PG-AS–1240 MPHS-11

P.G. DEGREE EXAMINATION — JULY 2024.

Physics

First Semester

CLASSICAL MECHANICS

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words.

1. Explain D'Alembert's principle of virtual work.

2. State and prove principle of least action.

3. Discuss the vibration of a linear triatomic molecule by applying the theory of small oscillations.

4. Deduce Euler's equations of motion for a rotating rigid body.

5. Derive the Lorentz transformation equations in special theory of relativity.

6. Show that $Q = \log\left(\frac{1}{q}\sin p\right)$; $P = q\cot p$ is canonical and obtain its generating function.

7. Write the notes on cyclic coordinates and conservation theorem.

8. Discuss in brief, inverse square law of force.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1000 words.

9. (a) Elaborate the conservations of linear and angular momenta. (10)

   (b) Using Lagrangian equation, Solve the problem of Atwood's machine. (5)

10. (a) Derive Hamilton's equation from variational principle. (5)

    (b) Explain the physical significance of Hamilton's principal functions. (5)

    (c) Show that Poisson brackets are invariant under canonical transformation. (5)

11. (a) Solve the linear harmonic oscillator problem by Hamilton's Jacobi method. (8)

(b) Discuss Kepler problem in Action Angle Variables. (7)

12. (a) Discuss the motion of a symmetrical top. (10)

(b) Elaborate angular momentum and kinetic energy of motion about a point. (5)

13. (a) Explain :

(i) Scattering in a central force field, and

(ii) Transformation of scattering to laboratory coordinates. (10)

(b) Deduce the relativistic Lagrangian of a particle. (5)

PG-AS-1241 **MPHS-12**

P.G. DEGREE EXAMINATION – JULY, 2024.

Physics

First Semester

MATHEMATICAL PHYSICS — I

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words

All questions carry equal marks

1. Show that (1, 0, 1), (0, 1, 1) and (1, 1, 0) represents linearly independent vectors.

2. Diagonalise the matrix $A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & -1 & 1 \\ 3 & 1 & 1 \end{pmatrix}$.

3. Show that any tensor of rank can be expressed as sum of symmetric and antisymmetric tensor both of rank 2.

4. Find out whether or not the following are the analytic function $(z = x + i\,y)$.

   (a) z^2 (b) $\frac{1}{z}$

5. Write short notes on isomorphism and homomorphism between groups.

6. Express curl in spherical polar coordinates.

7. Find the rank of the matrix $A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 4 & 7 \\ 3 & 6 & 10 \end{pmatrix}$.

8. Evaluate the integral $\oint_C \frac{dz}{z^2 + z}$ where C is a circle defined by $|z| = |R>|$.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1000 words

All questions carry equal marks

9. (a) State and prove Stoke's theorem.

   (b) Using Stoke's theorem evaluate $\vec{A} = (3x - 2y)\,\hat{i} + x^2 z\,\hat{j} + (z+1)\,\hat{k}$ for a plane rectangular area with vertices at (0, 0), (1, 0), (1, 2), (0, 2) in the x-y plane.

10. Determine the eigen values and corresponding eigen vectors of the matrix $A = \begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$.

11. (a) Discuss the contraction of tensor with an example.

    (b) Define Christoffel symbols $[i,j,k]$ and $\begin{Bmatrix} k \\ i \quad j \end{Bmatrix}$.

12. (a) State and prove Cauchy's Residue theorem.

    (b) Find the residue of the function $\frac{1}{(z^2+1)^2}$ at its poles.

13. (a) Define cyclic group and show that a group of order four may or may not be a cyclic group.

    (b) Explain the concept of group representations.

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PG-AS–1242 MPHS-13

P.G. DEGREE EXAMINATION — JULY 2024.

First Semester

LINEAR INTEGRATED ELECTRONICS

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words.

All questions carry equal marks.

1. With a basic circuit diagram explain the working of a zener regulator.

2. List the steps for finding Thevenin equivalent circuit.

3. Give the properties of an operational amplifier that are affected by operating frequency.

4. Write short note on content addressable memory.

5. With a neat sketch explain the binary ladder network.

6. Explain why the Schottky diode is called a *hot-carrier diode*. List the applications of Schottky diode.

7. If the collector current changes from 2 mA to 3 mA in a transistor when collector-emitter voltage is increased from 2V to 10V, what is the output resistance?

8. Draw the block diagram of PLA.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1000 words.

All questions carry equal marks.

9. Using illustrations, explain how the depletion region at a *pn*-junction is produced. List the characteristics of the depletion region.

10. State and explain the principle and working of JFET.

11. Explain the working of inverting and non-inverting Schmitt trigger.

12. With the help of a block diagram, explain :
    (a) RAM and
    (b) ROM.

13. Explain the working of ADC.

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PG–AS–1243 MPHSEL–1

P.G. DEGREE EXAMINATION — JULY 2024.

Physics

First Semester

NUMERICAL METHODS

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words

All questions carry equal marks.

1. The function $y = \sin x$ is tabulated below. Using Newton's interpolation formula, find the value of $\sin(\pi/6)$.

x	$y = \sin x$
0	0
$\pi/4$	0.70711
$\pi/2$	1.0

2. Briefly explain iterative method for polynomial equations.

3. Explain the Jacobi method for solving symmetry matrices.

4. Compute $I_p = \int_0^1 \frac{x^p dx}{x^3 + 10}$ for $p = 0$ using trapezoidal rule with the number of points 3.

5. Explain Euler's method for solving differential equations.

6. Find the real root of the equation $x^3 - x - 1 = 0$, using bisection method.

7. Write short notes on round-off errors.

8. Explain the polygon method to find the numerical solution to ordinary differential equations.

PART B — $(3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1000 words

All questions carry equal marks.

9. Find the cubic polynomial which takes the following values using difference table: $y(1) = 24$, $y(3) = 120$, $y(5) = 336$ and $y(7) = 720$. Hence, obtain the value of $y(4)$.

10. Find a real root of the equation $x = e^{-x}$, using the Newton-Raphson method.

11. Solve the following system by using Gauss-Jordan elimination method.

$x + y + z = 4$, $2x + 3y + 5z = 5$; $4x + 5z = 2$.

12. Evaluate $I = \int_0^1 \frac{1}{1+x} dx$, correct to four decimal places by Simpson's 1/3 rule, with $h = 0.25$ and 0.125.

13. Obtain the expression for Runge-Kutta fourth order formulae.

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PG–AS–1244 MPHS–21

P.G. DEGREE EXAMINATION – JULY, 2024.

Physics

Second Year

MATHEMATICAL PHYSICS — II

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words.

All questions carry equal marks.

1. Solve the equation $(D^2 - 4D + 4)\, y = 0$ given that $y = 1$ and $y = 3$ when $t = 0$.

2. Derive the expression for Bessel function of the first kind of order n.

3. Obtain the recurrence relations for Hermite polynomials using Rodrigue's formula.

4. Derive the solutions of Laplace differential equation in two dimensions.

5. Find the finite Fourier cosine transform of x.

6. Show that $\beta(m,n) = \beta(n,m)$.

7. Derive Rodriguez formula for Legendre polynomial $P_n(x)$.

8. Find the inverse Laplace transform of $L^{-1}\left[\frac{5}{s^2+3s+7}\right]$.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1000 words.

All questions carry equal marks.

9. Derive the general solution of the differential equation $y'' - k^2 y = 0$ (k = real constant) using power series method.

10. Derive any one of the recurrence formulas for Legendre polynomials.

11. Show that the Laguerre functions $e^{\frac{-x}{2}} L_n(x)$ are orthogonal in the interval $(0,\infty)$.

12. Derive the solution of Laplace's equation in cylindrical coordinates.

13. State and prove linearity property and shifting property of Laplace transform.

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PG-AS-1245 **MPHS-22**

U.G. DEGREE EXAMINATION — JULY 2024.

Physics

Second Semester

QUANTUM MECHANICS-I

Time : 3 hours Maximum marks : 70

PART A — (5× 5 = 25 marks)

Answer any FIVE questions out of Eight questions in 300 words.

1. Enlist the postulates of wave mechanics.
2. Obtain the time independent Schrodinger equation.
3. Give the solution for one dimensional harmonic oscillator.
4. What is the matrix representation of ket and bra operators? Explain in detail the matrix representation of operators.
5. Deduce an expression for scattering by screened coulomb potential.

6. Elaborate scattering amplitude in terms of phase shifts.

7. Explain the interaction picture.

8. Write a note on Spin and Pauli's matrices.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 200 words.

All questions carry equal marks.

9. (a) State and explain Ehrenfest's theorem. (10)

(b) Show that the the Eigen values of a self – adjoint operator and real. (5)

10. (a) Obtain the Schrodinger equation for rectangular barrier penetration problem. Solve it to obtain eigen values and eigen fuctions. (10)

(b) Elaborate the symmetry and antisymmetric wave functions. (5)

11. (a) Solve the radial part of Schrodinger's equation for the hydrogen atom and obtain its eigen values.

(b) Derive the commutation relation between orbital angular momentum with position. (10+5)

12. (a) Discuss the addition of angular momentum in quantum mechanics and Clebsh-Gordon coefficients. (10)

(b) Obtain the commutation relation between J^2 and J_z (5)

13. (a) Discuss the theory of Born approximation. Explain in detail. (10)

(b) Discuss the condition for validity of Born approximation. (5)

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PG–AS–1246 MPHS–23

P.G. DEGREE EXAMINATION — JULY 2024.

Physics

Second Year

ELECTROMAGNETIC THEORY

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words.

1. Derive Poisson's and Laplace equation.

2. State and explain Biot-Savart law.

3. Derive the continuity equation.

4. Write a note on gauge transformation.

5. Explain electric field vector 'E' parallel to the plane of incidence.

6. Elaborate Fresnel's equation, and Total internal reflection.

7. Use Gauss law to find electric field intensity due to a uniformly charged cylinder.

8. Write a note on ferromagnetism.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1,000 words.

9. Explain :

   (a) energy of a point charge distribution,

   (b) energy of continuous charge distribution, and

   (c) induced charges.

10. (a) Discuss :

      (i) Electromagnetic induction, and

      (ii) Ampere's Law in magnetized materials. (10)

   (b) Elaborate the effect of magnetic field on atomic orbit. (5)

11. (a) State and prove the Poynting theorem.

   (b) Write a note on reflection and transmission. (10+5)

12. (a) Discuss the EM wave propagation in rectangular wave guide in detail. (10)

(b) Discuss in brief about co-axial transmission line. (5)

13. Discuss the Reflection and transmission coefficients at the interface between two non-conducting media.

PG–AS-1247 MPHSEL–2

P.G. DEGREE EXAMINATION — JULY 2024.

Physics

First Year

MICROPROCESSOR AND MICROCONTROLLER

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words.

All questions carry equal marks.

1. Illustrate interfacing memory and I/O devices of 8085.
2. Mention various arithmetic operations performed in 8085 assembly language.
3. Discuss the pin configuration of 8086 microprocessor.
4. Differentiate microprocessor and microcontroller.
5. Explain the basic concepts of programmable device.

6. Write a note on interrupt priorities.

7. Discuss briefly about branching and single bit instructions.

8. Explain logical, branching and machine control operations with an example.

PART B — $(3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1,000 words.

All questions carry equal marks.

9. Explain the pin configuration and architecture and its operations of 8085 with a neat diagram.

10. Describe looping, counting and indexing assembly language programs and mention the difference between them.

11. Write the program for 8-bit data and 16-bit data for even address bank.

12. Describe pin configuration and key features of 8051 microcontroller.

13. Explain briefly about direct memory access controller.

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PG–AS-1248 **MPHS–31**

P.G. DEGREE EXAMINATION — JULY 2024.

Physics

Third Semester

QUANTUM MECHANICS – II

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions.

1. Explain the concept of stark effect in hydrogen atom.

2. Explain Fermi – Golden Rule.

3. Explain the principle of variation method. Show that variation method gives upper bound state to ground state energy.

4. Explain the ground state of helium atom.

5. Obtain the energy levels of the S-state of an electron that is bound to a 'Ze' nucleus using the WKB method.

6. Write note on HUND'S Rule.

7. Describe Dirac's relativistic equation for a free particle.

8. Obtain the covarient form of Dirac's equation in terms of γ matrices.

PART B — $(3 \times 15 = 45$ marks)

Answer any THREE questions.

9. Discuss time independent perturbation theory for a nondegenerate system and hence obtain the first order correction to energy and eigen function.

10. Derive Einstein's coefficients for spontaneous and stimulated emissions and Discuss selection rules for transitions from an excited state.

11. Discuss the WKB method to explain the penetration through the potential barrier and Obtain the energy levels of the S-state of an electron that is bound to a 'Ze' nucleus.

12. Discuss the Hartree-Fock method of central approximation

13. Obtain the free particle solutions (Dirac spinors) for a Dirac particle. Explain the probability density and the current density for a Dirac free particle.

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PG-AS-1249 **MPHS-32**

P.G. DEGREE EXAMINATION – JULY, 2024.

Physics

Third Semester

THERMODYNAMICS AND STATISTICAL MECHANICS

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions

1. Mention any two thermodynamic potentials. How are these related to the thermodynamic variables S, T, P and V? Explain.

2. Derive the relation between entropy and thermodynamics probability.

3. Explain grand canonical ensembles.

4. Obtain an expression for Fermi – Dirac distribution law.

5. Derive an expression for number of molecules having velocity within c and c + dc using Maxwell – Boltzmann distribution.

6. Obtain an expression for the partition function of a system of N diatomic molecules executing only the rotational motion.

7. Distinguish among microcanonical, canonical and grand canonical ensembles.

8. Discuss one dimensional ISING Model.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions

9. Using the thermodynamic potential functions: U, F, H, and G obtain the four Maxwell thermodynamic relations.

10. Derive the expression for translational partition function for an ideal monoatomic gas and hence show that for this gas the total energy $U_{(total)} = \frac{3}{2}$ (NKT).

11. Derive the Fermi-Dirac distribution formula for a gas of non-interacting Fermions at a temperature T.

12. State and explain Equipartition Theorem and its applications.

13. Derive the expression for the rotational partition function and hence obtain the expressions for total energy and specific heat for a system containing N diatomic molecules per unit volume.

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PG-AS-1250 **MPHS-33**

P.G. DEGREE EXAMINATION –
JULY 2024.

Physics

Third Semester

CONDENSED MATTER PHYSICS — I

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions.

1. What are Miller Indices? Obtain Miller Indices for a plane with Intercepts (a/p, b/q, c/r) along the crystallographic axes.

2. Explain the basic principles of neutron and electron diffraction.

3. Write note on quartz crystals.

4. Discuss briefly about the phonons.

5. State and Explain the Wiedemann-Franz law.

6. An electric field of 100 V/m is applied to a sample on n-type semiconductor whose Hall coefficient is $-0.0125\ m^3C^{-1}$. Determine the current density in the sample, assuming electron mobility to be $0.36\ m^2V^{-1}s^{-1}$.

7. Copper has an atomic weight 63.5, a density of $8.9 \times 10^3 kg/m^3$, and $\vartheta_l = 8.9 \times 10^3 m/s$ and $\vartheta_I = 4.76 \times 10^3 m/s$. Estimate the specific heat at low temperature say at 30 K.

8. For BCC iron, compute (a) the interplanar spacing and (b) the diffraction angle for the (220) set of planes. The lattice parameter for Fe is 0.2866 nm. Also, assume that monochromatic radiation having a wavelength of 0.1790 nm is used, and the order of reflection is 1.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions.

9. Discuss the structural Features of NaCl, Diamond and ZnS.

10. Describe the powder method of X-ray diffraction of a crystal and Explain Powder diffractometer.

11. Discuss in detail about point and line imperfections in crystals.

12. Obtain an expression for the specific heat capacity of a solid on basis of Einstein's theory. How far do the results from this theory agree with experimental data?

13. Describe Hall effect with a neat diagram. Derive expression for Hall coefficient and Hall constant. Discuss the applications of Hall effect.

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PG-AS-1251 MPHSEL-3

P.G. DEGREE EXAMINATION –
JULY 2024.

Physics

Third Semester

PHYSICS OF NANOMATERIALS

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions

1. Define nanomaterial? Give classification of nanomaterials.

2. Write short note on fullerenes.

3. Explain the electrical properties of nanophase materials.

4. Describe how to synthesis nanomaterials using sol -gel method and its advantages.

5. Discuss about Photoluminescence Spectroscopy.

6. Explain about superparamagnetic properties in nanoparticles.

7. Discuss about Nanocomposites.

8. What is DLVO theory ? Explain and List out the important assumptions in DLVO theory.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions

9. Discuss in detail about classification of nanomaterials and its types.

10. What is core-shell structure? Discuss in detail about Metal — Oxide structure of nanomatreials.

11. What is quantum confinement? How does it affect the band gap in nanostructures? and explain Quantum transport in nanoparticles.

12. Discuss the classification of Lithographic technique and explain Nanolithography and Nanomanipulator.

13. Describe the working principle of scanning tunneling microscopy for contact and non-contact modes and its applications.

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PG–AS-1252 **MPHS–41**

P.G. DEGREE EXAMINATION — JULY 2024.

Physics

Fourth Semester

SPECTROSCOPY

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words.

All questions carry equal marks.

1. Describe the features of spectra of alkali.

2. Give an account of the fine structures of lines in the hydrogen spectrum.

3. Describe the theory of IR rotation vibration of diatomic molecule.

4. Discuss some important applications of Laser Raman spectroscopy.

5. Write a note on relaxation processes.

6. Describe the experimental detection of NQR frequency.

7. Explain the basic principle of ESR.

8. Describe briefly about recoilless emission and absorption.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1,000 words.

All questions carry equal marks.

9. Discuss normal and anomalous Zeeman effect.

10. Describe the theory and working principle of FTIR spectrophotometer.

11. Discuss the quantum theory of Raman effect.

12. With a diagram, explain the principle and working of high resolution NMR spectrometer.

13. Give the instrumentation detail and working principle of ESR spectrometer.

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PG-AS-1253 **MPHS-42**

P.G. DEGREE EXAMINATION – JULY 2024.

Physics

Fourth Semester

NUCLEAR PHYSICS

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words

All questions carry equal marks

1. Explain the working principle of Neir's mass spectrometer.

2. Write a note on Collective model of the nucleus.

3. What do you mean by

   (a) Internal conversion and

   (b) Nuclear isomerism?

4. Write a note on proton-proton scattering at low energies.

5. Discuss the quark structure of nucleons.

6. What are called hidden variables? Explain briefly.

7. What is kinematics of nuclear reaction? What is the Q value and its significance?

8. Explain briefly about

   (a) Tensor force and

   (b) Exchange force.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1000 words

All questions carry equal marks

9. Explain the construction, theory and working of Bainbridge mass spectrometer.

10. Derive the expression for semi empirical mass formula.

11. Discuss the Fermi's theory of beta decay.

12. Explain the meson theory of nuclear forces.

13. Discuss the quantum numbers associated with elementary particles. Give the corresponding conservation laws.

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PG-AS-1254 **MPHS-43**

P.G. DEGREE EXAMINATION –
JULY, 2024.

Physics

Fourth Semester

CONDENSED MATTER PHYSICS – II

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight questions in 300 words

All questions carry equal marks

1. (a) Define polarizability and

   (b) What is called local electrical field at an atom.

2. Discuss the various dielectric break down mechanism.

3. Describe the dipole theory of Ferro electricity.

4. Explain the domain theory of anti-ferromagnetism.

5. What is called

   (a) Meissner's effect and

   (b) Coherence length?

6. Write a note on Nano electronics.

7. Compare DC and AC Josephson effect.

8. Explain briefly about Langevin's theory of Para-magnetism.

PART B — ($3 \times 15 = 45$ marks)

Answer any THREE questions out of Five questions in 1000 words

All questions carry equal marks

9. Explain the various polarization mechanisms in dieletric materials.

10. Explain the Landau theory of first order and second order phase transition.

11. Outline the classification of magnetic materials with example.

12. Derive London equation.

13. Explain the density of states of different dimensional nanostructures.

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PG–AS–1255 MPHSEL–4

P.G. DEGREE EXAMINATION —
JULY 2024.

Physics

Fourth Semester

INSTRUMENTAL METHODS OF ANALYSIS

Time : 3 hours Maximum marks : 70

PART A — ($5 \times 5 = 25$ marks)

Answer any FIVE questions out of Eight Questions in 300 words.

All questions carry equal marks.

1. What is chi square test used for? Give its limitations.

2. Write a note on photoelasticity.

3. Explain the principle of differential thermal analysis.

4. Compare single crystal and powder crystal diffraction.

5. Discuss the theory of X-ray fluorescence spectroscopy.

6. What are called excitons? Explain briefly.

7. Describe the two probe method of finding resistivity of a material.

8. Explain briefly about cyclic voltammetry working principle.

PART B — $(3 \times 15 = 45$ marks)

Answer any THREE questions out of Five Questions in 1000 words.

All questions carry equal marks.

9. Outline the various types of errors with examples.

10. Explain the determination of thermo chemical parameters using DSC technique.

11. Discuss the four crystal diffractometer for epitaxial characterizations.

12. Describe the theory, construction and working of TEM.

13. Discuss the van der pauw method of finding resistivity of a sample.

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