DE–4057

Sub. Code
11

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, MAY 2018.

CLASSICAL AND STATISTICAL MECHANICS

(2008 onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

Each question carries 20 marks.

($5 \times 20 = 100$)

1. (a) Obtain Lagrange's equations of motion. (10)

   (b) Obtain the Lagrange's equation of a simple pendulum. (6)

   (c) State and explain D'Alembert's principle. (4)

2. (a) State and explain Hamilton's variational principle. (10)

   (b) Write a note on conservative and non-conservative systems. (6)

   (c) What are generalized coordinates? Explain. (4)

3. (a) State that Poisson's brackets are invariant under canonical transformations. (10)

   (b) Deduce Hamiltonian equations of motion. (6)

   (c) What do you mean by action and angle variables? Explain. (4)

4. (a) State and prove the principle of least action. (10)

   (b) Discuss the elements of Hamilton-Jacobi theory. (6)

   (c) What are canonical transformations? Explain. (4)

5. (a) Deduce Hamilton-Jacobi equations and discuss its physical significance. (10)

   (b) List the Poisson's bracket relations. (6)

   (c) Write a note on infinitesimal canonical transformation. (4)

6. (a) Give the theory of small oscillations. (10)

   (b) What are Euler angles? Bring out their meaning. (6)

   (c) Discuss motion of symmetric top under the action of gravity. (4)

7. (a) Deduce Maxwell's distribution of velocities, mean, root mean square and most probable velocities. (10)

   (b) State and prove Liouville's theorem. (6)

   (c) Write a note on canonical ensembles. (4)

8. (a) Write a detailed note on microcanonical ensemble theory and its application to ideal gas of monoatomic particles. (10)

   (b) Discuss grand canonical ensembles theory. (6)

   (c) Deduce the viral theorem. (4)

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DE–4058

Sub. Code
12

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, MAY 2018.

MATHEMATICAL PHYSICS

(2008 onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

Each question carries 20 marks.

$(5 \times 20 = 100)$

1. (a) Define linear inverse transformation. (4)

(b) Find the eigen values and normalized eigen vectors of the given matrix

$$\begin{pmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{pmatrix}$$ (10)

(c) State and prove Cayley Hamilton theorem. (6)

2. (a) Describe Gram Schmidt's orthogonalization process. (8)

(b) Diagonalise the matrix $\begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$ (8)

(c) Evaluate e^A Where $A = \begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$ (4)

3. (a) Derive the relation between Beta and Gamma functions. (6)

(b) Write down the Legendre differential equation and hence find its solution. (10)

(c) Show that $H_n(-x) = (-1)^n H_n(x)$ (4)

4. (a) Show that $\overline{|1/2}\,\overline{|3/4} = \pi 2^{1/2}$ (4)

(b) Show that the Bessel differential equation

$y'' + \frac{1}{\rho} y' + \left(1 - \frac{v^2}{p^2}\right) y = 0 (v > 0)$ has two solutions, one regular $\rho = 0$ and the other singular. Prove that if v is an integer one solution is a constant multiple of the other. (10)

(c) Prove that $\int_{-1}^{1} x^m P_n(x) dx = 0$ where m, $n > o$. $m < n$.(6)

5. (a) Find the Fourier transform of the Gaussian distribution function $f(x) = Ne^{-\alpha x^2}$ where N and α are constants. (8)

(b) State and prove Parsevals theorem. (8)

(c) Evaluate the integral $\int_0^{\infty} \frac{e^{-t} \sin}{t} dt$. (4)

6. (a) Obtain the polar form of Cauchy–Riemam equations. (2)

(b) Find the poles and residues at the poles for the function $\frac{Z}{\cos Z}$. (9)

(c) Apply calculus of residues to show that $\int_0^{2\pi} e^{\cos\theta}\cos(n\theta-\sin\theta)d\theta=\frac{2\pi}{\sqrt{n}}$. (9)

7. (a) Derive two dimensional wave equation for a vibrating rectangular membrane. (5)

(b) The ends A and B of a rod 20 cm long are at temperature $30°C$ and $80°C$ respectively until steady state prevails. The temperatures at the ends are changed to $40°C$ and $60°C$ respectively. Find the temperature distribution in the rod at time *t*. (15)

8. (a) Discuss the following algebraic operations of tensors
(i) Addition
(ii) Subtractions. (8)

(b) State and explain orthogonality theorem. (8)

(c) Explain reducible and irreducible representations. (4)

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DE–4059

Sub. Code
13

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, MAY 2018.

INTEGRATED AND DIGITAL ELECTRONICS

(2008 Onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

(5 × 20 = 100)

1. (a) State and explain maximum power transfer theorem. (4)

(b) Analyze the functioning of transistor amplifier using 'h' parameter. (8)

(c) Explain the working of a source follower circuit using FET with a neat circuit diagram (8)

2. (a) State and explain Miller theorem. (4)

(b) Explain the working of a class A large signal amplifier with a neat circuit diagram (8)

(c) Explain the working of a push — pull amplifier with a neat circuit diagram. (8)

3. (a) What is input offset current? (4)

(b) Describe an operational amplifier. Explain its action as

(i) inverting amplifier

(ii) an integrator and

(iii) a current to voltage converter. (8)

(c) Design a circuit, using Op-Amps, to find the solutions of the given two simultaneous equations. (8)

4. (a) What are different characteristics of an ideal operational amplifier? (4)

(b) Construct (i) differentiator (ii) a unity gain amplifier and (iii) a comparator using operational amplifier and explain its functioning. (8)

(c) What are active filters? Explain the action of high pass filter and band pass filter with a neat circuit diagram. (8)

5. (a) What are universal gates? Why are they called so? (4)

(b) State and prove DeMorgan's theorems. (8)

(c) Using K-map minimize the Boolean expression

$F(A,B,C,D) = \sum(1, 5, 10, 11, 14, 15)$. (8)

6. (a) Give the truth table of S-R and D-flipflops. (4)

(b) Describe the operation of parallel in parallel out (PIPO) shift register. (8)

(c) Design a MOD-6 synchronous counter using J-K Flip-Flops. (8)

7. (a) Explain branch group instructions and logical group instructions in 8085 microprocessor. (8)

(b) Explain the function of the following pins in Intel 8085.

ALE, $I_O / \overline{M}$, $INTR$, and HLDA. (4)

(c) With a neat diagram explain the various registers and flags available and their Use in 8086 microprocessor. (8)

8. (a) Explain in detail the fabrication of monolithic IC's. (8)

(b) What is a solar cell? Describe an experiment to study its I-V characteristics. (8)

(c) Define Hall effect. (4)

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DE–4060

Sub. Code
14

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, MAY 2018.

ELECTROMAGNETIC THEORY

(2008 onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

Each question carries 20 marks.

(5 × 20 = 100)

1. (a) Discuss propagation of plane electromagnetic waves in a free space and non conducting isotropic media. (10)

   (b) Write the Maxwell's equations in differential form. (6)

   (c) State and explain Poynting vector. (4)

2. (a) Discuss refraction of electromagnetic wave at the interface of non-conducting media. (10)

   (b) Obtain the boundary conditions at the surface of discontinuity. (6)

   (c) What is total internal reflection? Explain (4)

3. (a) Discuss reflection and transmission coefficients at an interface between two non-conducting media. (10)

   (b) Obtain Fresnel's equations. (6)

   (c) State and explain Brewster's law. (4)

4. (a) Write a detailed note on theory of scattering of electromagnetic waves. (10)

   (b) Explain dispersion in solids and liquids (6)

   (c) Obtain Lorentz formula. (4)

5. (a) Obtain the Clasusius Mossotti relation. (10)

   (b) What do you mean by normal and anomalous dispersion? Explain. (6)

   (c) Briefly explain coherence and incoherence of scattering light. (4)

6. (a) Describe modes of propagation in rectangular and cylindrical wave guides. (10)

   (b) Explain the operation of Klystron. (5)

   (c) Briefly explain the generation of microwaves. (5)

7. (a) Explain the theory of resonant cavities in TE modes. (10)

   (b) Explain the operation of magnetron. (6)

   (c) What are Gunn diodes? Explain its operation. (4)

8. (a) Write a detailed note on charged particles in electric and magnetic fields. (10)

   (b) Discuss magnetohydrodynamics. (5)

   (c) What are Plasma waves? Explain. (5)

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DE–4061

Sub. Code
15

DISTANCE EDUCATION

M.Sc. DEGREE EXAMINATION, MAY 2018.

Physics

NUMERICAL METHODS AND PROGRAMMING

(2008 onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

Each question carries 20 marks.

(5 × 20 = 100)

1. (a) What is an array? How will you declare and initialise one-dimensional arrays? (5)

   (b) Discuss about the character set in C. Explain some of the special characters. (5)

   (c) Explain the 'while', 'do-while', 'If-else' and 'break' statements in C language. (10)

2. (a) What is the use of structure in C? Also how structure elements are stored in the memory. (5)

   (b) Define unions in C. (5)

   (c) Explain the general features of 'string input' and 'output'. (10)

3. (a) Describe and explain the various classes available for file operations with suitable examples. (7)

   (b) Distinguish between structures and unions. (8)

   (c) Write a C language program to multiply two matrices. (5)

4. (a) What are the looping statement in C? Explain each of them with examples. (7)

(b) Explain the Regula Falsi method of finding the roots of an algebraic equation. (7)

(c) Explain the criterion for the convergence in Newton-Raphson's method. (6)

5. (a) Solve $x^3 - 4x + 1 = 0$ by Regula Falsi method. (7)

(b) Solve $x^3 + x + 1 = 0$ by iteration method. (7)

(c) Derive the normal equations of fitting a straight line with best fit. (6)

6. (a) Solve the system of equations

$$x + 2y + z = 3$$
$$2x + 3y + 3z = 10$$
$$3x - y + 2z = 13$$

using Gauss-Jordan's method. (8)

(b) Solve

$$4x + 2y + z = 14$$
$$x + 5y - z = 10$$
$$x + y + 8z = 20$$

using Gauss-Seidal's method. (7)

(c) From the following table, find $f(x)$ and hence $f(6)$ using Newton's divided difference interpolation formula. (5)

x	1	2	7	8
$y = f(x)$	1	5	5	4

7. (a) Using Lagrange's interpolation formula find $y(9.5)$ given the values. (8)

x	7	8	9	10
$y = f(x)$	3	1	1	9

(b) Evaluate $\int_0^2 \frac{dx}{x^2 + x + 1}$ to three decimal places by dividing the range of integration into 10 equal parts using Simpson's rule. (7)

(c) Evaluate $\int_0^1 e^{-x} dx$ with 10 sub interval using trapezoidal's rule. (5)

8. (a) Compute $y(0.25)$ using modified Euler's method for the differential equation $\frac{dy}{dx} = 2xy$ given $y(0) = 1$. (5)

(b) Using R.K method of second order (correct to 4 decimals) compute $y(0.3)$ for the equation $\frac{dy}{dx} = -y - xy^2$, with $y(0) = 1$, taking $h = 0.1$. (8)

(c) Use Euler's method to find $y(0.4)$ for the equation $y' = xy$ given $y(0) = 1$. (7)

DE–4062

Sub. Code
21

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, MAY 2018.

SPECTROSCOPY

(2008 onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

(5 × 20 = 100)

1. (a) Discuss the Heitler London theory for hydrogen molecule. (10)

   (b) Explain the sp and sp^2 hybridizations. (10)

2. (a) What are rigid and non-rigid rotators? Give examples. (5)

   (b) Explain quadrupole hyperfine interaction. (5)

   (c) Discuss the features of pure rotational Raman spectra. (10)

3. (a) Define Stark effect and enumerate its importance in microwave spectroscopy. (10)

   (b) Discuss the molecular structure analysis through IR spectroscopy. (10)

4. (a) Discuss the vibrational spectra of diatomic molecules. (10)

   (b) Explain rotational course spectra. (10)

5. (a) Explain in detail Franck-Condon principle. (10)

   (b) Describe the disassociation and predisassociation processes. (10)

6. (a) Explain hyper Raman effect. (5)

(b) Give an account of coherent and Stoke's Raman Scattering. (5)

(c) Discuss the theory of multiphoton absorption. (10)

7. (a) Define resonance and then nuclear resonance. (5)

(b) Explain dipole-dipole interaction. (5)

(c) Discuss the principles of ESR spectroscopy. (10)

8. (a) Give the theory for chemical shift. (10)

(b) Explain the experimental study of Mossbauer effect. (10)

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DE–4063

Sub. Code
22

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, MAY 2018.

QUANTUM MECHANICS

(2008 onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

Each questions carries 20 marks.

($5 \times 20 = 100$)

1. (a) Explain the postulates of quantum mechanics. (4)

   (b) Obtain the solution of time dependent Schrodinger equation. (8)

   (c) Explain the tunnel effect in rectangular potential barrier. Derive the expressions for reflection coefficient and transmission coefficient. (8)

2. (a) State and explain uncertainty principle. (6)

   (b) Show that an electron cannot be contained inside a nucleus using the uncertainty principle. (7)

   (c) Explain Heisenberg's uncertainty principle experimentally using diffraction of waves at a single slit. (7)

3. (a) Solve the problem of a three dimensional harmonic oscillator in quantum mechanics. What is the significance of zero point energy? (10)

   (b) Obtain the degree of degeneracy for a three dimensional harmonic oscillator with the energy Eigen values $\hbar w(n + 3/2)$. (4)

   (c) Discuss the parity of the Eigen functions and zero point energy. (6)

4. (a) Describe WKB method for the solution of Schrondinger equation in a potential field. (10)

   (b) What is the drawback of WKB method? Derive the connection formula. (6)

   (c) Obtain the quantisation condition for a bound state using WKB method. (4)

5. (a) What is meant by Hermitian operator? Show that Hermitian operators have real Eigen values. (7)

   (b) Discuss about Dirac bra and Ket notations. (5)

   (c) Discuss the first order perturbation theory. (8)

6. (a) Derive the Fermi-Golden rule for the transition rate from a given initial state to a final state of continuous. (9)

   (b) Discuss the application of time dependent perturbation theory to semi classical theory of radiation. (8)

   (c) Explain spontaneous emission of radiation. (3)

7. (a) Explain the method of partial wave analysis to calculate phase shifts and scattering amplitude. (10)

   (b) State and explain optical theorem. (4)

   (c) Explain diffusion theory of scattering. (6)

8. (a) Explain angular momentum of system of particles and the conservation theorem. (6)

   (b) Derive the communication relations of total angular momentum with its components. (8)

   (c) Obtain the Eigen values of J^2 and J_z. (6)

DE–4064

Sub. Code
23

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, MAY 2018.

SOLID STATE PHYSICS

(2008 onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

Each question carries 20 marks.

($5 \times 20 = 100$)

1. (a) Why are there no crystals with 5 and 7-fold symmetry? (4)

   (b) Describe the structure of cesium chloride. (6)

   (c) Explain the significance of Brillouin zone with reference to BCC and FCC lattice. (10)

2. (a) Write notes on diffraction of waves by crystals. (6)

   (b) Obtain the Van der Walls — London equation and hence show that the interaction energy is inversely proportional to the 8th power of the distance between the dipoles. (10)

   (c) Explain covalent crystal with examples. (4)

3. (a) Obtain the dispersion relation for vibrations of crystals with monatomic basis. (10)

   (b) Write notes on thermal properties of phonons. (5)

   (c) What are the consequences of theory of lattice vibrations? (5)

4. (a) Derive expression for the number of orbitals per unit energy range of free electron gas in three dimensions. (10)

   (b) Describe the nearly free electron model, origin and magnitude of energy gap. (10)

5. (a) Discuss the Kronig-Peimy model for the motion of an electron in a periodic potential. (10)

   (b) Prove that heat capacity of the electron gas is $C_{et} = \frac{1}{2}\pi^2 N k_B \frac{T}{T_F}$. (10)

6. (a) Explain donor states and acceptor states of semi-conductor crystals. (10)

   (b) Obtain the expression for intrinsic carrier concentration of semiconductor. (10)

7. (a) What is the relationship between dielectric constant and polarizability? (5)

   (b) Explain the quantum theory of paramagnetism. (10)

   (c) Write a note on ferromagnetic order. (5)

8. (a) Explain anti-ferromagnetism and describe the variation of its susceptibility with temperature. (10)

   (b) Write a note on neutron magnetic scattering. (5)

   (c) Explain magnetic bubble domains. (5)

DE–4065

Sub. Code
24

DISTANCE EDUCATION

M.Sc. (Physics) DEGREE EXAMINATION, MAY 2018.

NUCLEAR AND PARTICLE PHYSICS

(2008 onwards)

Time : Three hours Maximum : 100 marks

Answer any FIVE questions.

Each question carries equal marks.

($5 \times 20 = 100$)

1. (a) Describe the method of measuring helicity of neutrino with neat sketch. (8)

   (b) Explain the parity violation in β-decay. (7)

   (c) Write a note on electron capture. (5)

2. (a) Explain crystal diffraction method to measure the wavelength of Gamma ray. (7)

   (b) Discuss about internal conversion. Also describe an experiment to determine internal conversion coefficients. (8)

   (c) Explain nuclear isomerism. (5)

3. (a) Explain the theory of single particle shell model, assuming the square well of infinite depth for potential. (8)

   (b) Discuss the limitations and failures of the single particle shell model. (7)

   (c) Write a note on Schmidt lines. (5)

4. (a) Assuming square well type of nuclear potential, give the theory of the deutron problem. Obtain a relation between the depth and width of the well and deutron binding energy. (10)

   (b) Discuss the excited states of deutron. (4)

   (c) Write the properties of deutron. (6)

5. (a) Discuss the neutron-proton scattering at low energy. Show how the assumption of spin-dependence of nuclear force can explain the experimental results. (12)

   (b) Explain the method of partial wave analysis for n-p scattering and determine the phase shift. (8)

6. (a) Describe Bohr's compound nucleus formation hypothesis for nuclear reactions. (8)

   (b) Explain the continuum states of the compound nucleus. (6)

   (c) Discuss the decay rates of the compound nucleus. (6)

7. (a) Explain the interaction of neutron with matter. Find the energy loss after collision and average energy after collision. (8)

   (b) Discuss about thermal neutrons. Also, explain energy distribution of thermal neutrons and flux distribution for thermal neutrons. (6)

   (c) Determine the critical size of the nuclear reactor. (6)

8. (a) Explain the classification of elementary particles. (8)

   (b) Discuss the conservation of leptons and baryons. (8)

   (c) Write a note on quarks. (4)
