NALANDA OPEN UNIVERSITY

B.Sc. Physics (Hons.)

PART–I, PAPER–I

Annual Examination, 2013

Time : 3 Hours. **Full Marks : 80**

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

Group–A

1. State and prove Green's theorem in vector calculus. Use this theorem to evaluate the integral $\int_C \left[\left(x^2 + xy\right)dx + \left(x^2 + y^2\right)dy\right]$.

   Where C is a square formed by the lines $y = \pm 2,\ x = \pm 2$.

2. Describe the Cartesian, Spherical Polar and Cylindrical Coordinate system by indicating the position of a particle and infinitesimal volume element in each system. Draw all necessary diagrams.
3. Explain the following terms : Degrees of freedom, Constraints and Generalized Coordinates. Find out the degrees of freedom and the constraining equations for a particle moving on the inside surface of (a) a conical vessel & (b) a hemispherical bowl.
4. Use Lagrange's equations to find the necessary differential equations of motion of a compound pendulum.
5. State and explain the variational principle of least action. Use this to derive Lagrange's equations of motion.

Group–B

6. State clearly the basic postulates of the Special theory of Relativity. Derive the Lorentz transformation Equations using these Postulates.
7. Use Lorentz transformation to obtain (i) Doppler effect and (ii) Aberration of light.
8. Use the four dimensional formulation of relativity to obtain the equation for variation of mass with velocity.

Group–C

9. Formulate the differential equation for damped vibration in one dimension and solve it to obtain the motion of a particle undergoing damped vibration.
10. Write short notes on any two of the following :—
    (a) Kepler's laws of planetary motion.
    (b) Rutheford Scattering.
    (c) Ultrasonic Waves.

* * *

NALANDA OPEN UNIVERSITY

B.Sc. Physics (Hons.)

PART–I, PAPER–II

Annual Examination, 2013

Time : 3 Hours. **Full Marks : 80**

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

Group–A

1. Derive Maxwell's velocity distribution formula for the molecules of a gas stating clearly the assumptions mode. Use this formula to find the most probable velocity.
2. 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.
3. Deduce an expression for steady state temperature distribution along a uniform metal rod heated at one end.
4. Deduce Stefan-Boltzmann law using thermodynamics. Also, state and explain Wien's displacement law.
5. Use Debye's theory to find the formula for specific heat of a sold.

Group–B

6. State and explain Carrot's theorem. How do you obtain thermodynamical scale of temperature on the basis of this theorem.
7. Write down Maxwell's equations in thermodynamics and apply then to solve at least two simple physical problems.
8. What are the various methods of production of low temperature ? How can these temperatures be measured ?
9. What is thermodynamic probability ? Explain phase space representation of a particle. Also, give the statistical Interpretation of the 2nd law of thermodynamics.
10. Write short notes on any ***Two*** of the following :—
    (a) Joule-Thomson effect.
    (b) Clausius-Clapeyron equation.
    (c) Reversible and irreversible processes.

* * *

Nalanda Open University
Annual Examination - 2013
B.Sc. Physics (Subsidiary), Part-I
Paper-I

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

Answer any five questions. All questions are of equal value.

1. Draw a neat diagram to describe the Michelson–Morley experiment. Give experimental details and theory of this experiment and state clearly the inferences drawn from it.
2. Derive the relativistic law of addition of velocities in inertial frames of reference. Use this equation to find transformation rule for velocity of light.
3. Show that the electromagnetic wave equation $\nabla^2\phi - \frac{1}{c^2}\frac{\partial^2\phi}{\partial t^2} = 0$ retains its form under Lorentz transformation.
4. Discuss the trorsional oxillation of suspended cylinder and hence find the time period of oxillations.
5. Explain the terms: degrees of freedom; constraints & generalised coordinates. Differentiate between holonomic and non holonomic constraints by giving suitable examples.
6. Establish the differential equation for the propagation of one dimensional wave motion. Explain, with the help of diagrams, the concept of stationary waves and progressive waves.
7. Derive Maxwell's molecular velocity distribution law. Find the most probable speed on the basis of this law.
8. Explain 2nd law of thermodynamics. What is Carnot's theorem and Carnot cycle? Find the efficiency of a Carnot engine.
9. Derive Planck's law of radiation. Show that Wien's displacement law may be derived form Planck's law of radiation.
10. Write short notes on any two of the following:
    (a) Ultrasonics
    (b) Joule–Thomson effect
    (c) Lagrange's equations of motion
    (d) Lorentz Transformation and its consequences.

NALANDA OPEN UNIVERSITY

B.Sc. Physics (Hons.)

PART–II, PAPER–III

Annual Examination, 2013

Time : 3 Hours. **Full Marks : 80**

Answer Five Questions in all, selecting at least Three Question from Group 'A' and Two Question 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. What is Newton's Ring ? Give an experiment for the construction of these Rings. Prove that the diameters of dark rings are proportional to the square root of natural numbers. Explain the cause of darkness of central spot as seen by reflection.
3. State and explain the construction and working of Michelson interferometer. Explain how is the instrument used to find wavelength of light from a monochromatic source.
4. Deduce an expression for the resolving poser of a prism.
5. Describe the construction and working of Babinet's Compensator. How is it superior than a quarter wave plate ?
6. What is the basic principle of a laser ? Discuss the construction and working of Ruby laser.

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. Discuss the propagation of electromagnetic waves through a conducting medium.
9. Obtain Lorentz dispersion relation on the basis of electromagnetic theory for dispersion in gases.
10. Write notes on any ***Two*** of the following :—
    (a) Rayleigh's scattering.
    (b) Poynting's theorem.
    (c) Fresnel's relations.
    (d) Scalar and vector potentials.

* * *

Examination Programme, 2013

Bachelor of Science, Part–II

All Honours Subjects (B.Sc., Part–II के सभी विद्यार्थियों के लिए)

(Except B.Sc. Geography & Home Science) (B.Sc., Part–II भूगोल और गृह विज्ञान को छोड़कर)

Date	Paper	Time	Name of Examination Centre
03/6/2013	HONOURS PAPER – III	3.30 to 6.30 pm	Nalanda Open University, Patna
05/6/2013	HONOURS PAPER – IV	3.30 to 6.30 pm	Nalanda Open University, Patna
07/6/2013	(SUB.) (Botany -II)	8 to 11 am	Nalanda Open University, Patna
08/6/2013	(SUB.) (Math -II)	8 to 11 am	Nalanda Open University, Patna
10/6/2013	(SUB.) (Chemistry - II)	8 to 11 am	Nalanda Open University, Patna
11/6/2013	(SUB.) (Geography -II)	8 to 11 am	Nalanda Open University, Patna
12/6/2013	(SUB.) (Physics- II)	8 to 11 am	Nalanda Open University, Patna
13/6/2013	(SUB.) (Zoology - II)	8 to 11 am	Nalanda Open University, Patna
15/6/2013	(SUB.) (Home Science II)	8 to 11 am	Nalanda Open University, Patna
19/6/2013	Hindi 100 orUr 50+Hn50	3.30 to 6.30 pm	Nalanda Open University, Patna

NALANDA OPEN UNIVERSITY

B.Sc. Physics (Hons.)

PART–II, PAPER–IV

Annual Examination, 2013

Time : 3 Hours. **Full Marks : 80**

Answer any Five Questions. All questions carry equal marks.

1. Discuss the phenomenon of (a) Reflection and (b) Refraction of electromagnetic waves at the boundary of two non-conducting media.
2. Find the electrostatic potential due to a uniform circular disc of change 'q' and unit radius at a point on its axis.
3. Describe various methods for measuring strong magnetic fields.
4. Describe Weiss' theory of ferromagnetism. Discuss the temperature dependence of spontaneous magnetization.
5. Describe the principle, construction and working of a moving coil galvanometer and give its advantages over other galvanometers.
6. Give the principle and working of De Santy's bridge using necessary diagrams and vector diagrams.
7. Discuss the growth of change and current in an LCR circuit when a direct e.m.f. is applied to it.
8. Discuss Ruthenford-Soddy's theory of radioactive decay. Find expressions for Activity, Half life and Average life of a radioactive nucleus.
9. Give an account of Heisenberg's uncertainty principle. Outline an idealized experiment to bring out its significance.
10. Write short notes on any ***Two*** of the following :—
    (a) Classification of Elementary particles.
    (b) Nuclear fission.
    (c) Cyclotron.

* * *

: Important Notice :

Programme of B.Sc Part–II Physics (Hons.) Practical Counselling Classes and Examination–2013.

Practical Counselling Classes

Date	Time
26.06.2013 to 28.06.2013	12:00 to 4:00 PM

Practical Examinations

Date	Time	Paper
29.06.2013	11:30 AM to 2:30 PM	III
29.06.2013	2:45 PM to 5:45 PM	IV

Venue : Physics Lab 1st Floor Biscomaun Tower, Patna

NALANDA OPEN UNIVERSITY

B.Sc. (Hons.)
Physics Subsidiary
PART–II, PAPER–II
Annual Examination, 2013

Time : 3 Hours. **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. Also, describe Weiss theory of ferromagnetism and discuss the temperature dependence of spontaneous magnetization.
3. Describe, with a neat diagram, the construction and working of a moving coil ballistic galvanometer.
4. Give the theory of the oscillatory discharge of a condenser through a circuit containing an inductance and a resistance. Obtain an expression for the frequency.
5. Describe the Millikan's Oil Drop method of measurement of charge on an electron using neat diagram and derive the necessary formula.
6. (a) Deduce the law of radioactive decay.
   (b) Give the theory, action and uses of a Cyclotron.
7. (a) Give a full account of the structure and properties of nuclei.
   (b) Describe, briefly the nuclear liquid drop model.
8. What is Compton effect? Prove the formula $\Delta\lambda = \frac{h}{m_0 c}(1-\cos\phi)$ of wavelength shift in Compton effect. Explain why Compton effect is not experimentally observed for visible light.
9. Give the theory of Newton's rings and show how can it be used to find λ of sodium light.
10. What are solid state Lasers? Discuss the construction and working of Ruby Laser.

Nalanda Open University
Annual Examination - 2013
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. Write down and solve Legendre's differential equation. Also, write the Legendre polynomial of nth order in compact form.

2. (a) Use power series solution method to solve the differential equation:

$$\frac{d^2y(x)}{dx^2} - y(x) = 0$$

   (b) What is Dirac delta function? Show that $x\delta(x)=0.$

3. What is analytic function? Derive the Cauchy–Riemann conditions for such functions.

4. Discuss the various algebraic properties of tensors of arbitrary rank containing both covariant and contravariant indices.

5. State and prove Cauchy's Integral theorem.

6. (a) Write the Hamiltonian of a simple harmonic oscillator and then set up Hamilton's canonical equations for the system and find the time period.

   (b) Write down Lagrange's equations of motion for n-particle system and explain how these equations are used for solving dynamical problems.

7. What are Poisson's brackets? State and prove some of its properties.

8. 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.

9. Apply action-angle variables method to find the time period of small oscillations of a simple pendulum.

10. Write notes an any two of the following:-
    (a) Laurent's theorem
    (b) D' Alembert's principle
    (c) Motion of a symmetrical Top
    (d) Moment of Inertia of rigid body.

******

Examination Programme-2013
B.Sc (Part–III)
Botany, Chemistry, Mathematics, Physics, तथा Zoology Honours के सभी विद्यार्थियों के लिए

Date	Papers	Time	Examination Centre
30/4/2013	Honours Paper–V	3.30 to 6.30 p.m	Nalanda Open University, Patna
02/5/2013	Honours Paper–VI	3.30 to 6.30 p.m	Nalanda Open University, Patna
04/5/2013	Honours Paper–VII	3.30 to 6.30 p.m	Nalanda Open University, Patna
06/5/2013	Honours Paper–VIII	3.30 to 6.30 p.m	Nalanda Open University, Patna
08/5/2013	Paper –XV (Gen.Studies)	3.30 to 6.30 p.m	Nalanda Open University, Patna

Nalanda Open University
Annual Examination - 2013
B.Sc. Physics (Honours), Part-III
Paper-VI (Quantum Mechanics & Statistical Mechanics)

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

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

1. Derive Schrodinger's equations for matter waves in both (i) time independent and (ii) time dependent cases. What is the physical interpretation of wave function?
2. What are the basic postulates of quantum mechanics? Explain correspondence principle in quantum mechanics.
3. Write down and solve Schrodinger's equation for one dimensional infinite square well. Find expressions for Eigen values and normalized eigen functions for this case.
4. Solve the problem of one dimensional harmonic oscillator in quantum mechanics to obtain its eigen values & eigen functions .
5. Establish angular momentum operator in quantum mechanics and show that $[\hat{L}_x, \hat{L}_y] = \text{its}\,\hat{L}_Z$ and that $[\hat{L}^2, \hat{L}_x] = 0 = [\hat{L}^2, \hat{L}_y] = [\hat{L}^2, \hat{L}_Z]$.
6. Give the possible states of the He-atom and its Hamiltonian. Also, find the ground state of He-atom and its energy.
7. State the fundamental assumptions of statistical mechanics. Define ensemble and distinguish between three different types of ensembles.
8. Obtain the expression for the entropy of a classical ideal gas. What is Gibb's paradox and how can it be resolved?
9. Apply grand canonical ensemble theory to obtain free energy and internal energy of a perfect gas.
10. Deduce Bose–Einstein statistics for bosons and obtain Planck's radiation formula using this statistics.

******

Examination Programme-2013
B.Sc (Part–III)
Botany, Chemistry, Mathematics, Physics, तथा Zoology Honours के सभी विद्यार्थियों के लिए

Date	Papers	Time	Examination Centre
30/4/2013	Honours Paper–V	3.30 to 6.30 p.m	Nalanda Open University, Patna
02/5/2013	Honours Paper–VI	3.30 to 6.30 p.m	Nalanda Open University, Patna
04/5/2013	Honours Paper–VII	3.30 to 6.30 p.m	Nalanda Open University, Patna
06/5/2013	Honours Paper–VIII	3.30 to 6.30 p.m	Nalanda Open University, Patna
08/5/2013	Paper –XV (Gen.Studies)	3.30 to 6.30 p.m	Nalanda Open University, Patna

B.Sc.Part-III, Physics (H) Counselling and Practical Programme see the back page

Nalanda Open University
Annual Examination - 2013
B.Sc. Physics (Honours), Part-III
Paper-VII

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 do you mean by scalar and vector potentials? Show that they satisfy an inhomogeneous wave equation under Lorentz condition.
3. Discuss the microscopic and macroscopic properties of plasma. What do you mean by 'Plasma Oscillator'?
4. (a) What do you mean by quasineutrality of plasma? Also, explain Debye length and Debye shielding.
   (b) Obtain the value for Debye length and the no. of plasma particles within a Debye sphere in a plasma for the parametus.
   $$T = 10^3\,K \quad \text{and} \quad n_0 = 10^{15}/m^3$$
5. State and explain Paschen-Back effect. Use quantum mechanical treatment for explanation.
6. State and explain Moseley's law. Discuss the importance of Moseley's observations of X-ray spectra of different elements.
7. Discuss the rotational spectra of a diatomic molecule treated as a rigid rotator.
8. State and explain the principle of LASER. What is Laser spectroscopy and what are its applications?
9. Discuss the size, mass, mass defect and binding energy of atomic nucleus. Describe the variation of binding per nucleon with mass number and related consequences.
10. Give an account of the liquid, drop model of nucleus. Explain 'Magic Number' for nuclei.

******

Examination Programme-2013
B.Sc (Part–III)
Botany, Chemistry, Mathematics, Physics, तथा Zoology Honours के सभी विद्यार्थियों के लिए

Date	Papers	Time	Examination Centre
30/4/2013	Honours Paper–V	3.30 to 6.30 p.m	Nalanda Open University, Patna
02/5/2013	Honours Paper–VI	3.30 to 6.30 p.m	Nalanda Open University, Patna
04/5/2013	Honours Paper–VII	3.30 to 6.30 p.m	Nalanda Open University, Patna
06/5/2013	Honours Paper–VIII	3.30 to 6.30 p.m	Nalanda Open University, Patna
08/5/2013	Paper –XV (Gen.Studies)	3.30 to 6.30 p.m	Nalanda Open University, Patna

B.Sc.Part-III, Physics (H) Counselling and Practical Programme see the back page

Nalanda Open University
Annual Examination - 2013
B.Sc. Physics (Honours), Part-III
Paper-VIII

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 Madelung constant and show that for an infinite line of ion, its value is $2\log^2$.
2. Prove that in a three dimensional lattice, the separation between the lattice planes (h k l) along the three crystal axes a, b, c are a/h, b/k and c/l respectively. X rays of $\lambda=1.2\text{Å}$ suffer 1st order reflection from the (100) plane of a cubic crystal at the glancing angle of 13.5^0. Calculate the separation between the (100) planes of this crystal.
3. Deduce Laue's equation of diffraction of X-ray by a crystal. Show how Bragg's law follow from that equation.
4. Discuss Kronig–Penny model for energy band structure of solids. Distinguish clearly between a metal, semi conductor and insulators on the basis of energy bands in solids.
5. Distinguish between classical theory, Einstein's theory and Debye's theory of specific heat of solids. Give some features of Debye's theory and explain why is theory, most successful.
6. State and explain 'Super position theorem' and 'Maximum power transfer theorem'.
7. Discuss the functions of high pass filter and distinguish if from low pass filter using necessary diagrams.
8. What is an amplifier? Discuss the working of an R.C coupled amplifier with a neat circuit diagram. Give the 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 Zener diode? Explain its working and show with a neat diagram, its use as a 'voltage stabilizer'.

******

Examination Programme-2013
B.Sc (Part–III)
Botany, Chemistry, Mathematics, Physics, तथा Zoology Honours के सभी विद्यार्थियों के लिए

Date	Papers	Time	Examination Centre
30/4/2013	Honours Paper–V	3.30 to 6.30 p.m	Nalanda Open University, Patna
02/5/2013	Honours Paper–VI	3.30 to 6.30 p.m	Nalanda Open University, Patna
04/5/2013	Honours Paper–VII	3.30 to 6.30 p.m	Nalanda Open University, Patna
06/5/2013	Honours Paper–VIII	3.30 to 6.30 p.m	Nalanda Open University, Patna
08/5/2013	Paper –XV (Gen.Studies)	3.30 to 6.30 p.m	Nalanda Open University, Patna

B.Sc.Part-III, Physics (H) Counselling and Practical Programme see the back page