D–5096

Sub. Code
34511

DISTANCE EDUCATION

M.Sc.(Physics) DEGREE EXAMINATION, DEC 2020.

First Semester

CLASSICAL MECHANICS

(CBCS 2018–19 Academic Year onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. What are degrees of freedom?

2. Define principle of virtual work.

3. What are ignorable co-ordinates?

4. Define Poisson bracket.

5. Show that [q, q] = 0.

6. What is length contraction?

7. State the general theory of relativity.

8. What are the principal axes of a rigid body?

9. Write a note on normal modes of small oscillations.

10. What are the Eigen values of small oscillations?

PART B — ($5 \times 5 = 25$ marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) State and prove D'Alembert's principle.

Or

(b) Obtain the equation of motion of a simple pendulum by using Lagrange method.

12. (a) Derive Hamilton's equations of motion.

Or

(b) Derive Hamilton's Jacobi equation for a conservative system.

13. (a) What is frame of reference? Show that a frame of reference having a uniform rectilinear motion relative to an inertial frame is also inertial.

Or

(b) The spectral line of $\lambda = 5000$ Å in the light coming from a distant star is observed at 5200 Å. Find the recessional velocity of the star.

14. (a) Discuss Eulerian angles.

Or

(b) Derive the kinetic energy of a rigid body rotating about the fixed axis.

15. (a) Derive the secular equation for small oscillations.

Or

(b) Derive the normal coordinates and normal frequencies of a linear triatomic molecule.

PART C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Derive Lagrange's equations from D'Alembert's principle.

17. Derive the Routhian equation of motion for a system with cyclic coordinates.

18. Derive the principle of least action for a conservative system.

19. State and prove Kepler's laws of planetary motion.

20. Derive the Lagrangian equations of motion for small oscillations of a linear triatomic molecule.

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D–5097

Sub. Code
34512

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, DEC 2020.

First Semester

MATHEMATICAL PHYSICS – I

(CBCS 2018-19 Academic year onwards)

Time : Three hours Maximum : 75 marks

PART A — ($10 \times 2 = 20$ marks)

Answer ALL the questions.

1. Prove that div $grad\,\varphi = \nabla^2\varphi$.

2. Evaluate $\iiint_V \left(x^2 + y^2 + z^2\right) dx\,dy\,dz$ where V is sphere having center at origin and radius equal to a.

3. Show that the spherical polar coordinate system is orthogonal.

4. What is the characteristics equation of a matrix $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$.

5. Show that eigen values of a Hermitian matrix are real.

6. Show that $\Gamma\frac{1}{2} = \sqrt{\pi}$.

7. Show that the Legendre's equation is self adjoint.

8. Write the Rodrigue's formula for legendre polynomial. Hence find the value of $P_1(x)$ and $P_2(x)$.

9. Write the infinite Fourier cosine and sine transforms.

10. Find the Laplace transform of t_n, $n > -1$.

PART B — ($5 \times 5 = 25$ marks)

Answer ALL the questions Choosing either (a) or (b)

11. (a) Evaluate $\iiint (\nabla \times F) dV$ where V is the closed region bounded by the plane $x = 0$, $y = 0$, $z = 0$ and $2x + 2y + z = 4$ and $F = (2x^2 - 3z)i - 2yj - 4xk$.

Or

(b) Express the following quantities in cylindrical coordinates.

(i) $\nabla \cdot A$

(ii) $\nabla \times A$

(iii) $\nabla^2 \varphi$

12. (a) Find the rank of the matrix A where $A = \begin{pmatrix} 1 & -1 & 3 & 6 \\ 1 & 3 & -3 & -4 \\ 5 & 3 & 3 & 11 \end{pmatrix}$.

Or

(b) Using gamma function, show that $\int_0^1 \frac{35x^2}{32\sqrt{1-x}}\, dx$.

13. (a) Obtain the Rodrigue's formula for Legendre's polynomials.

Or

(b) Prove that $H_n'(x) = 2nH_{n-1}(x)$.

14. (a) Obtain the expression for the generating function of Laguerre polynomials.

Or

(b) Prove that the Recurrence formula $xJ_n'(x) = nJ_n(x) - xJ_{n+1}(x)$.

15. (a) State and prove convolution theorem of Fourier transform.

Or

(b) Obtain the Laplace transform of the function $F(t) = \sinh at \sin at$.

PART C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. State and prove Guass's divergence theorem.

17. Diagonalize the following matrix $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$.

18. Discuss orthogonality of Bessel's function of function of first kind. Also prove that $2_n J_n(x) = x[J_{n-1}(x) + J_{n+1}(x)]$.

19. Prove that

(a) $\int_0^\infty e^{-\lambda y} y^{n-1} dy = \frac{\Gamma n}{\lambda^n}$

(b) $\Gamma n = \int_0^1 \left\{ \log e \frac{1^{n-1}}{y} \right\} dy$

(c) $\Gamma n = \frac{1}{n} \int_0^\infty e^{-y1/n} dy$

(d) $\Gamma 1/2 = \sqrt{\pi}$.

20. (a) Find the finite sine transform of e^{ax} .

(b) Find the inverse Fourier transform of $e^{-\lambda n}$.

(c) Find the Laplace transform of $\sinh at$ and $\cosh at$.

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D–5098

Sub. Code
34513

DISTANCE EDUCATION

M.Sc.(Physics) DEGREE EXAMINATION, DEC 2020.

First Semester

LINEAR AND INTEGRATED ELECTRONICS

(CBCS 2018–19 Academic Year onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Describe the difference between donor and acceptor impurities.

2. Define Peak inverse voltage and breakdown voltage of a diode.

3. Write down the advantages and disadvantages of a Schottky diode.

4. What is the difference between NPN and PNP transistors?

5. What is faithful amplification?

6. What is Q point in BJT?

7. What is the difference between JFET and bipolar transistor?

8. What are the applications of RC phase shift oscillator?

9. What is offset voltage in op-amp?

10. What do you mean by slew rate of an OP-amp?

PART B — (5 × 5 = 25 marks)

Answer ALL questions choosing either (a) or (b)

11. (a) Draw and explain the forward and reverse V-I characteristics of a zener diode.

Or

(b) What is a Shockley diode? Explain the construction working of a Shockley diode.

12. (a) How will you determine the input and output characteristics of CB connection experimentally?

Or

(b) Describe the potential divider method in detail. How stabilization of operating point is achieved by this method.

13. (a) Explain the working of push pull amplifier with a neat circuit diagram.

Or

(b) Show that maximum collector efficiency of class A transformer coupled power amplifier is 50%.

14. (a) Define the JFET parameters and establish the relationship between them.

Or

(b) Explain the construction and working of a DIAC.

15. (a) Discuss the operation of OP-amp subtractor.

Or

(b) Discuss the operation of OP-amp differentiator.

PART C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Describe the various methods used for transistor biasing. State their advantages and disadvantages.

17. Draw the V-I characteristics of an SCR. What do you infer from them?

18. With a neat diagram, explain the construction working of Wien bridge oscillator also state its applications.

19. Construct analog computer to solve any second order linear differential equation with arbitrary coefficients. How do you solve a differential equation with constant coefficient using analog computation?

20. What are active filters? Explain how band-pass and high-pass filter can be constructed using op-amp.

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D–5102

Sub. Code
34531

DISTANCE EDUCATION

M.Sc.(Physics) DEGREE EXAMINATION, DEC 2020.

Third Semester

MOLECULAR SPECTROSCOPY

(CBCS 2018–19 Academic Year onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Outline briefly the molecular orbital method.
2. Give the importance of stark effect studies in microwave spectroscopy.
3. Homonuclear diatomic molecules do not show vibrational spectra. Why?
4. Explain the effect of an harmonicity on the vibrational spectra of diatomic molecules.
5. What is nuclear quadrupole moment?
6. Distinguish between dissociation energies D_C and D_O.
7. Why very intense light sources are needed for the observation of non–linear Raman effects?
8. Write short note on multiphoton absorption.
9. Explain Larmor precession. What is larmor frequency?
10. What is a Mossbauer spectrum?

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Explain the effect of isotopic substitution on the rotational spectrum of a diatomic molecule.

Or

(b) Distinguish between Raman spectroscopy and infrared spectroscopy.

12. (a) What are stokes and antistokes lines? How are they explained using quantum theory?

Or

(b) Discuss the rule of mutual exclusion regarding Raman and IR activities.

13. (a) Write short notes on : Born oppenheimer approximation and Frank – Condon principle. Give their significance in electronic spectroscopy.

Or

(b) Explain inverse Raman effect in detail.

14. (a) What is multiphoton spectroscopy? Explain the multiphoton absorption.

Or

(b) Explain briefly the theory of NMR spectroscopy. Write a note on chemical shift.

15. (a) Give the theory of the interaction between the spin and a magnetic field.

Or

(b) Explain spin-lattice relaxation and spin-spin relaxation.

PART C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Discuss in detail, the Heitler – London theory for hydrogen molecule.

17. Outline the theory of vibrational spectra of diatomic molecules and polyatomic molecules.

18. Give the preliminaries of non–linear Raman phenomena. Explain hyper Raman scattering and stimulated Raman scattering.

19. Describe Frank-Condon principle in emission and absorption. Explain the intensity distribution on the absorption spectra of diatomic molecules.

20. Explain the following applications of Mossbauer spectroscopy:

    (a) Electronic structure

    (b) Molecular structure

    (c) Crystal symmetry and magnetic structure

    (d) Surface studies.

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D–5103

Sub. Code
34532

DISTANCE EDUCATION

M.Sc.(Physics) DEGREE EXAMINATION, DEC 2020.

Third Semester

QUANTUM MECHANICS – II

(CBCS 2018–19 Academic Year onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Write any two properties of Pauli's spin matrices.
2. What are the differences between Hartee and Hartee Fock equation?
3. State Born approximation.
4. What is the order of Klein Gordon equation?
5. State optical theorem.
6. State the role of Greens function in scattering theory.
7. Write the physical significance of scattering amplitude in scattering theory.
8. Differentiate partial wave analysis and Born approximation to calculate scattering amplitude.
9. What is meant by second quantization of relativistic field?
10. Show that $\sigma_x\sigma_y + \sigma_y\sigma_z = 0$ where σ_x, σ_y and σ_z are Paulis spin matrices.

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Prove that (i) $[J_z, J_+] = \hbar J_+$ and (ii) $[J_+, J_-] = 2\hbar J_z$ where $J_+ = J_x \pm i J_y$.

Or

(b) If σ_x, σ_y and σ_z are pauli spin matrices for any two constant vectors A and B show that

$$(\vec{\sigma} \cdot \vec{A})\,(\vec{\sigma} \cdot \vec{B}) = \vec{A} \cdot \vec{B} + i\vec{\sigma}(\vec{A} \times \vec{B})$$

12. (a) Derive the eigen value spectrum of J^2 and J_z.

Or

(b) Derive Wein Gordon equation. Hence obtain the equation of continuity and explain the term probability density $\rho(x, t)$ and current density $S(x, t)$.

13. (a) (i) The dimension of Dirac matrices is 4. Why?

(ii) Obtain the anticommutation relations between Dirac matrices.

Or

(b) Show how you would obtain the quantized form of the Hamiltonian of the non relativistic field. Discuss the results.

14. (a) Explain the significance of negative energy state.

Or

(b) Explain the quantization of electromagnetic field.

15. (a) Define (i) differential scattering and (ii) total scattering cross – sections. What is scattering amplitude.

Or

(b) Calculate the differential scattering cross-section for a screened coulomb potential

$$V(r) = \frac{-Ze^2}{r} e^{-\chi r} \text{ where } \chi = \frac{1}{a}.$$

PART C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Derive Dirac relativistic equation for a free particle and find its solution.

17. Derive an expression for scattering amplitude using partial wave analysis and deduce optical theorem.

18. Prove that the symmetry of the wave function is invariant with respect to time for a system of identical particles. Formulate Pauli's principle for N-particle system. State the physical significance of the principle.

19. Outline the method of addition of two angular momenta. Evaluate the Clebsch Gordon coefficients for two spin half particles.

20. Solve the Klein Gordon equation under coulomb potential.

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D–5104	Sub. Code
	34533

DISTANCE EDUCATION

M.Sc.(Physics) DEGREE EXAMINATION, DEC 2020.

Third Semester

MICROPROCESSOR AND ELECTRONIC INSTRUMENTATION

(CBCS 2018–19 Academic Year onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. What are the status flags used in 8085 microprocessor?

2. What is the function of LOCK pin in 8086 microprocessor?

3. Briefly explain any four instructions in logical group instructions.

4. What do you men by interrupt?

5. Give the differences between microprocessor and microcontroller.

6. What do you mean by hardware and software interrupts?

7. What are the internal registers used in 8259 PIC?

8. What do you mean by synchronous data transfer?

9. How will you classify transducers?

10. Give some examples of displacement transducers.

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Explain the addressing modes of microprocessor 8085.

Or

(b) Draw the pin configuration of microprocessor 8086 and explain its functions.

12. (a) Write an assembly language programme to find the smallest number between the given two numbers.

Or

(b) Explain the arithmetic and logical group instructions in 8085 microprocessor.

13. (a) Give the data transfer and branch control group instructions in 8051 microcontroller.

Or

(b) Explain the pin configuration of 8259 PIC.

14. (a) Explain the pin configuration of 8251 PCI.

Or

(b) What do you mean by sample and hold technique? Explain the working of sample and hold circuits.

15. (a) Give the construction and working of bonded strain gauges.

Or

(b) Explain the construction of photovoltaic transducers.

PART C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Draw the architecture of microprocessor 8085 and explain its features in detail.

17. Give the flow chart and write an assembly language programme for traffic control system.

18. Explain the interrupt structure of 8051 microcontroller.

19. What are the data transfer schemes involved in microprocessor? Explain in detail.

20. What is called thermistor? Explain its applications.

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D–6494

Sub. Code
34541

DISTANCE EDUCATION

M.Sc. DEGREE EXAMINATION, DECEMBER 2020.

Fourth Semester

Physics

CONDENSED MATTER PHYSICS

(CBCS 2018 – 2019 Academic Year Onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Explain Wigner–Seitz cell.
2. Describe briefly the symmetry elements.
3. What is the main difference between free electron theory and band theory?
4. What is polarizability?
5. Explain pyro electricity.
6. What are magnons?
7. What do you mean by coherence length?
8. What are cooper pairs?
9. What is ferromagnetism?
10. Explain the Lorentz field.

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Obtain a relation between crystal lattice axes and crystal reciprocal lattice axes.

Or

(b) Explain the Miller indices of crystal planes, and also simple cubic crystal structures.

12. (a) Explain the various types of bending in solids.

Or

(b) Explain quantisation of lattice vibrations.

13. (a) Explain the Kronig–Penny model.

Or

(b) Derive the Clausius– Mosotti relation in dielectrics subjected to static fields.

14. (a) Describe the origin of ferromagnetic domains.

Or

(b) Give a brief account of the quantum theory of para magnetism.

15. (a) Describe the Meissner effect and distinguish between Type-I and Type-II super conductors.

Or

(b) Explain high temperature superconductors.

PART C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. With a neat sketch, describe the various types of three dimensional lattices.

17. What is Fermi energy? Discuss the free electron gas in three dimensions and arrive at an expression for the density of states.

18. Discuss in detail the three types of polarizations and their dependence on temperature.

19. Distinguish between ferromagnetic, ferrimagnetic and anti-ferromagnetic substances. Deduce on expression for the susceptibility of an anti ferromagnetic material above and below the Neel temperature.

20. Discuss the Josephson effects. Give the formulation of a.c. Josephson effect. Explain how ac Josephson effect can estimate $e/\hbar$

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D–6495

Sub. Code
34542

DISTANCE EDUCATION

M.Sc (Physics) DEGREE EXAMINATION, DECEMBER 2020.

IV Semester

NUCLEAR AND PARTICLE PHYSICS

(CBCS 2018 – 2019 Academic Year Onwards)

Time : 3 hours Maximum : 75 marks

PART A — ($10 \times 2 = 20$ marks)

Answer ALL questions

1. Give the types of nuclear fission.

2. Write down the Geiger - Nuttall law.

3. Mention any two similarities between the liquid drop and the nucleus.

4. Write a note on charge independence of nuclear forces.

5. What are moderators? Give an example.

6. What is the similarity between (nn) and (pp) forces?

7. What is a compound nucleus? Give an example.

8. Why parity is not conserved in β decay?

9. Illustrate Baryon number conservation through a nuclear reaction.

10. What are strange particles? Give examples.

PART B — (5 × 5 = 25 marks)

Answer ALL questions choosing either (a) or (b)

11. (a) Explain Gamow theory of alpha decay.

Or

(b) Explain how the study of electric quadrapole moment of the nucleus gives information about the shape of the nucleus.

12. (a) What are the assumptions of the liquid drop model? Explain the phenomenon of nuclear fission using the liquid drop model.

Or

(b) Explain the compound nucleus theory of nuclear reaction.

13. (a) Give a brief account on the meson theory of nuclear forces.

Or

(b) Write a short note on nuclear reactors.

14. (a) Distinguish between nuclear fission and fusion.

Or

(b) What are elementary particles? How are they classified on the basis of their masses and interactions?

15. (a) Discuss briefly SU (2) and SU(3) multiplets.

Or

(b) What are the conservation laws accompanied in a nuclear reaction?

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions

16. Discuss in detail about Fermi's theory of β decay, and Gamow Teller selection rule.

17. Derive the four factor formula for thermal nuclear reactors.

18. Describe the basic ideas of Yukawa's mesons exchange theory of the nuclear force.

19. Give a detailed account on nuclear shell model. Also discuss its merits and demerits.

20. State and explain charge conjugation (C), Time reversal (T), CP, and CPT invariance.

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D–6496

Sub. Code
34543

DISTANCE EDUCATION

M.Sc. DEGREE EXAMINATION, DECEMBER 2020.

Fourth Semester

Physics

MATERIALS SCIENCE

(CBCS 2018-2019 Academic year onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL the questions.

1. Define hardness of a material.
2. Explain the corrosion of metals.
3. What is meant by thermal evaporation in thin films?
4. Define Lattice Misfit and Imperfections.
5. Explain Q-Switching.
6. What is semiconductor laser?
7. Explain Aconsto-Optic effect.
8. Define Ceramic matrix composites.
9. Explain the electronic properties of composite materials.
10. Define Nitinol.

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Explain addition and condensation polymerization.

Or

(b) Write a short note on viscoelastic behaviour of metals.

12. (a) Explain the methods to prevent the corrosion and oxidation of metals.

Or

(b) Explain the Rotary pump with its working mechanism.

13. (a) Write a short note on Quartz Crystal method.

Or

(b) Explain the working principle of Liquid Phase Epitaxy.

14. (a) Write a short note on population inversion in four level systems.

Or

(b) Explain the working principle of CO_2 laser with its energy level diagram.

15. (a) Describe briefly about Amorphous and glassy materials.

Or

(b) Explain the Pseudo elasticity with its applications.

PART C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. Describe in detail about the structure and properties of polymers.

17. (a) Explain the structural aspects of Epitaxy. (5)

(b) Explain the vapour phase Epitaxy. (5)

18. Describe briefly about the He-Ne lasers with its energy level diagram.

19. Explain in detail about the Electro-optic effect and also explain about Electro-optic modulators.

20. Describe briefly about the working mechanism of shape memory alloys.

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