

Nalanda Open University
Annual Examination - 2012
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. Define Gradient of a scalar, divergence and Curl of a vector. How do you express these quantities in Cartesian and spherical Polar Coordinates ?
2. Distinguish between holonomic and non-holonomic constraints. Give suitable examples for each.
What are generalised coordinates? What is the advantage of using these Coordinates for a physical system.
3. Set up the Lagrangian for a (i) one dimensional harmonic oscillator & (ii) particle of mass m falling freely in uniform gravitational field. Write equations of motion in each case using Lagrange's equations.
4. Derive the expression for force experienced by a particle in rotating frame of reference and hence define the 'centrifugal force' and 'Coriolis force'.
5. Write notes on any two of the following:
(a) Kepler's laws (b) D'Alembert's principle (c) Hamilton's Equations of Motion

Group-B

6. Describe with a neat diagram, the Michelson-Morley Experiment and explain clearly the conclusions drawn from this experiment.
7. State and explain Lorentz Transformation Equations and use them to obtain rule for transformation of velocity of a particle. Prove that velocity of light is invariant under L.T.
8. Establish the following equations for a relativistic system.
(a) $E^2 = p^2 c^2 + m_0^2 c^4$ & (b) $p = \frac{1}{c} \sqrt{K^2 + 2m_0 c^2 K}$
where the symbols have the usual meaning.

Group-C

9. Determine the position of nodes and antinodes in the formation of stationary waves.
10. What are ultrasonic Waves? How are they produced? Mention its properties.

Nalanda Open University
Annual Examination - 2012
B.Sc. Physics (Honours), Part-I
Paper-II

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. Derive the expressions for mean free path, λ , of gas in molecules on the basis of Kinetic theory of gases.
2. Evaluate the constants 'a' and 'b' appearing in Van-der-Waal's equation of state in terms of the critical constants P_c , V_c and T_c .

Calculate the critical temperature of helium atom if $p_c = 2.26$ atm, critical density & 0.069 gm/..... and $R = 8.31$ Jmole⁻¹K⁻¹.

3. Give the Einstein's theory of Brownian motion.
4. Derive Planck's radiation formula. Use this to obtain Stefan-Boltzmann law.
5. Derive Einstein's specific heat formula and show how does it modify Dulong–Petit's law. What are the limitations of this formula?

Group-B

6. Using 1st law of thermodynamics, find the variation of internal energy of a system as a function of (i) volume & temperature (ii) pressure and temperature and (iii) pressure and volume.
7. Derive the expression for efficiency of Carnot engine using 2nd law of thermodynamics. Define Carnot's refrigerator.
8. Derive 'clausius–clapeyron equation' for 1st order phase transition. Also, explain 'triple point' giving suitable diagrams.

Group-C

9. State and explain Joule–Thomson effect. What is the third law of thermodynamics?
10. Write notes on any **two** of the following:
 - (a) Statistical basis of thermodynamics
 - (b) Thermodynamics probability
 - (c) Chemical Potential

Programme of B.Sc. Part-I Physics (Hons.) Practical
Counselling Classes and Examination 2012
Practical Counselling Class

<i>Date</i>	<i>Time</i>	<i>Paper</i>	<i>Batch</i>	<i>Enrollment No.</i>
23.04.12 to 26.04.2012	I & II	11:15 A.M. to 03:15 P.M.	P1	090500062, 100500011 to 100500061 110500001 to 110500011
27.04.2012 to 29.04.2012	I & II	11:15 A.M. to 03:15 P.M.	P2	110500019 to 110470056
30.04.2012 to 02.05.2012	I & II	11:15 A.M. to 03:15 P.M.	P3	110500061 to 110470105

Practical Examination

<i>Date</i>	<i>Time</i>	<i>Paper</i>	<i>Batch</i>	<i>Enrollment No.</i>
03.05.12	11:15 A.M. to 02:15 P.M.	I	P1	090500062, 100500011 to 100500061 110500001 to 110500011
03.05.12	02:30 A.M. to 5:30 P.M.	I	P2	110500019 to 110470056
04.05.12	11:15 A.M. to 02:15 P.M.	I	P3	110500061 to 110470105
04.05.12	02:30 A.M. to 5:30 P.M.	II	P1	090500062, 100500011 to 100500061 110500001 to 110500011
05.05.12	11:15 A.M. to 02:15 P.M.	II	P2	110500019 to 110470056
05.05.12	02:30 A.M. to	II	P3	110500061 to 110470105

	5:30 P.M.			
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Venue : 1 st Floor, Biscomaun Tower, Physics Lab.

Nalanda Open University
Annual Examination - 2012
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. State and explain Einstein's postulates of special theory of relativity. Write Lorentz transformation and explain at least one important consequence of this.
2. Derive relativistic equations for (i) aberration of light and (ii) Doppler effect (longitudinal and transverse).
3. Derive relativistic mass-energy relation $E = mc^2$.
4. Set up the Lagrangian for a one-dimensional harmonic oscillator and obtain the Lagrange's equations of motion.
Also, set up the Lagrangian for a particle of mass m falling freely in uniform gravitational field.
5. State Kepler's laws of planetary motion and derive the third law.
6. Define Young's modulus, Bulk modulus and Shear modulus of elasticity. If Y , K , & η represent these moduli respectively then prove that $Y = \frac{9\eta k}{3k + \eta}$
7. Evaluate the Fourier coefficients in the solution for motion of a plucked string.
8. Explain behaviour of real gases and derive Van-der-Waals' equation of state for such gases.
9. State and explain the first law of thermodynamics and use it to obtain (i) difference of C_p and C_v & (ii) Law governing an adiabatic process.
10. Write notes on any **Two** of the following :
 - (a) Clausius-Clapeyron Equation
 - (b) Planck's law of radiation
 - (c) Entropy
 - (d) Latent heat of phase transition

Nalanda Open University
Annual Examination - 2012
B.Sc. Physics (Honours), Part-II
Paper-III (Optics & Electromagnetic Theory)

Time: 3.00 Hrs.

Full Marks: 80/75

Answer any three questions from Group 'A' and two from Group 'B'.

All questions carry equal marks.

Group-A (Optics)

1. Describe Fabry-Perot interferometer with a suitable diagram. What is Fabry-Perot etalon? Show how this instrument is useful in the study of fine structure of spectral lines.
2. Explain the construction and the mode of action of a plane diffraction grating and derive an expression for its resolving power.
3. What do you understand by resolving power of an optical instrument? Deduce an expression for the resolving power of a prism.
4. Describe the construction and working of a nicol prism. How is it used as a polariser and analyser?
5. What do you understand by polarisation of light? Distinguish between the unpolarised and polarised light. How will you change unpolarised light into plane polarised light by reflection? State Brewster's law.
6. What are Einstein's A & B coefficients? Explain spontaneous emission and stimulated emission. What are the important features of these emissions?

Group-B (Optics)

7. Show that for a system of current carrying elements in empty space, the total energy in the magnetic field is

$$W = \frac{1}{2c^2} \int d^3 X \int d^3 X' \frac{\vec{J}(\vec{X}) \cdot \vec{J}(\vec{X}')}{|\vec{X} - \vec{X}'|}$$

where $\vec{J}(\vec{X})$ is the current density.

8. Explain the laws of reflection of plane waves at the interface of Non-Conducting media on the basis of electromagnetic theory.
9. Derive Rayleigh's scattering formula for the scattering of electromagnetic wave by a bound charge.
10. Write notes on any *two* of the following:
 - (a) Maxwell's stress tensor
 - (b) Dispersion in Gases
 - (c) Poynting's theorem.

Nalanda Open University
Annual Examination - 2012
B.Sc. Physics (Honours), Part-II
(Electrostatics, Magnetism, Current Electricity & Modern Physics)
Paper-IV

Time: 3.00 Hrs.

Full Marks: 80/75

Answer any five questions. All questions carry equal marks.

1. Define electromagnetic field vectors $\vec{E}, \vec{D}, \vec{B}$ & \vec{H} and find the boundary conditions which the time dependent field vectors satisfy at the interface between two different media.
2. Express Laplace's equation in Cartesian, Spherical Polar and Cylindrical Coordinates. Give the importance of this equation. What is Poisson's equation?
3. Describe Langevin's Theory of paramagnetism. How was this extended by Weiss to explain the phenomenon of ferromagnetism?
4. Describe, with theory the construction and action of a moving coil ballistic galvanometer. Give some of the important applications of this galvanometer.
5. Obtain an expression for the growth and decay of charge in a condenser through a resistance. What is the time constant of the circuit?
6. Obtain the resonance frequency of a series resonant circuit. Discuss the sharpness of the resonance of the circuit.
7. Explain the working of Anderson's bridge for measurement of the inductance of a coil with the help of necessary circuit diagram and vector diagram.
8. Describe Millikan's experiment to find the charge of an electron.
9. Write short note on any two of the following:
(a) Liquid drop model (b) Fermi Gas Model (c) Shell model
10. State and explain Compton effect. How do you experimentally find the change in wavelength predicted by Compton? What is Compton Wavelength.

Nalanda Open University
Annual Examination - 2012
B.Sc. Physics (Subsidiary), Part-II
Paper-II

Time: 3.00 Hrs.

Full Marks: 80/75

Answer any five questions. All questions carry equal marks.

1. The charge density for the electron in a hydrogen atom has a distribution given by $\rho(r) = \frac{e}{\pi a_0^3} e^{-2r/a_0}$, where a_0 is the Bohr radius. Show that the electron-proton interaction energy is given by $U = -\frac{e^2}{4\pi\epsilon_0 a_0}$.

2. Describe Langevin's theory of paramagnetism? What are the three assumptions that Weiss made to explain the phenomena of ferromagnetism? What is Curie's law?
3. Explain: (a) Seebeck effect & (b) Thomson's effect. Also explain the following terms? 'inversion temperature', 'thermo electric power' & 'Thomson coefficient'.
4. Discuss the growth of charge and current in a circuit containing resistance, inductance and capacitance when a direct emf is applied.

5. Describe the construction and operation of a Geiger Muller Counter.

The half life of a radioactive nuclide is 20 hours. What fraction of original 'activity' will remain after 40 hours?

6. Give an account of (i) the nuclear shell model & (ii) collective model of the nucleus. What are the limitations of these models?
7. What is photo electric effect? Derive Einstein's photoelectric equation.

The photoelectric threshold for a certain metal is 300 nm. Determine the max^m energy of the electron ejected by a radiation of wavelength 200 nm. (Given that $h = 6.6 \times 10^{-34}$ JS.)

8. Distinguish between an amplifier and an oscillator. Describe with a neat diagram the working of an oscillator.
9. Explain the construction and the mode of action of a plane diffraction grating and derive an expression for its resolving power.

10. What are Gas lasers? Discuss the construction and working of He - Ne Laser.
Explain how lasing action takes place.

Nalanda Open University
Annual Examination - 2012
B.Sc. Physics (Honours), Part-III
Paper-V (Mathematical Physics & Classical Mechanics)

Time: 3.00 Hrs.

Full Marks: 80/75

Answer any Five Questions. All questions carry equal marks.

1. Find the solution of Laplace's equation

$$\nabla^2 \phi = 0$$

in Cartesian or Spherical Polar Coordinate system.

2. (a) Solve the differential equation

$$\frac{du(x,t)}{dx} = 2 \frac{du(x,t)}{dt} + u(x,t), \quad \text{using the method of separation of}$$

variable.

- (b) Solve the differential equation

$$\frac{d^2 y(x)}{dx^2} + \alpha^2 y(x) = 0, \text{ using the power series solution method.}$$

3. State and prove that Cauchy's Residue theorem.
4. State and prove that Taylor's theorem.
5. (a) Show that energy tensor can be expressed as the sum of two tensors, one of which symmetric and the other skew symmetric.
- (b) Prove that the symmetric or skew-symmetric nature of any tensor A_{st}^{pqr} w. r. t. p and q indices does not change in going from one coordinate system to another.
6. Choose a suitable set of coordinates for a double pendulum, allowed to swing in a vertical plane, and write the Lagrangian function for this system. Then use the Euler-Lagrange's equation of the system to find the frequency of vibration.
7. Discuss the motion of a symmetrical top. Apply it to the special case of a sleeping top.
8. Establish Hamilton-Jacobi equation and solve harmonic oscillator problem by this technique.
9. State and prove Jacobi's Identity for Poisson Brackets.
10. Apply the method of action-angle variables to the motion of a particle in a plane under a central force.

Nalanda Open University
Annual Examination - 2012
B.Sc. Physics (Honours), Part-III
Paper-VI (Quantum Mechanics & Statistical Mechanics)

Time: 3.00 Hrs.

Full Marks: 80/75

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

1. Show that two eigen functions of Hermitian operator, belonging to different eigen values, are orthogonal to each other.
Define the expectation value of a quantum mechanical operator and show that it corresponds to on classical observable.
2. Given the Schrödinger equation, define the probability density and the probability current density. Deduce the continuity equation and show that the probability density is constant and does not change with time for stationary state explain.
3. Find the transmission probability for a particle incident on a one-dimensional potential barrier of height V_0 and width a . Consider the two cases when (a) the energy of the particle $E > V_0$ and (b) $E < V_0$.
4. A particle of mass m moving freely along the x -axis between two rigid walls situated at $x = 0$ and $x = L$. Determine the allowed values of energy and the corresponding normalized wave functions.
5. 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.
6. What are symmetric and anti symmetric wave functions? Discuss, in detail, the symmetry of wave functions.
7. State and prove Liouville's theorem.
8. Find the relation between pressure and temperature of vapour treated as a gas during liquid-vapour transition.
9. Establish the Fermi-Dirac distribution formula and hence obtain an expression for Fermi energy.
10. Write short notes on any two of the following:
 - (a) Gibb's paradox
 - (b) Grand Canonical ensemble
 - (c) Bose Einstein Statistics.
 - (d) Plank's radiation formula.

Nalanda Open University
Annual Examination - 2012
B.Sc. Physics (Honours), Part-III
Paper-VII

Time: 3.00 Hrs.

Full Marks: 80/75

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

1. What are the retarded and advanced potentials? Obtain retarded and advanced scalar potentials by the solution of inhomogeneous wave equation. Give physical interpretation of these potentials.
2. What is electromagnetic field tensor? Find all 16 components of this in terms of components of electric and magnetic field. What is its physical significance?
3. Define a Plasma State and describe all plasma parameters. Define the concept of temperature in plasma.
4. Describe Stern-Gerlach experiment with all the necessary diagram and show how this experiment shows the existence of the magnetic moment of an electron due to its spin.
5. What is Zeeman effect? Distinguish between normal and anomalous Zeeman effect. How do you observe normal Zeeman effect?
6. Discuss the vibrational spectra of a diatomic molecule treated as a Harmonic Vibrator. Give necessary diagrams. What is the short coming of this model?
7. What do you mean by N.M.R. Spectroscopy? Describe with diagram, the continuous wave NMR Spectrometer.
8. What is LASER Spectroscopy? Explain the working of
(i) optically pumped laser and (ii) He-Ne gas laser.
9. Discuss how spin, magnetic moment and electric quadrupole magnetic moment can be associated with atomic nucleus.
10. Describe the extreme single particle model of nuclei and hence explain Magic numbers of nuclei.

MOST IMPORTANT NOTICE

: अत्यन्त महत्वपूर्ण सूचना :

बी०एस०सी०(प्रतिष्ठा)पार्ट-III एवं मनोविज्ञान(प्रतिष्ठा)पार्ट- III के सभी विद्यार्थियों को सूचित करना है कि उनके सामान्य एवं पर्यावरणीय अध्ययन (**G.S**) की परीक्षा 2012 जो पूर्व से दिनांक-23.02.2012 को द्वितीय पाली समय 12 से 3 बजे, अपराह्न में निर्धारित थी, अब यह परीक्षा दिनांक 24.02.2012 को द्वितीय पाली समय 12 से 3 बजे, अपराह्न में संचालित होगी। तदनुरूप परीक्षा में उपस्थित हों।

Nalanda Open University
Annual Examination - 2012
B.Sc. Physics (Honours), Part-III
Paper-VIII

Time: 3.00 Hrs.

Full Marks: 80/75

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

1. What do you understand by space lattice? Mention and explain with examples the types of lattices in cubic system.
 Show that for a simple cubic lattice:- $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$.
2. Describe the face centred Cubic and hexagonal Closed packed structures. Prove that the close packing of atoms in the hcp structure demands on axial ratio $C/a = \sqrt{\frac{8}{3}}$.
 Lead is fcc and its atomic radius is 0.175nm. What is its volume?
3. Show that the normalized wave function for the free electrons in a cubical box of length L is given by

$$\Psi = \left(\frac{8}{L^3}\right)^{1/2} \sin \frac{n_x \pi x}{L} \cdot \sin \frac{n_y \pi y}{L} \cdot \sin \frac{n_z \pi z}{L}$$
4. What do you mean by energy band? Distinguish clearly between a metal, semiconductor and insulator on the basis of energy bands in solids.
5. What is Hall effect? Obtain an expression for the Hall Coefficient of a metal and also discuss the experimental determination of Hall Coefficient.
6. What is free electron theory of metals? Derive the expression for Conductivity of metals on the basis of Drude-Lorentz theory.
7. State and explain Thevenin's theorem & Norton's theorem. How are these theorems used in Circuit analysis. Give at least one example.
8. What is photodiode? Discuss its working, Characteristics and uses.
9. Give the complete description of each of the logic gates: AND, OR, NAND, NOR, OR & XOR. Explain why NAND and NOR gates are Universal gates.
10. What is filter circuit? Give their classification and describe the elementary filter theory. State and explain Reciprocity theorem.

**Programme of B.Sc Part-III Physics (Hons.) Practical Counselling
 Class and Examination 2012**

Practical Counselling Class

<i>Date</i>	<i>Time</i>	<i>Paper</i>	<i>Time</i>	<i>Paper</i>
12.03.12	12:00 to 2:00 PM	VII	2:00 to 4:00 PM	VIII
13.03.12	12:00 to 2:00 PM	VII	2:00 to 4:00 PM	VIII
14.03.12	12:00 to 2:00 PM	VII	2:00 to 4:00 PM	VIII

Practical Examination

<i>Date</i>	<i>Time</i>	<i>Paper</i>	<i>Time</i>	<i>Paper</i>
16.03.12	11:30 to 2:30 PM	VII	2:30 to 5:30 PM	VIII

Venue –Physics lab 1st Floor Biscomaun Tower, Patna