1721/MP1/PPHY01 NOVEMBER 2016

MATHEMATICAL PHYSICS

Time : Three hours Maximum : 100 marks

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

(5 × 20 = 100)

1. (a) (i) Obtain an expression for the Gradient and Divergence in orthogonal curvilinear coordinates. (10)

(ii) Explain contravariant and covariant vector. (10)

Or

(b) (i) A square matrix A is defined by $A = \begin{bmatrix} -1 & 2 & -2 \\ 1 & 2 & 1 \\ -1 & -1 & 0 \end{bmatrix}$ find the modal matrix P and the resulting diagonal matrix D of A. (10)

(ii) State and prove rearrangement theorem. (10)

2. (a) (i) Explain Cauchy's integral and ratio test. (10)

(ii) For what values of the variables x the given series converges?

$$1 - x + \frac{x^2}{2^2} - \frac{x^3}{3^2} + ... + (-1)^n \frac{x^n}{n^2} + ... \quad (10)$$

Or

(b) (i) Find the Fourier series for the periodic function $f(x)$ defined by

$$f(x) = -\pi \quad if \; -\pi \le x \le 0$$
$$= x \quad if \; 0 \le x \le \pi$$

Hence prove that

$$\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + ... \quad (10)$$

(ii) Show that

$$\beta(m, n) = \int_0^\infty \frac{y^{n-1}}{(1+y)^{m+n}} dy . \quad (10)$$

3. (a) (i) Derive Cauchy – Riemann equations. (10)

(ii) Using Cauchy's integral theorem, evaluate $I = \oint_C \frac{dz}{(z-a)}$ where C is a simple closed curve. (10)

Or

(b) (i) State and prove Taylors theorem.

(ii) Prove that $\int_0^\pi \frac{1 + 2\cos\theta}{5 + 4\cos\theta} d\theta = 0$. (10)

4. (a) (i) Obtain the generating function for Bessel differential equation. (10)

(ii) Prove that $\beta(m, n) = \frac{\lceil m \rceil \lceil n \rceil}{\lceil (m+n) \rceil}$. (10)

Or

(b) (i) Prove that $H_n(x) = e^{x^2} (-1)^n \frac{d^n}{dx^n} (e^{-x^2})$ and hence find $H_2(x)$. (10)

(ii) Obtain the series solution of Laguerre's differential equations. (10)

5. (a) What is Green's function? Explain the method of Green's functions for solving non-homogeneous differential equations. (20)

Or

(b) Explain solution for the wave equations by the method of separation of variables. (20)

1722/MP2/PPHY02 NOVEMBER 2016

CLASSICAL MECHANICS AND STATISTICAL MECHANICS

Time : Three hours Maximum : 100 marks

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

(5 × 20 = 100)

1. (a) Write a note on the following applications of Lagrangian formulation.

   (i) Atwood's machine

   (ii) Simple pendulum.

   Or

   (b) Explain conservation of linear momentum and energy.

2. (a) Write a note on Kepler's laws.

   Or

   (b) Give a account on Euler's theorem on the motion of a rigid body.

3. (a) Describe conservation theorem for generalized momentum and energy.

   Or

   (b) Explain principle of least action and prove it.

4. (a) Explain how canonical transformation is used to solve harmonic oscillator problem. Give two more examples for the canonical transformation.

   Or

   (b) Describe Kepler problem in action angle variables.

5. (a) Describe Fermi-Dirac distribution function. Also compare B.E, F.D and classical distribution functions.

   Or

   (b) Write a note on electro gas.

1723/MP3/PPHY03 NOVEMBER 2016

ELECTROMAGNETIC THEORY

Time : Three hours Maximum : 100 marks

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

All questions carry equal marks.

1. (a) What do you understand by electric dipole and quadrapole moments? Obtain expression for electric potential and field at a point in space due to a dipole as well as due to a quadrapole.

Or

(b) Calculate field Eo at an external point using

(i) Coulomb's law (ii) potential (iii) gauss law.

2. (a) Define dielectric polarization, electric susceptibility and dielectric constant. Also derive an expression for electric displacement using gauss law in dielectric.

Or

(b) (i) With the schematic diagram, explain the point charge in a dielectric medium.

(ii) Prove that the tangential component of the electric field is continuous across an interface.

3. (a) Obtain the magnetic field produced by a magnetic material and also find the magnetic scalar potential and pole density.

Or

(b) Define self induction and mutual induction. Derive the co – efficient of compiling. Obtain an expression for the magnetic energy of a coupled circuit and the energy density in the magnetic field.

4. (a) Discuss the reflection and refraction of two non conducting media with normal incidence.

Or

(b) (i) From Maxwell's equation, derive wave equation for $\tilde{E}$ for the conducting medium.

(ii) Explain the Drude free – electron theory.

5. (a) (i) Find the angular distribution of radiated power of the radiation resistance of the antenna.

(ii) Explain the relation concept from a half – wave antenna.

Or

(b) Explain the field of a uniformly moving point charge and an accelerated point charge.

1724/MP4/PPHY04 NOVEMBER 2016

OPTICS AND SPECTROSCOPY

Time : Three hours Maximum : 100 marks

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

(5 × 20 = 100)

1. (a) Describe multilayer film coating and its applications.

Or

(b) Write a note on multiple beam interference.

2. (a) Derive the equation for Kirchoff's integral theorem. Explain Balinet's principle.

Or

(b) Explain the ruby laser. Write a note on Dye laser and semiconductor laser.

3. (a) Write a note on rigid diatomic molecules. Explain symmetric top-molecules.

Or

(b) Explain microwave spectrometer.

4. (a) Write a note on rotational fire structure of electronic - vibration transitions.

Or

(b) Explain :

(i) Born - oppenheimer approximation. (10)

(ii) Dissociation energy and dissociation products. (10)

5. (a) Explain the working of ESR spectrometer.

Or

(b) Brief :

(i) Isomer shift.

(ii) Electronic structure.

(iii) Molecular structure.

(iv) Biological applications with Mossbauer spectroscopy basis.

1725/MPA/PPHY05 NOVEMBER 2016

QUANTUM THEORY

Time : Three hours Maximum : 100 marks

Answer ALL questions.

Each question carries equal marks.

(5 × 20 = 100)

1. (a) Write a note on :

   (i) Black body radiation. (10)

   (ii) Explain Specific heat of solids. (10)

   Or

   (b) Brief

   (i) Physical interpretation of eigen value, eigen function and expansion coefficient. (10)

   (ii) Uncertainty principle. (10)

2. (a) Give an account on Schrodinger equation for Harmonic Oscillator. Also explain harmonic oscillator eigen functions.

   Or

   (b) Obtain the expressions for differential and total scattering cross sections.

3. (a) Explain Transformation theory.

   Or

   (b) Give all account on matrix representation of J^2 in the $|jm>$ basis.

4. (a) Write a note on first and second order perturbation of non-degenerate cases.

   Or

   (b) Give a detailed account on ground stale of Helium.

5. (a) Apply Klein Gordon equation to Hydrogen atom and obtain the expression for its energy.

   Or

   (b) Write a note on Lagrangian formulation.

1726/MPB/PPHY06 NOVEMBER 2016

DIGITAL ELECTRONICS AND MICROPROCESSORS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

Each question carries equal marks.

$(5 \times 20 = 100)$

1. (a) Write a note on six basic theorems of Boolean algebra and De Morgan's theorem.

Or

(b) Simplify the Boolean function $F(w,x,y,z) = \Sigma(1,3,7,11,15)$ and the don't care condition $d(w,x,y,z) = \Sigma(0,2,5)$.

2. (a) Describe the working of Clocked R-S and D Flip-flops with circuit diagram and truth tables.

Or

(b) Explain integrated-circuit and magnetic-core memories.

3. (a) Write a note on registers and memory systems of a microcomputer system.

Or

(b) Give an account on Logic operations, counter and time delays in microprocessors.

4. (a) Brief Stack, conditional call and return instructions.

Or

(b) Write a program for converting Binary to ASCII Hex code.

5. (a) Explain interfacing technique. Describe interfacing I/O using Decoder.

Or

(b) Describe the method of interfacing seven segment display using 8085 microprocessor with relevant diagrams.

1727/MPC/PPHY07 NOVEMBER 2016

ATOMIC AND NUCLEAR PHYSICS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

Each question carries equal marks.

(5 × 20 = 100)

1. (a) (i) Write a note on L-S coupling. (10)

(ii) Explain X-ray diffraction and obtain Bragg's law. (10)

Or

(b) Explain different types of hybridization mechanism in polyatomic molecules.

2. (a) Explain the electromagnetic methods for determining the nuclear radius.

Or

(b) Obtain the expression for the nuclear quadrupole moment.

3. (a) Write a note on beta decay and give its selection rules. What is meant by parity violation?

Or

(b) Discuss alpha particle scattering experiment and obtain Rutherford scattering formula.

4. (a) Write a note on different kinds of nuclear reactions and different conservation laws.

Or

(b) Explain Breit – Wigner dispersion formula.

5. (a) Write a note on classification of elementary particles and different types of interactions.

Or

(b) Give a note on production and detection of antiprotons and antineutrons.

1728/MPD/PPHY08 NOVEMBER 2016

CONDENSED MATTER PHYSICS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

Each question carries equal marks.

(5 × 20 = 100)

1. (a) Describe the structures of Sodium chloride, Cesium chloride. Hexagonal close packed and diamond with neat diagrams.

Or

(b) What is meant by ionic crystals? Obtain the expression for Madelung energy of ionic crystals.

2. (a) (i) Discuss Hall effect. (10)

(ii) Describe Wiedemann-Franz law. (10)

Or

(b) Explain Kronig-Penny model of square well periodic potential.

3. (a) Describe Flux quantization.

Or

(b) Give an account on Type-I, Type-II and High temperature superconductors.

4. (a) Derive the expression for Screened Coulomb potential.

Or

(b) Write a note on different types of Exitons.

5. (a) Give the Langevin Classical theory and Quantum theory of diamagnetism.

Or

(b) What are colour centres? Explain different types of colour centres with necessary diagrams.