequency of a Rejecter Circuit.
10. Study of the parameter of wave i.e. Amplitude, phase and time period of a complex signal by CRO.
11. Measurement of self/ mutual inductance.
12. Study of electric circuits by black box.

PAPER-D ELECTRONICS & MODERN PHYSICS

1. Determination of e/m of an electron.
2. Ionization potential of mercury.
3. Characteristics of a semiconductor Diode (compare with (Si & Ge diode)
4. Setting up of half & full wave rectifier & study of following factors
    - Smoothing effect of a capacitor
    - Ripple factor and its variation with load.
    - Study of regulation of out put voltage with load.
5. To set up a single stage amplifier & measure its voltage gain and band width.
6. To set up transistor oscillator circuit and measure its frequency by an oscilloscope.
7. To set up and study various logic gates (AND, OR, NAND etc.) using diode and develop their truth table.
8. To set up an electronic switching circuit using transistor LDR and demonstrate its use as a NOT gate.
9. Characteristics of a Transistor.
10. To study the characteristics curve of a G. M. counter and use it to determine the absorption co-efficient of β-particle in Aluminium.
11. Determination of a range of a α – Particle.
12. Mass absorption co-efficient of Pb for γ-rays using G. M. counter.

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