

Nalanda Open University

Annual Examination - 2015

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. Describe Cartesian, Spherical Polar and Cylindrical Co-ordinate system and show the position Co-ordinates in each of them and establish their inter relations. Write expressions for infinitesimal volume element in each of them.
2. Explain generalized co-ordinates, degrees of freedom and constraints. Use Lagrange's equation to discuss the motion of a compound pendulum.
3. Derive the expression for force experienced by a particle in a rotating frame of reference and hence explain the centrifugal force and the coriolis force.
4. State and explain the principle of least action. Use this to derive Lagrange's equations of motion.
5. Define divergence and curl of a vector. Write their expressions in the Cartesian and the spherical polar co-ordinates.

Group - B

6. Write down Einstein's postulates of the special theory of relativity and hence derive Lorentz transformation equations.
7. Using four dimensional formulations in relativity obtain the equation for variation of mass with velocity.
8. Establish the equation $E^2 = p^2 c^2 + m_0^2 c^4$ for a relativistic system and discuss it.

Group - C

9. Obtain the differential equation of damped vibrations in one dimension and discuss its solution.
10. Obtain the equation of stationary waves and find the positions of nodes and anti-nodes.



Examination Programme, 2015

B.Sc (Part – I) All Honours Subjects

(Except Home Science and Geography Honours)

Date	Papers.	Time	Examination Centre
23/3/2015	(Hons) P-I	3.30 to 6.30 pm	Nalanda Open University, Patna
25/3/2015	(Hons) P-II	3.30 to 6.30 pm	Nalanda Open University, Patna
28/3/2015	Rastrabhsha-100 orHindi +Urdu 100-I	3.30 to 6.30 pm	Nalanda Open University, Patna
30/3/2015	Botany (Sub) P-I	8 to 11 am	Nalanda Open University, Patna
31/3/2015	Math (Sub) P-I	8 to 11 am	Nalanda Open University, Patna
01/4/2015	Geography (Sub) P-I	8 to 11 am	Nalanda Open University, Patna
02/4/2015	Chemistry (Sub) P-I	8 to 11 am	Nalanda Open University, Patna
03/4/2015	Home Scince (Sub)-P I	8 to 11 am	Nalanda Open University, Patna
04/4/2015	Zoology (Sub) P-I	8 to 11 am	Nalanda Open University, Patna
06/4/2015	Physics (Sub) P-I	8 to 11 am	Nalanda Open University, Patna

Nalanda Open University

Annual Examination - 2015

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. Deduce Maxwell's law of velocity distribution amongst the molecules of an ideal gas. Use this law to find an expression for the most probable velocity.
2. Give the Einstein's theory of Brownian motion.
3. Deduce an expression for steady state temperature distribution along a uniform metal rod heated at one end.
4. State the principle of equipartition of energy and derive the result that the mean energy of a system of gases is $\frac{1}{2} kT$ per degree of freedom.
5. Use Debye's theory to find the formula for specific heat of a solid.

Group - B

6. Derive the expression for efficiency of a Carnot engine using the second law of thermodynamics. Define Carnot's refrigerator.
7. Derive Maxwell's thermodynamic relations. On their basis solve at least two simple physical problems.
8. What is first order phase transition? Derive the Clausius-Clapeyron equation for these transitions. Also, explain triple point with the help of suitable diagram.
9. State and explain Joule-Thomson effect. What is the third law of thermodynamics?
10. Write brief notes on *any Two* of the following :
 - (a) Reversible and irreversible processes.
 - (b) Adiabatic and isothermal changes
 - (c) Chemical potential
 - (d) Thermodynamical probability



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

Venue : 1st Floor Biscomaun Tower, Patna

Practical Counselling

<i>Date</i>	<i>Paper</i>	<i>Time</i>	<i>Roll No.</i>
07.04.2015 to 09.04.2015	I & II	11:15 AM to 3:15 PM	All Old Students & 140500001 to 140500030
10.04.2015 to 13.04.2015	I & II	11:15 AM to 3:15 PM	140500031 to 140500075
15.04.2015 to 17.04.2015	I & II	11:15 AM to 3:15 PM	140500076 to 140500125

Practical Examination

<i>Date</i>	<i>Paper</i>	<i>Time</i>	<i>Roll No.</i>
18.04.2015	I	11:15 AM to 2:15 PM	All Old Students & 140500001 to 140500030
	II	2:30 PM to 5:30 PM	
20.04.2015	I	11:15 AM to 2:15 PM	140500031 to 140500075
	II	2:30 PM to 5:30 PM	
21.04.2015	I	11:15 AM to 2:15 PM	140500076 to 140500125
	II	2:30 PM to 5:30 PM	

Nalanda Open University
Annual Examination - 2015
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. Describe the arrangements of Michelson-Morley experiment with the help of neat diagram. Discuss the theory of this experiment and describe the results so obtained.
2. Derive relativistic mass-energy equation: $E=mc^2$.
3. Give the theory of torsional oscillation of a suspended cylindrical solid wire and derive expression for its time-period.
4. Explain the terms: generalized co-ordinates, degrees of freedom, constraints differentiate between holonomic and non-holonomic constraints.
5. Evaluate the Fourier Coefficients in the solution of equation of vibration of a plucked string.
6. Derive Van der Waal's equation of state for real gases. Evaluate 'a' and 'b' in terms of P_c , V_c & T_c .
7. What is Carnet's Cycle? Find Efficiency of a Carnot's engine.
8. Derive Planck's law of radiation. Show that Wein's displacement law may be derived from Planck's law of radiation.
9. State and explain the first law of thermodynamics and hence obtain expression for (C_p-C_v) .
10. Write brief notes on *any Two* of the following:
 - (a) Lagrange's equation of motion.
 - (b) Ultrasonics
 - (c) Entropy
 - (d) Clausius-Clapeyron Equation



Nalanda Open University
Annual Examination - 2015
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. Describe the construction of Michelson's interferometer. Explain the theory of its working. How will you measure the difference in wavelength of D lines of sodium light?
2. What is a zone plate? Show that it has multiple focii compare the zone plate with convex lens.
3. Describe and explain the diffraction pattern formed by a narrow wire illuminated by monochromatic light from a narrow slit parallel to the wire. How is the thickness of the wire measured?
4. Give the theory of determination of wavelength of monochromatic light by measuring the diameters of Newton's rings.
5. What is Rayleigh's criterion of resolution? Deduce an expression for resolving power of a microscope.
6. What is Brewster's law? Show that when a ray is incident at the Brewster's angle the reflected ray is perpendicular to the refracted ray.
7. Give the construction and working of a Babinet's compensator.

Group - B

8. State Maxwell's equations and deduce the equation of a plane e.m. wave in free space. Show that the velocity of the wave is equal to C , the velocity of light.
9. What is Poynting's vector and Poynting's theorem? Deduce Poynting's theorem.
10. Show that in case of total internal reflection a phase difference is introduced between the \vec{E} vector in the plane of incidence and that in the plane perpendicular to it.

OR

Deduce the laws of reflection and the laws of refraction of e.m. waves.



For Examination and Practical Programme See Back Page

Nalanda Open University

Annual Examination - 2015

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. What is hysteresis? Show that the energy loss per unit volume per cycle of magnetization is equal to μ_0 times the area of the hysteresis loop.
3. Define π and σ and making use of the thermodynamic laws derive the relations (a) $\pi = T \cdot \frac{dE}{dT}$ (b) $\sigma = -T \cdot \frac{d^2E}{dT^2}$
4. Investigate the growth of current in an LCR circuit subjected to a steady e.m.f.
5. Give the theory of a Carey Foster's a.c. bridge. Draw the vector diagram when it is balanced.
6. Using j operator discuss the impedance of an LCR circuit.
7. Describe Thomson's method of determining e/m of electron.
8. Describe a Geiger Muller Counter and explain its working together with that of a dekatron.
9. Describe construction and the theory of working of a cyclotron. Obtain an expression for energy of the particle accelerated by it.
10. State and explain the law of photoelectric emission and describe experiment to verify them.



Programme of B.Sc. Part-II Physics (Hons.),
Practical Class and Practical Examination, 2015

Venue:- 1st Floor, Biscomaun Tower, Patna

(A) Practical Counselling Class

Date	Paper	Time	Roll No.
16.03.2015 to 17.03.2015	III & IV	11:15 AM to 3:15 AM	All Old Students
18.03.2015 to 19.03.2015	III & IV	11:15 AM to 3:15 AM	130500003 to 130500115

(B) Practical Examination

Date	Paper	Time	Roll No.
20.03.2015	III	11:15 AM to 2:15 AM	All Old Students
	IV	2:30 PM to 5:30 PM	
21.03.2015	III	11:15 AM to 2:15 AM	130500003 to 130500115
	IV	2:30 PM to 5:30 PM	

Nalanda Open University

Annual Examination - 2015

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. Explain the concept of 'electrical image'. Find the field due to a point charge and an infinite grounded conducting plane.
2. What is ferromagnetism? Explain ferromagnetism on the basis of domain theory. What is Curie's law?
3. Set up the equation for discharge of capacitor through a pure inductor and solve it. Discuss the results so obtained.
4. Applying the laws of thermodynamics to a thermoelectric circuit obtain the expression for thermo e.m.f. $E = \frac{\pi_1}{T}(T_2 - T_1)$
5. Discuss the theory of Anderson's a.c. bridge. What is the merit of this bridge?
6. Discuss Rutherford-Soddy's theory of radioactive decay and obtain expression for half-life.
7. Give a neat circuit diagram of a Hartley Oscillator and explain its working.
8. Give theory of determination of wavelength of sodium light by measuring the diameters of Newton's rings.
9. Discuss Fresnel's diffraction due to a straight edge. How is the wavelength of light determined from these diffraction fringes?
10. What is meant by resolving power of an optical instrument? Derive an expression for resolving power of a telescope.



Nalanda Open University, Patna

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

Practical Class and Practical Examination, 2015

Venue:- 4th Floor, Chemistry Lab, Biscomaun Bhawan, Patna

(A) Practical Counselling Class

<i>Date</i>	<i>Time</i>	<i>Hons. Subject</i>
30.03.2015	10:15 AM to 3:15 PM	<i>All Math (Hons.) Students</i>
31.03.2015	10:15 AM to 3:15 PM	<i>All Chemistry, Zoology & Geography (Hons.) Students</i>

(B) Practical Examination

<i>Date</i>	<i>Time</i>	<i>Hons. Subject</i>
01.04.2015	11:15 to 2:15 PM	<i>All Math (Hons.) Students</i>
	2:30 PM to 5:30 PM	<i>All Chemistry, Zoology & Geography (Hons.) Students</i>

Nalanda Open University
Annual Examination - 2015
B.Sc. Physics (Honours), Part-III
Paper-V (Mathematical Physics & Classical Mechanics)

Time: 3.00 Hrs.

Full Marks: 80

Answer any five questions. All questions carry equal marks.

1. Explain analytic function. Derive Cauchy-Riemann conditions for such function.
2. State and prove Cauchy's integral theorem.
3. Write down and solve Legendre's differential equation. Also, write the Legendre polynomial of n th order in compact form.
4. Find the solution of Laplace's equation in $\nabla^2\phi = 0$ in spherical polar co-ordinate system.
5. Using Forbenius method solve the differential equation $\frac{d^2y}{dx^2} + \alpha^2y = 0$.
6. (a) Show that energy tensor can be expressed as the sum of two tensors, one of which symmetric and the other skew symmetric.
(b) Show that by contraction the rank of a tensor is reduced by two.
7. Apply action-angle variables method to find time period of small oscillations of a simple pendulum.
8. What are Poisson's brackets? State and prove some of its properties.
9. Explain canonical transformation. Prove that the transformation $P = \frac{1}{2}(p^2 + q^2)$, $Q = \tan^{-1}\left(\frac{p}{q}\right)$ is canonical.
10. Write notes on any *Two* of the following :
 - (a) Moment of inertia of rigid body
 - (b) Lorent's theorem
 - (c) Principle of least action
 - (d) D'Alembert's principle



Examination Programme-2015

B.Sc (Part-III) Botany, Chemistry, Mathematics, Physics & Zoology Honours

Date	Papers	Time	Examination Centre
16/2/2015	Honours Paper-V	12 to 3 P.M	Nalanda Open University, Patna
18/2/2015	Honours Paper-VI	12 to 3 P.M	Nalanda Open University, Patna
20/2/2015	Honours Paper-VII	12 to 3 P.M	Nalanda Open University, Patna
23/2/2015	Paper -XV (General Studies)	12 to 3 P.M	Nalanda Open University, Patna
25/2/2015	Honours Paper-VIII	12 to 3 P.M	Nalanda Open University, Patna

Nalanda Open University
Annual Examination - 2015
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 are basic postulates of quantum mechanics? Explain correspondence principle in quantum mechanics.
2. Give the physical interpretation of wave function. Derive Schrodinger's equation for matter waves in both (i) time independent and (ii) time dependent cases.
3. Define expectation value of a quantum mechanical operator and show that it corresponds to a classical observable.
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. Give the possible states of the He-atom and its Hamiltonian. Also, find ground state of the He-atom and its energy.
6. Write down the fundamental assumptions of statistical mechanics. Define ensemble and distinguish between the three different types of ensembles.
7. What do you mean by statistical entropy. Obtain the expression for the entropy of a classical ideal gas. What is Gibb's paradox and how can it be solved?
8. Apply the grand canonical ensemble theory to obtain free energy and internal energy of a perfect gas.
9. Deduce Bose-Einstein statistics for bosons and obtain Planck's radiation formula using this statistics.
10. Explain Bose-Einstein condensation. How does it differ from ordinary condensation?

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Nalanda Open University
Annual Examination - 2015
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. Establish the covariance of Maxwell's equations under Lorentz transformation.
2. What are retarded and advanced potentials? Obtain retarded and advanced potentials by the solution of inhomogeneous wave equation. Give physical interpretation of these potentials.
3. Define plasma state and describe all plasma parameters. Define the concept of temperature in Plasma.
4. With the help of necessary diagrams of the experimental set-up describe the Stern-Gerlach experiment and show how it explains the existence of the magnetic moment of an electron due to its spin.
5. State and explain Paschen-Back effect. Give its quantum mechanical explanation.
6. Discuss the rotational spectra of diatomic molecule treated as a rigid rotator.
7. What is LASER? Explain its origin theoretically. Describe and explain the theory of working of a He-Ne laser.
8. Discuss spin magnetic moment and electric quadrupole magnetic moment associated with atomic nucleus.
9. Give an account of the 'liquid drop model' of nucleus. Explain 'magic number' for nuclei.
10. What do you mean by NMR spectroscopy? Describe with diagram, the continuous wave NMR spectrometer.



Programme of B.Sc. Part-III Physics (Hons.)
Annual Practical Counselling & Practical Examination - 2015

Venue : 4th Floor Biscomaun Bhawan, Patna - 800 001

Practical Counselling

Date	Time	Paper
27.02.2015 to 28.02.2015	11:30 AM to 3:30 PM	VII & VIII

Practical Examination

Date	Time	
	11:30 AM to 2:30 PM	2:45 AM to 5:45 PM
02.03.2015	Paper-VII	Paper-VIII

Nalanda Open University
Annual Examination - 2015
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 lattice energy? Calculate the lattice energy of an ionic crystal. Define Madlung constant and show that for an infinite line of ions, its value is $2 \log_e 2$ (or $2 \ln 2$).
2. Deduce Laue's equation of diffraction of X-rays and obtain Bragg's diffraction condition from them.
3. Discuss Kronig-Penny model for energy band structure of solids. Distinguish clearly between a metal, a semi conductor and an insulator on the basis of energy bands in solids.
4. Distinguish between Einstein's theory and Debye's theory of specific heat of solids. Discuss Debye's theory and explain why this theory is most successful.
5. State and prove :
(a) Superposition theorem and (b) Maximum power transfer theorem.
6. Define 'molar specific heat' (a) at constant pressure (b) at constant volume and the lattice heat capacity.
7. What is Zener diode? Explain its working and show with a neat diagram, its use as a voltage stabilizer.
8. What is an amplifier? Discuss the working of an R.C. coupled amplifier with a circuit diagram. Obtain expression for voltage gain.
9. Explain the principle of frequency modulation. Define frequency deviation and the modulation index for frequency modulated carrier.
10. What is photodiode? Discuss its working, characteristics and uses.



Programme of B.Sc. Part-III Physics (Hons.)
Annual Practical Counselling & Practical Examination - 2015

Venue : 4th Floor Biscomaun Bhawan, Patna - 800 001

Practical Counselling

<i>Date</i>	<i>Time</i>	<i>Paper</i>
27.02.2015 to 28.02.2015	11:30 AM to 3:30 PM	VII & VIII

Practical Examination

<i>Date</i>	<i>Time</i>	
	<i>11:30 AM to 2:30 PM</i>	<i>2:45 AM to 5:45 PM</i>
02.03.2015	Paper-VII	Paper-VIII