Nalanda Open University

Annual Examination - 2016

B.Sc. Physics (Honours), Part-I

Paper-I

Time: 3.00 Hrs. **Full Marks: 80**

*Answer any **Five** questions, selecting at least one from each group. All questions carry equal marks.*

Group - A

1. Explain devergence of a vector. State and prove Gauss divergnece theorem.
2. State the Kepler's laws of planetary motion. On the basisi of inverse square law of gravitation deduce these laws.
3. Derive Rutherford scattering formula for the differential scattering cross-saction for particles in the inverse square law of force field.
4. Explain the variational principle of least action. On its basis derive Lagrange's equations of motion.
5. Show the position co-ordinates in Cartesian and spherical polar Co-ordinate systems. Give the infinitacimal volume element in both the systems.

Group - B

6. With the help of neat diagrams, give the theory of Michelson-Morley experiment. Explain the result of the experiment.
7. Deduce the equation of variation of mass of a particle with its valocity and hence show that $E=mc^2$
8. On the basis of the special theory of relativity discuss (i) Length contraction and (ii) time-dilation.

Group - C

9. What is damped motion? Discus the theory of this motion with special ease of over-damped motion.
10. What are Ultrasonic waves? Give a brief account of their production and uses in practical life.

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Annual Examination - 2016

B.Sc. Physics (Honours), Part-I

Paper-II

Time: 3.00 Hrs. **Full Marks: 80**

*Answer any **Five** questions, selecting at least Two from each group. All questions carry equal marks.*

Group - A

1. Derive the expression for mean free path λ of gas molecules on the basis of Kinetic theory of gases. How is this quantity experimentally determined?
2. Describe the Einstein's theory of Brownian Motion and obtain the expressiion for average square displacement of a particle. Compare this with Langevin's theory of Brownian motion.
3. State the principle applied by Planck for the energy of an oscillator. Derive Planck's radiation formula and give its application.
4. Deduce an expression for steady state temperature distribution along a uniform metal rod heated at one end.
5. State the principle of equipartition of energy and derive the result that the mean energy of system of gases is ½kT per degree of freedom.

Group – B

6. Derive the expression for efficiency of Carnot's engine using the laws of thermodynamics. Define Carnot's refrigerator.
7. Derive Clausius-Clapeyron equation of 1st order phase transition and explain triple point.
8. Write down Maxwell's equations in thermodynamics and apply then to solve at least two simple physical problems.
9. Describe porous-plug experiment. What is Joule-Thomson effect?
10. What is thermodynamic probability ? Explain phase space representation of a particle. Also, give the statistical Interpretation of the 2nd law of thermodynamics.

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Annual Examination - 2016
B.Sc. Physics (Subsidiary), Part-I
Paper-I

Time: 3.00 Hrs. **Full Marks: 80**

*Answer any **Five** questions. All questions carry equal marks.*

1. Derive relativistic mass-enery equation: $E=mc^{2.}$
2. Give the theory of torsional oscillation of a suspended cylindrical solid wire and derive expression for its time-period.
3. Obtain the expression for depression of a Cantilever beam when a force W is applied at its free end.
4. Evaluate the Fourier Coefficients in the solution for motion of a plueked String.
5. Derive Stefan-Boltzmann law. Also, write down Wien's distibution law and Raylaigh-Jean's law.
6. Set up the lagrangian for a one-dimensional harmonic Oscillator and obtain the Lagrange's equation of motion.
7. Derive Van der Wall's equation of state for real gases, Evaluate 'a' and 'b' in terms of P_c V_c & $T_{c.}$
8. Derive Planck's law of radiation. Show that Wein's displacement law may be derived from Planck's law of radiation.
9. Explain the terms: degrees of freedom; constratints & generalised coordinates. Differentiate between holonomic and non holonomic constraints by giving suitable examples.
10. Explain second law of thermodynamics. Explain Carnot's theorem and Carnot cycle? Find the efficiency of a Carnot engine.

Nalanda Open University

Annual Examination - 2016

B.Sc. Physics (Honours), Part-II

Paper-III (Optics & Electromagnetic Theory)

Time: 3.00 Hrs. **Full Marks: 80**

*Answer any **Three** questions from group 'A' and **Two** from group 'B'. All questions carry equal marks.*

Group - A

1. Obtain the Fraunhoffer Diffraction pattern produced by a single slit using necessary diagrams. Also, find the angular width of its maxima.
2. Explain the formation of fringes in Febry-Perot interferometer. How would you use it for the measurement of wavelength of light.
3. What do you understand by resolving power of a an optical instrument. Explain Reyleigh criterion of resolution. What is Resolving Power of a Telescop whose objective lens has diameter of 200 inches and □ = 6000Å.
4. Describe the construction and working of Babinet's Compensator. How is it superior than a quarter wave plate ?
5. What is the basic principle of a laser ? Discuss the construction and working of Ruby laser.
6. What are Einstein's A and B co-efficient? Derive the ratio of these two co-efficients.

Group - B

7. State the basic laws of electricity and magnetism in differential form and use these equations to obtain the four Maxwell's equations. What is displacement current ?
8. Obtain Lorentz dispersion relation on the basis of electromagnetic theory for dispersion in gases.
9. Discuss the propagation of electromagnetic waves through a conducting medium.
10. Write notes on any Two of the following:-
    (a) Maxwell's stress Tensor (b) Pressure of Radiation
    (c) Thomson Scattering (d) Dispersion in Gases

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Annual Examination - 2016

B.Sc. Physics (Honours), Part-II

Paper-IV (Electrostatics, Magnetism current Electricity and Modern Physics)

Time: 3.00 Hrs. **Full Marks: 80**

*Answer any **five** questions. All questions carry equal marks.*

1. Define a quadrupole. Calculate the field and potential at a point far away from a linear quadrupole.
2. Describe Weiss' theory of ferromagnetism. Discuss the temperature dependence of spontaneous magnetization.
3. Give the principle and working of De Sauty's bridge using necessary diagrams.
4. Define Thomson and Petlier Coefficient. Show that, in a thermocouple AB, the total emf is given by : $E = \pi + \int_{T1}^{T2} (\sigma_A - \sigma_B) dT$, Where symbols have their usual meaning.
5. Describe the Millikan's oil drop experiment to find the charge on an electron.
6. Obtain the resonance frequency of parallel resonant circuit. Discuss the sharpness of resonance of the circuit.
7. Discuss the growth of charge and current in an LCR circuit when a direct e.m.f. is applied to it.
8. Give an account of Heisenberg's uncertainty principle. Outline an idealized experiment to bring out its significance.
9. State and explain Compton effect. How do you experimentally find the change in wave-length by Compton Effect?
10. What is Einstein's quantum Hypothesis and write down photo electric equation. Calculate the work function of sodium light in electron volt. Given that the threshold Wavelength is 6800 $\AA$ and $h = 6.625 \times 10^{-34}$ JS^{-1}

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B.Sc. Physics (Subsidiary), Part-II

Paper-II

Time: 3.00 Hrs. **Full Marks: 80**

*Answer any **five** questions. All questions carry equal marks.*

1. Define electric intensity $\vec{E}$, electric polarization $\vec{P}$ and electric displacement $\vec{D}$ and establish a relation between them.
2. Distinguish between Dia–, Para – and ferro – magnetism. Give Langeviw's theory of paramagnetism.
3. Describe the Millikan's Oil Drop method of measurement of charge on an electron using neat diagram and derive the necessary formula.
4. Explain Seeback effect, Pettier effect and Thomson's effect. Define Pettier Coefficient and derive its expression. What is Thomson's coefficient?
5. What is photo electric effect? Derive Einstein's photoelectric equation. The photo electric threshold for a certain metal is 300 nm. Determine the maxm energy of the electron ejected by a radiation of $\lambda = 200$ nm (Given that $h = 6.6 \times 10^{-34}$ JS).
6. What is Compton effect? Prove the formula of wavelength shift $\Delta\lambda = \frac{h}{m_0 c}(1-\cos\phi)$ in Compton effect. Explain why Compton effect is not experimentally observed for visible light.
7. Give the theory of Newton's rings and show how can it be used to find λ of sodium light.
8. What are solid state Lasers? Discuss the construction and working of Ruby Laser.
9. State Brewster's Law. How will you change unpolarised light into plane polarised light by reflection? What is double refraction?
10. Give an account of Bohr's theory of hydrogen atom.

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B.Sc. Physics (Honours), Part-III

Paper-V (Classical Mechanics and Mathematical Physics)

Time: 3.00 Hrs. **Full Marks: 80**

Answer any five questions. All questions carry equal marks.

1. Derive the equation of motion of a symmetric top. Discuss the special case of a sleeping top.
2. What is Poison's bracket? State and prove its properties, Jacobin's identity in particular.
3. Establish Hamilton Jacobi equation, and with its help solve the problem of motion of a harmonic oscillator.
4. Prove that the sum of two tensore is also a tensor. Discuss the various algebraic properties of tensors of arbitrary rank containing both covariant and contravariant indices.
5. (a) Using the method of separation of variables solve the differential equation $\frac{du}{dx} = 2\frac{du}{dt} + u, \; Where \;\; u = u\,(x,t)$.

   (b) What is Dirac delta function? Show that x $\delta(x)=0$
6. Discuss the solution of Laplace's equation. $\triangleleft^2 \phi = 0$ in spherical polar co ordinates
7. State and prove Canchy's Residue theorem.
8. State and prove Laurent's theorem.
9. Write the Lagrangian of motion of a double pendulum and deduce the frequency of its motion.
10. Write notes on any *Two* of the following:
    (a) D'Alembert's principle
    (b) Gyroscopic Motion.
    (c) Hamitto's equation of Motion
    (d) Moment of inertia and products of inertia.

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B.Sc. Physics (Honours), Part-III

Paper-VI (Quantum Mechanics and Statistical Mechanics)

Time: 3.00 Hrs. **Full Marks: 80**

Answer any five questions. All questions carry equal marks.

1. What is hermitian operator? Show that two eign functions of Harmitian operator, belonging to different eigen values are orthogonal to each other. Explain the expectation value of a quantum mechanical operator.

2. Derive Schrodinger's equations in both time independent and time dependent cases. What is the physical interpretation of wave function?

3. What is uncertainty principle? Derive Heisenberg's uncertainty relation for the position and momentum variabels. Show that an electron connot exist inside the nucleus.

4. Define angular momentum in quantum mechanics. Show that the components of angular momentum commute with L^2, whereas they do not commute with each other.

5. A particle is incident on a one-demensional potential barrier of height V_0 and width a. Deduce an expression for its transmission probability. Discuss the two cases when the energy E of the particle is (i) $E>V_0$ and (ii) $E< V_0$.

6. What are symmetric and anti-symmetric wave functions? Discuss the symmetry of a wave function, in detail.

7. State and prove Liouiville's theorem.

8. Establish the Fermi-Dirac distribution formula and hence obtain an expression for Fermi energy.

9. Deduce Planck's rediation formula on the basis of Bose-Einstein's statistics.

10. Find the relation between pressure and temperature of vapour treated as a gas during liquid-vapour transition.

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Annual Examination - 2016

B.Sc. Physics (Honours), Part-III

Paper-VII (Classical Electrodynamics, Plasma Physics, Physics of Atoms, Molecules and Nuclei)

Time: 3.00 Hrs. **Full Marks: 80**

Answer any five questions. All questions carry equal marks.

1. What is lienard-Wiechert potential? On its basis obtain electric and magnetic field intensity due to a uniformly moving charge.

2. Explain electromegnetic field tensor. Find all the sixteen components of it in terms of the electric and magnetic fields.

3. Discuss the covariance of maxwell's field equations under Lorentz transpformations.

4. Discuss the microscopic and macroscopic properties of plasma. Explain quasineutrality of plasma and Debye shielding and Debye length.

5. Distinguish between normal and anomalous Zeeman effects. How are they explained theoritically?

6. Give the theory of rotational spectra of diatomic molecules treated as a non rigit rotator.

7. Give the construction of He-Ne laser and the theory of its working. What is an optically pumped laser.

8. Discuss angular momentum, magnetic moment and electric quadmpole moment associated with an atomic nucleus. What is the importance of these properties of a nucleus?

9. Give the theory of shell model of nucleus and on its basis explain the angular momentum of the ground state of the nucleus.

10. Describe and discuss the Stern-Gerlach experiment to show the existence of magnetic moment of an electron due to its spin.

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B.Sc. Physics (Honours), Part-III

Paper-VIII (Condensed Matter Physics & Electronics)

Time: 3.00 Hrs. **Full Marks: 80**

Answer any five questions. All questions carry equal marks.

1. What is space lattice? Describe various types of lattices in the cubic system. Show that for a simple cubic lattice, $d_{100}:d_{110}:d_{111}=\sqrt{6}:\sqrt{3}:\sqrt{2}$

2. Discuss Van-der-waals binding. Obtain expression for the total potential energy of pairs of atoms in the crystal on the basis of this theory.

3. Explain Drude-Lorentz theory. Derive Wiedmann-Franz relation between thermal and electrical conductivities on the basis of this theory.

4. State and explain Thevenin's theorem. Giving an example show how this theorem helps in circuit analysis.

5. Explain energy band. On the basis of energy bands of solids distinguish between a metal, a semiconductor and an insulator.

6. What is photodiode? Discuss its working, characteristics and uses.

7. Whia is filter circuit? Give their classification and describe elementary filter theory.

8. Explain the principle of frequency modulation. Define frequency deviation and modulation index for a frequency modulated carrier.

9. What is an amplifier? Giving a neat circuit diagram discuss the working of an R. C. Coupled amplifier. Explain Voltage gain.

10. Describe the face centred cubic and hexagonal closed packed crystal structures. Prove that the close packing of atoms in the hcp structure demands on axial ratio $\frac{c}{a}=\sqrt{\frac{8}{3}}$.