

# NALANDA OPEN UNIVERSITY

## B.Sc. Physics, Part-I

### PAPER-I (Honours)

(Methods of Mathematical Physics and Mechanics, Special Theory of Relativity, Waves and Vibration)

Annual Examination, 2022

Time : 3 Hours.

Full Marks : 80

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

#### GROUP 'A'

1. Explain divergence of a vector, State and prove Gauss divergence theorem.
2. State the Kepler's laws of planetary motion. On the basis of inverse square law of gravitation, deduce these laws.
3. Derive Rutherford scattering formula for the differential scattering cross-section for particles in the inverse square law of free field.
4. Explain the variational principle of least action. On its basis, derive Lagrange's equation of motion.
5. Show the position coordinates in Cartesian and Spherical polar coordinate systems. Give the infinitesimal volume element in both the systems.

#### GROUP 'B'

6. With help of neat diagram, 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 velocity 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? Discuss the theory of this motion with special case of over damped motion.
10. What are Ultrasonic waves? Give a brief account of their production and uses in practical life.



### EXAMINATION PROGRAMME, 2022

### B.Sc. Physics, Mathematics, Botany & Zoology (Hons.), Part-I

| Date       | Papers   | Time               | Examination Centre   |
|------------|--|--------------------|--|
| 19.12.2022 | Honours Paper-I  | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 21.12.2022 | Honours Paper-II   | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 22.12.2022 | Hindi Composition-100 or<br>Hindi-50 + Urdu-50 or Eng-50 | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 26.12.2022 | Chemistry (Sub)-I  | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 29.12.2022 | Physics (Sub)-I  | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 30.12.2022 | Botany (Sub)-I   | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 03.01.2023 | Mathematics (Sub)-I                                      | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 04.01.2023 | Zoology (Sub)-I  | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 06.01.2023 | Geography (Sub) P-I                                      | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 10.01.2023 | Home Science (Sub) P-I                                   | 2.30 PM to 5.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |

**NALANDA OPEN UNIVERSITY**

**B.Sc. Physics, Part-I**

**PAPER–II (Honours)**

(Heat, Thermodynamics and Statistical Physics)

**Annual Examination, 2022**

**Time : 3 Hours.**

**Full Marks : 80**

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

**GROUP 'A'**

1. Derive the expression for mean free path  $\lambda$  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 expression for average square displacement of particles. Compare with this 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 a system of gases is  $1/2KT$  per degree of freedom.

**GROUP 'B'**

6. Derive the expression for efficiency of carnot's engine using the laws of thermodynamics. Define carnot refrigerator.
7. Derive Clausius-Clapeyron equation of 1<sup>st</sup> order phase transition and explain triple point.
8. Write down Maxwell's equations in thermodynamics and apply them 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 end law of thermodynamics.



प्रायोगिक परामर्श कक्षा एवं प्रायोगिक परीक्षा का कार्यक्रम पार पृष्ठ पर देखें ।

**B.Sc. Part-I Physics (Hons.)***Programme for Practical Counselling Class & Practical Examination 2022***Venue : 1st Floor, Physics Lab, Biscomaun Tower, Patna****(For Enrollment No-190500001 to 190500200, 200500001 to 200500260)**

| <i>Counselling Class Programme</i> |                      | <i>Practical Examination</i> |             |                      |
|------------------------------------|----------------------|------------------------------|-------------|----------------------|
| <b>Date</b>                        | <b>Time</b>          | <b>Paper</b>                 | <b>Date</b> | <b>Time</b>          |
| <b>23.12.2022</b>                  | 10.00 AM to 04.00 PM | I (Hons)                     | 24.12.2022  | 10.00 AM to 01.00 PM |
|                                    |                      | II(Hons)                     | 24.12.2022  | 02.00 PM to 05.00 PM |

**(For Enrollment No-200500261 to 200500600)**

| <i>Counselling Class Programme</i> |                      | <i>Practical Examination</i> |             |                      |
|------------------------------------|----------------------|------------------------------|-------------|----------------------|
| <b>Date</b>                        | <b>Time</b>          | <b>Paper</b>                 | <b>Date</b> | <b>Time</b>          |
| <b>25.12.2022</b>                  | 10.00 AM to 04.00 PM | I (Hons)                     | 27.12.2022  | 10.00 AM to 01.00 PM |
|                                    |                      | II(Hons)                     | 27.12.2022  | 02.00 PM to 05.00 PM |

**(For Enrollment No-210500001 to 21050080)**

| <i>Counselling Class Programme</i> |                      | <i>Practical Examination</i> |             |                      |
|------------------------------------|----------------------|------------------------------|-------------|----------------------|
| <b>Date</b>                        | <b>Time</b>          | <b>Paper</b>                 | <b>Date</b> | <b>Time</b>          |
| <b>07.01.2023</b>                  | 10.00 AM to 04.00 PM | I (Hons)                     | 08.01.2023  | 10.00 AM to 01.00 PM |
|                                    |                      | II(Hons)                     | 08.01.2023  | 02.00 PM to 05.00 PM |

**(For Enrollment No-210500081 to 21050160)**

| <i>Counselling Class Programme</i> |                      | <i>Practical Examination</i> |             |                      |
|------------------------------------|----------------------|------------------------------|-------------|----------------------|
| <b>Date</b>                        | <b>Time</b>          | <b>Paper</b>                 | <b>Date</b> | <b>Time</b>          |
| <b>12.01.2023</b>                  | 10.00 AM to 04.00 PM | I (Hons)                     | 13.01.2023  | 10.00 AM to 01.00 PM |
|                                    |                      | II(Hons)                     | 13.01.2023  | 02.00 PM to 05.00 PM |

**(For Enrollment No-210500161 to 21050250)**

| <i>Counselling Class Programme</i> |                      | <i>Practical Examination</i> |             |                      |
|------------------------------------|----------------------|------------------------------|-------------|----------------------|
| <b>Date</b>                        | <b>Time</b>          | <b>Paper</b>                 | <b>Date</b> | <b>Time</b>          |
| <b>14.01.2023</b>                  | 10.00 AM to 04.00 PM | I (Hons)                     | 15.01.2023  | 10.00 AM to 01.00 PM |
|                                    |                      | II(Hons)                     | 15.01.2023  | 02.00 PM to 05.00 PM |

**(For Enrollment No-210500251 to 21050300)**

| <i>Counselling Class Programme</i> |                      | <i>Practical Examination</i> |             |                      |
|------------------------------------|----------------------|------------------------------|-------------|----------------------|
| <b>Date</b>                        | <b>Time</b>          | <b>Paper</b>                 | <b>Date</b> | <b>Time</b>          |
| <b>16.01.2023</b>                  | 10.00 AM to 04.00 PM | I (Hons)                     | 17.01.2023  | 10.00 AM to 01.00 PM |
|                                    |                      | II(Hons)                     | 17.01.2023  | 02.00 PM to 05.00 PM |

# NALANDA OPEN UNIVERSITY

## B.Sc. Physics, Part-I

### PAPER-I (Subsidiary)

*Annual Examination, 2022*

**Time : 3 Hours.**

**Full Marks : 80**

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

1. Derive mass-energy 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 plucked string.
5. Derive Stefan-Boltzmann law. Also, write down Wien's distribution law and Rayleigh-Jean's law.
6. Set up the Lagrangian for a one dimensional harmonic oscillator and obtain the Lagrange's equation & motion.
7. Derive Van-der Waals' equation of state for real gases. Evaluate 'a' & 'b' in terms of  $P_c$ ,  $V_c$  and  $T_c$ .
8. Derive Planck's law of radiation. Show that Wien's displacement law may be derived from Planck's law of radiation.
9. Explain the terms : degrees of freedom, Constraints and generalised co-ordinates. Differentiate between holonomic and non holonomic constraints by giving suitable examples.
10. Explain 2nd law of thermodynamics. Explain Carnot's theorem and Carnot cycle ? Find the efficiency of a Carnot engine.



### *Practical Counselling Classes and Practical Examination Programme, 2022 of*

### **B.Sc., Part-I (Physics Subsidiary, Paper-I)**

**Venue : Physics Lab, 1<sup>st</sup> Floor, Biscomaun Tower, Patna**

#### **PRACTICAL COUNSELLING CLASS PROGRAMME**

| Date       | Time   |  |  |  |
|------------|--|--|--|--|
|            | 9:00 AM to 11:00 AM  | 11:00 AM to 1:00 PM  | 1:00 PM to 3:00 PM   | 3:00 PM to 5:00 PM   |
| 27.01.2023 | Enrollment No. of Mathematics (Hons.) Students<br>200490001 to 200490600<br>210490001 to 210490050                         | Enrollment No. of Mathematics (Hons.) Students<br>210490051 to 210490120 | Enrollment No. of Mathematics (Hons.) Students<br>210490121 to 210490230                       | Enrollment No. of Mathematics (Hons.) Students<br>210490231 to 210490350   |
| 30.01.2023 | Enrollment No. of Chemistry (Hons.) Students<br>190470001 to 190470200<br>200470001 to 200470500<br>210470001 to 200470070 | Enrollment No. of Chemistry (Hons.) Students<br>210470071 to 210470300   | Enrollment No. of Zoology (Hons.) Students<br>200510001 to 200510700<br>210510001 to 210510420 | Enrollment No. of Zoology (Hons.) Students<br>210510421 to 210510650<br>All New & Old Students of Botany (Hons.), B.Sc. Yoga (H), B.Sc. Geography (Hons.) & B.Sc. Home Science (Hons.) |

#### **PRACTICAL EXAMINATION PROGRAMME**

| Date       | Time   |  |  |  |
|------------|--|--|--|--|
|            | 9:00 AM to 11:00 AM  | 11:00 AM to 1:00 PM  | 1:00 PM to 3:00 PM   | 3:00 PM to 5:00 PM   |
| 28.01.2023 | Enrollment No. of Mathematics (Hons.) Students<br>200490001 to 200490600<br>210490001 to 210490050                         | Enrollment No. of Mathematics (Hons.) Students<br>210490051 to 210490120 | Enrollment No. of Mathematics (Hons.) Students<br>210490121 to 210490230                       | Enrollment No. of Mathematics (Hons.) Students<br>210490231 to 210490350   |
| 31.01.2023 | Enrollment No. of Chemistry (Hons.) Students<br>190470001 to 190470200<br>200470001 to 200470500<br>210470001 to 200470070 | Enrollment No. of Chemistry (Hons.) Students<br>210470071 to 210470300   | Enrollment No. of Zoology (Hons.) Students<br>200510001 to 200510700<br>210510001 to 210510420 | Enrollment No. of Zoology (Hons.) Students<br>210510421 to 210510650<br>All New & Old Students of Botany (Hons.), B.Sc. Yoga (H), B.Sc. Geography (Hons.) & B.Sc. Home Science (Hons.) |

**Nalanda Open University**  
**Annual Examination - 2022**  
**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** Questions from group 'B'.  
 All questions carry equal marks.*

**Group - 'A'**

1. What is a Zone plate? Show that it has multiple focii. Compare the zone plate with convex lens.
2. Explain the formation of fringes in Febry-Perot interferometer. How would you use it for measurement of wavelength of light.
3. What do you understand by resolving power of an optical instrument ? Deduce an expression for resolving power of a microscope.
4. Describe the construction and working of a Babinet 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 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.

**Group - 'B'**

7. Deduce the laws of reflection and the laws of refraction of e.m. wave.
8. What are Poynting vector and Poynting theorem? Deduce Poynting theorem.
9. 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.
10. Write notes on any **Two** of the following:-
  - (a) Dispersion in gases
  - (b) Scattering of e.m. waves
  - (c) Pressure of radiation
  - (d) Einstein's 'A' and 'B' coefficient.



*Programme of B.Sc. Part-II Physics (Hons.),  
 Practical Counselling Class and Practical Examination Programme, 2022  
 Venue:- 1st Floor, Physics Lab, Biscomaun Tower, Patna*

**(A) Practical Counselling Class**

| Date       | Paper    | Time                 | Roll No.                                     |
|------------|----------|----------------------|--|
| 02.02.2023 | III & IV | 10:00 AM to 04:00 PM | All Old Students &<br>200500001 to 200500060 |
| 04.02.2023 | III & IV | 10:00 AM to 04:00 PM | 200500061 to 200500600                       |

**(B) Practical Examination**

| Date       | Paper | Time                 | Roll No.                                     |
|------------|-------|----------------------|--|
| 03.02.2023 | III   | 10:00 AM to 01:00 PM | All Old Students &<br>200500001 to 200500060 |
|            | IV    | 01:30 PM to 04:30 PM |  |
| 06.02.2023 | III   | 10:00 AM to 01:00 PM | 200500061 to 200500600                       |
|            | IV    | 01:30 PM to 04:30 PM |  |

**Nalanda Open University**  
**Annual Examination - 2022**  
**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 magnetisation.
3. Define  $\pi$  and  $\sigma$  and making use of the thermodynamic laws derive the relations  
 (a)  $\pi = T \frac{dE}{dT}$  (b)  $\sigma = -T \frac{d^2 E}{dT^2}$
4. Give the principle and working of De Sauty's bridge using necessary diagram.
5. Investigate the growth of current in an LCR circuit subjected to a steady e.m.f.
6. Describe the millikan's oil drop experiment to find the charge on an electron.
7. Obtain the resonance frequency of parallel resonance circuit. Discuss the sharpness of resonance of the circuit.
8. State and explain compton effect. How do you experimentally find the change in wavelength by compton effect.
9. Describe a Geiger Muller counter and explain its working together with that of a dekatron.
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  $6800\text{\AA}$  and  $h = 6.625 \times 10^{-34} \text{ Js}^{-1}$ .



*Programme of B.Sc. Part-II Physics (Hons.),  
 Practical Counselling Class and Practical Examination Programme, 2022  
 Venue:- 1st Floor, Physics Lab, Biscomaun Tower, Patna*

**(A) Practical Counselling Class**

| <i>Date</i> | <i>Paper</i> | <i>Time</i>                 | <i>Roll No.</i>  |
|-------------|--------------|-----------------------------|--|
| 02.02.2023  | III & IV     | <i>10:00 AM to 04:00 PM</i> | <i>All Old Students &amp;<br/>200500001 to 200500060</i> |
| 04.02.2023  | III & IV     | <i>10:00 AM to 04:00 PM</i> | <i>200500061 to 200500600</i>                            |

**(B) Practical Examination**

| <i>Date</i> | <i>Paper</i> | <i>Time</i>                 | <i>Roll No.</i>  |
|-------------|--------------|-----------------------------|--|
| 03.02.2023  | III          | <i>10:00 AM to 01:00 PM</i> | <i>All Old Students &amp;<br/>200500001 to 200500060</i> |
|             | IV           | <i>01:30 PM to 04:30 PM</i> |  |
| 06.02.2023  | III          | <i>10:00 AM to 01:00 PM</i> | <i>200500061 to 200500600</i>                            |
|             | IV           | <i>01:30 PM to 04:30 PM</i> |  |

**Nalanda Open University**  
**Annual Examination – 2021**  
**(Only for Yoga Hon's)**  
**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. What is LASER? Discuss the construction and working of Ruby Laser.
2. Discuss the growth of charge in a d.c. circuit having resistance, inductance & capacitance.
3. Describe the millikan's Oil Drop method of measurement of charge on an electron using neat diagram and derive the necessary formula.
4. Define electric Intensity  $\vec{E}$ , electric polarisation  $\vec{P}$  and electric displacement  $\vec{D}$  and establish a relation between them.
5. State Brewster's law. How will you change unpolarised light into plane polarised light by reflection? What is double refraction.
6. Explain Seeback effect, Peltier effect and Thomson effect. Define Peltier Coefficient and derive its expression. What is Thomson's coefficient.
7. Give an account of Borh's theory of hydrogen atom .
8. Distinguish between Dia, para and ferro magnetism. Give Langevin's theory of para magnetism.
9. Give the theory of Newton's ring and show how can it be used to find  $\lambda$  of sodium light.
10. What is photoelectric effect? Derive Einstein's photoelectric equation.



B.Sc. Zoology, Chemistry & Physics (Subsidiary), Part II, Practical Exam 2021  
**[For B.Sc Yoga (Hons. Part-II Students)]**

Venue: For Zoology - 1st Floor, Zoology Lab, Biscomaun Tower, Patna-1

For Physics- 1st Floor, Physics Lab, Biscomaun Tower, Patna-1

For Chemistry- 1st Floor, Chemistry Lab, Biscomaun Tower, Patna-1

**Annual Practical Examination 2021**

| Date       | Time                   |                      |
|------------|------------------------|----------------------|
|            | 11.00 AM to 2.00 PM    | 2.30 PM to 05.30 PM  |
| 29.09.2022 | -----                  | Zoology (Subsidiary) |
| 30.09.2022 | Chemistry (Subsidiary) | Physics (Subsidiary) |

**Nalanda Open University**  
**Annual Examination – 2022**  
**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 polarisation  $\vec{P}$  and electric displacement  $\vec{D}$  and establish a relation between them.
2. Distinguish between Dia, para and ferro magnetism. Give Langevin's theory of para magnetism.
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, Peltier effect and Thomson effect. Define Peltier Coefficient and derive its expression. What is Thomson's coefficient.
5. What is photoelectric effect? Derive Einstein's photoelectric equation.
6. Discuss the growth of charge in d.c. circuit having resistance, inductance & capacitance.
7. Give the theory of Newton's ring and show how can it be used to find  $\lambda$  of sodium light.
8. What is LASER? 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 Borh's theory of hydrogen atom .



**Nalanda Open University, Patna**  
**Programme of B.Sc. Part-II Physics (Subsidiary),**  
**Practical Class and Practical Examination, 2022**  
**Venue:- 1st Floor, Physics Lab, Ist Floor Biscomaun Tower, Patna**

**(A) Practical Counselling Class**

| <i>Date</i> | <i>Time:- 10.30 AM to 01.00 PM</i>  | <i>Time:- 01.30 PM to 04.30 PM</i>      |
|-------------|---|---|
| 07.02.2023  | All B.Sc. Zoology(H) B.Sc. Yoga(H) B.Sc. Geo (H) B.Sc. H. Science. (H) B.Sc. Botany(H) Students | _____                                   |
| 09.02.2023  | All Chemistry(Hon's) Students   | Math(H) Student<br>160490001-200490080  |
| 11.02.2023  | Math (Hon's) Students<br>200490081-200490270  | Math(H) Students<br>200490271-200490600 |

**(B) Practical Examination**

| <i>Date</i> | <i>Time:- 10.00 AM to 01.00 PM</i>  | <i>Time:- 130.00 PM to 04.30 PM</i>     |
|-------------|---|---|
| 08.02.2023  | All B.Sc. Zoology(H) B.Sc. Yoga(H) B.Sc. Geo (H) B.Sc. H. Science. (H) B.Sc. Botany(H) Students | _____                                   |
| 10.02.2023  | All Chemistry(Hon's) Students   | Math(H) Student<br>160490001-200490080  |
| 13.02.2023  | Math (Hon's) Students<br>200490081-200490270  | Math(H) Students<br>200490271-200490600 |



**Nalanda Open University, Patna**  
**Programme of B.Sc. Part-II Physics (Subsidiary),**  
**Practical Class and Practical Examination, 2022**  
 Venue:- 1st Floor, Physics Lab, Ist Floor Biscomaun Tower, Patna

**(A) Practical Counselling Class**

| <i>Date</i> | <i>Time:- 10.30 AM to 01.00 PM</i>  | <i>Time:- 01.30 PM to 04.30 PM</i>      |
|-------------|---|---|
| 07.02.2023  | All B.Sc. Zoology(H) B.Sc. Yoga(H) B.Sc. Geo (H) B.Sc. H. Science. (H) B.Sc. Botany(H) Students | —————                                   |
| 09.02.2023  | All Chemistry(Hon's) Students   | Math(H) Student<br>160490001-200490080  |
| 11.02.2023  | All Math (Hon's) Students<br>200490081-200490270  | Math(H) Students<br>200490271-200490600 |

**(B) Practical Examination**

| <i>Date</i> | <i>Time:- 10.00 AM to 01.00 PM</i>  | <i>Time:- 130.00 PM to 04.30 PM</i>     |
|-------------|---|---|
| 08.02.2023  | All B.Sc. Zoology(H) B.Sc. Yoga(H) B.Sc. Geo (H) B.Sc. H. Science. (H) B.Sc. Botany(H) Students | —————                                   |
| 10.02.2023  | All Chemistry(Hon's) Students   | Math(H) Student<br>160490001-200490080  |
| 13.02.2023  | All Math (Hon's) Students<br>200490081-200490270  | Math(H) Students<br>200490271-200490600 |

# Nalanda Open University

Annual Examination - 2022

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

Paper-V (Mathematical Physics and Classical Mechanics)

Time: 3.00 Hrs.

Full Marks: 80

Answer any five questions. All questions carry equal marks.

- (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  $x\delta(x) = 0$
- Discuss the solution of Laplace's equation  $\nabla^2\phi = 0$  in spherical polar coordinates.
- State and prove Cauchy's Residue theorem.
- State and prove Laurent's theorem.
- Write Lagrangian of motion of a double pendulum and deduce the frequency of its motion.
- What are Poisson's brackets? State and prove some of its properties.
- Derive the equation of motion of a symmetric top. Discuss the spherical case of a sleeping top.
- Explain canonical transformation. Prove that the transformation  $P = \frac{1}{2}(p^2 + q^2)$ ,  
 $Q = \tan^{-1}\left(\frac{p}{q}\right)$  are canonical.
- Apply action-angle variables method to find time period of small oscillation of a simple pendulum.
- Write notes on any Two of the following :-
  - M.I. of rigid body.
  - D'Alembert's principle
  - Hamilton's equation of motion
  - Principle of least action.



## EXAMINATION PROGRAMME-2022 B.Sc. Physics & Chemistry (Hons.), Part-III

| Date       | Papers                     | Time                | Examination Centre   |
|------------|----------------------------|---------------------|--|
| 03.01.2023 | Paper-V                    | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 04.01.2023 | Paper-VI                   | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 06.01.2023 | Paper-VII                  | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 07.01.2023 | Paper-VIII                 | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 09.01.2023 | Paper-XV (General Studies) | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |

# NALANDA OPEN UNIVERSITY

## B.Sc. Physics, Part-III

### PAPER-VI (Honours)

(Quantum Mechanics and Statistical Mechanics)

**Annual Examination, 2022**

**Time : 3 Hours.**

**Full Marks : 80**

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

1. Derive Schrodinger equation in both the time dependent & time independent cases. What are stationary states?
2. Write uncertainty principle for three sets of canonical variables. Derive Heisenberg's uncertainty relation for the position and momentum variables.
3. 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.
4. Write down the Schrodinger equation for one dimensional potential barrier of height ' $V_0$ ' and width ' $a$ '. Calculate the transmission probability when the energy  $E > V_0$ .  $E$  represents the energy of the particle.
5. What are symmetric and anti-symmetric wave functions ? Discuss the symmetry of a wave function in detail.
6. State and prove Liouville's theorem.
7. Establish the Fermi-Dirac distribution formula and hence obtain an expression for Fermi Energy.
8. Deduce Planck's radiation formula on the basis of Bose-Einstein statistics.
9. Define ensemble and distinguish between three different types of ensemble.
10. Find the relation between pressure and temperature of vapour treated as a gas during liquid-vapour transition.



### EXAMINATION PROGRAMME-2022

### B.Sc. Physics & Chemistry (Hons.), Part-III

| Date       | Papers                     | Time                | Examination Centre   |
|------------|----------------------------|---------------------|--|
| 03.01.2023 | Paper-V                    | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 04.01.2023 | Paper-VI                   | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 06.01.2023 | Paper-VII                  | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 07.01.2023 | Paper-VIII                 | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |
| 09.01.2023 | Paper-XV (General Studies) | 10.30 AM to 1.30 PM | Nalanda Open University,<br>2 <sup>nd</sup> Floor, Biscomaun Bhawan, Patna |

# NALANDA OPEN UNIVERSITY

## B.Sc. Physics, Part-III

### PAPER-VII (Honours)

(Classical Electrodynamics, Plasma Physics, Physics of Atoms, Molecules & Nuclei)

**Annual Examination, 2022**

**Time : 3 Hours.**

**Full Marks : 80**

*Answer any Five Questions.*

*All Questions carry equal marks.*

1. Write Maxwell's field equations and discuss their covariance under Lorentz transformations.
2. Explain electromagnetic field tensor. Find all the sixteen components of it in terms of electric and magnetic fields.
3. What is Lienard-Wiechert potential? On its basis, obtain electric and magnetic field intensity due to a uniformly moving charge.
4. Discuss the microscopic and macroscopic properties of plasma. Explain quasineutrality of Plasma and Debye shielding and Debye length.
5. Give the theory of rotational spectra of diatomic molecules treated as a non rigid rotator.
6. Distinguish between normal and anomalous Zeeman effects. How are they explained theoretically?
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 quadrupole moment associated with an atomic 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. 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 - 2022

Venue : 1st Floor, Physics Lab, Biscomaun Tower, Patna - 800 001

#### *Practical Counselling*

| <i>Date</i> | <i>Paper</i> | <i>Time</i>          | <i>Roll No</i>         |
|-------------|--------------|----------------------|------------------------|
| 18.01.2023  | VII & VIII   | 10.00 AM to 04.00 PM | All Old & New Students |

#### *Practical Examination*

| <i>Date</i> | <i>Paper</i> | <i>Time</i>          | <i>Roll No</i>         |
|-------------|--------------|----------------------|------------------------|
| 19.01.2023  | VII          | 10.00 AM to 01.00 PM | 170500001 to 190500060 |
|             | VIII         | 01.30 PM to 04.50 PM |                        |
| 20.01.2023  | VII          | 10.00 AM to 01.00 PM | 190500061 to 190500300 |
|             | VIII         | 01.30 PM to 04.50 PM |                        |

# NALANDA OPEN UNIVERSITY

## B.Sc. Physics, Part-III

### PAPER–VIII (Honours)

(Condensed Matter Physics & Electronics)

**Annual Examination, 2022**

**Time : 3 Hours.**

**Full Marks : 80**

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

1. Discuss Van-der-walls binding. Obtain expression for the total potential energy of pairs of atoms in the crystal on the basis of this theory.
2. What is space lattice ? Describe various types of lattices in the cubic system. Show that for a simple cubic lattice,  $d_{100}:d_{110}:d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$
3. Explain Hall effect. Define Hall coefficient and give its importance. How are they determined in the laboratory ?
4. Explain Drude-Lorentz Theory. Derive Wiedmann-Franz relation between thermal and electrical conductivities on the basis of this theory.
5. Explain energy band. On the basis of energy bands of solids distinguish between a metal, a semiconductor and an insulator.
6. State and explain Thevenin's theorem. Giving an example show how this theorem helps in circuit analysis.
7. What is photodiode ? Discuss its working, characteristics and uses.
8. What is filter circuit ? Give their classification and describe elementary filter theory.
9. Explain the principle of frequency modulation. Define frequency deviation and modulation index for a frequency modulated carrier.
10. What is an amplifier ? Giving a neat circuit diagram discuss the working of an R.C. coupled amplifier. Explain voltage gain.



### Programme of B.Sc. Part-III Physics (Hons.)

#### Annual Practical Counselling & Practical Examination - 2022

Venue : 1st Floor, Physics Lab, Biscomaun Tower, Patna - 800 001

#### *Practical Counselling*

| <i>Date</i> | <i>Paper</i> | <i>Time</i>          | <i>Roll No</i>         |
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