PHYICS (HONS.) PAPER – V

Answer six questions selecting at least two questions from each group.

Group - A

1. What do you mean by the divergence and the curl of the vector? Explain it with suitable example and discuss its significance. (13
2. State and prove green's theorem in vector analysis .How do you obtain gauss's theorem from green's theorem? **(13,11**
3. What is an analytic function? Describe necessary and sufficient conditions for a function to be analytical? Show that log Z is an analytical function? (13

   OR,

   What do you mean by analytic function? Derive Cauchy-Rieman equations for analytic functions and prove that the real and imaginary parts of an analytic of two variables are harmonic functions. (10,08
4. State and prove Cauchy's integral formula for a complex function? Or, solve Laplaces equation in spherical coordinates? (13
5. State and prove Stoke's theorem. What is its physical significant? (12,10
6. State and prove Gauss's divergence theorem. (12,10
7. If a function f(z) is an analytic on inside a contour except for a finite number of poles within C, then prove that

   $$\int_c^{2\pi} f(z)\, dz = 2\pi\, i \sum R$$

   Using this theorem evaluate $\int_c^{2\pi} \frac{d\theta}{5+4sin\theta}$ (12,09,07
8. Setup wave equation and obtain its solution. (**11,09,07**
9. What do you mean by tensor? Prove that the sum of two tensor is a tensor. Show that by contraction, the rank of tensor is reduced by two. **(11,09,07**
10. Setup Laplace equation in Cartesian Co-ordinates and obtain its solution. Hence, find an expression for parallel plate capacitor. (10,08
11. Write a short notes on (any two) following :
    a. Volume integral (12,09
    b. Cylindrical co-ordinates (12,09
    c. Green's theorem **(12,09,07**
    d. Covariant tensor (12
    e. Surface integral **(11,09,07**
    f. Curvilinear co-ordinates (11,07
    g. Divergence of a vector (11
    h. Cauchy's integral theorem (11
    i. Poisson;s equation (08
    j. Residue theorem (08
    k. Curl of vector field (08
    l. Gauss's theorem (08

Group – B

1. Derive Lagrange's equation of motion for holonomic conservable systems (in terms of generalized co-ordinates) for D-Alembert's principle. Discuss one its application. **(13,11,09**
2. Derive Kepler's laws of planetary motion. **(13,11,09,07**
3. Show that the conservation theorem of classical mechanics is closely connected with the symmetrical properties. **(13,10,07**
4. Discuss the motion of symmetric top. (13
5. State and prove Hamilton's principle. (12,10,08
6. What is the Poisson's Bracket? State and prove Jacobi identity. (12,10,08
7. What is Euler's angle? Derive the Euler's equation motion for rotation of rigid body. (12,10,08
8. Deduce the equation of canonical transformation taking different forms of the generating function. (12,09,07
9. State and prove the principle of last action. (11,
10. Write short notes on any two of the following :
    I. Hamilton's equation of motion (11
    II. Gyroscopic motion (11,08
    III. Coriolis and centrifugal forces (11,08
    IV. Canonical transformation (11
    V. Conservation theorem (09
    VI. Principle of least action (09,07
    VII. Hamiltonian of charged particle in an electromagnetic field. (09
    VIII. Precission motion of spinning top (09
    IX. Lagrangian for free particle (08
    X. Laws of motion of rigid body (07
    XI. Moment of inertia and product of inertia. (07

Group – C

1. Derive the **Heisenberg's uncertainty principle** for position and momentum variables. Show that an electron can not exist inside the nucleus. How it is experimentally verified? **(13,11,09,07**
2. Set up Schrodinger wave equation for a linear harmonic Oscillator and obtain eigen values and eigen function of this oscillator. **(13,11,09,07**
3. Describe the application of **Schrodinger wave equation** in obtaining transmission coefficient of particle through potential step. (13
4. Prove that no two of three components of angular momentum L commute with each other, but all of them commute with L^2. (13
5. Set up Schrodinger equation for hydrogen atom. Obtain the solution of the radial part and calculate the energy eigen value. (12,10,08
6. Write down and solve wave equation for a rigid rotator with free axis and obtain energy eigen values. (12,10,08
7. Write down and solve Schrodinger wave equation for a particle in potential box. (12,10
8. What is the dual nature of matter? Describe **de-Broglie relation** and explain its experimental verification. (11,09
9. Describe the transmission of particle through potential step. (08

10. Discuss the communication relation between the components of orbital angular moments with L_x, L_y and L_z. (07
11. Write short notes on any two of the following :
    i. Postulates of the quantum mechanics (12
    ii. Pauli spin matrices (12
    iii. Angular momentum operator (12
    iv. Eigen value and eigen functions (12
    v. Communication relations (11
    vi. Symmetric and anti-symmetric wave functions (11,07
    vii. Bohr's correspondence principle (11
    viii. Rigid rotator (11
    ix. Pauli exclusion principle (10,08
    x. Physical significance or interpretation of wave function (10,08
    xi. Transmission of particle through potential step (10
    xii. Eigen value of an operator L^2 (10
    xiii. Grand canonical function (09
    xiv. Boltzmann distribution law (09
    xv. Bose – Einstein statics (09
    xvi. Inadequacy of classical mechanics (07
    xvii. **de–Broglie equation** (07

PHYSICS (Hons.) Paper – VI

Answer six questions, selecting at least three questions from each groups.

Group – A

1. What do you mean by entropy? Derive an expression for the entropy of a perfect gas. (13,07
2. Derive expression for Bose – Einstein distribution function and deduce Plank's law of radiation from it. **(13,11**
3. Discuss fluctuation in thermodynamic quantities. (13
4. Define grand canonical ensemble. Obtain thermodynamic function of perfect gas using grand canonical ensemble. (13
5. What is Gibbs paradox? Explain how it can be resolved. **(13,11,09,07**
6. Describe the Bragg-William Theory of ising model. Show that it never exhibits ferromagnetism. **(13,11,09,07**
7. What is canonical ensemble? Discuss the energy fluctuation in canonical ensemble. (12,10
8. Explain first and second order phase transitions. Illustrate your answer with one suitable example of each (12,10,08
9. What are fermions? Derive distribution function for fermions and discuss its temperature dependence. (12,1008
10. Define phase space, phase point and density of phase point. Prove Livovill's theorem and give its physical significance. (12,10,08
11. What is canonical partition function? Establish its relation with thermo-dynamical quantities. (12,10,08
12. Discuss grand partition function of an ideal gas and obtain expression for it. (11,09,07
13. Discuss elements of ensemble theory in detail. (11,08
14. Differentiate between canonical and micro-canonical ensemble. Obtain an expression for the entropy of a micro-canonical ensemble. (09
15. Derive Fermi-Dirac distribution law. (09
16. Describe Bose-Einstein condensation. How does it is differ from ordinary condensation? Discuss the anomsulous properties of liquid Helium at the transition temperature. (07
17. Write short notes on any two of the following :
    i. Macro-states and macro states (12
    ii. Sackur-Tetrode equation (12
    iii. Critical-exponent (12,10,08
    iv. Specific heat of electron gas (12
    v. Entropy of perfect gas (11
    vi. Helmholtz free energy (11
    vii. Probability distribution (11
    viii. Boltzmann distribution law (11,09
    ix. Fundamental assumptions of statistical mechanics (10,08
    x. Grand canonical ensemble (10
    xi. Planks's radiation formula (10
    xii. Grand canonical function (09
    xiii. Bose-Einstein statistics (09
    xiv. Energy fluctuation in canonical ensemble (08

Group - B

1. State and prove :
   i. Norton's theorem **(13,11,09,07**
   ii. Maximum power transfer theorem (13
   iii. Reciprocity theorem **(11,09,07**
2. Derive Child-Langmuir equation and discuss its experimental verification. (**13,11,09,07**
3. Derive Hartley Oscillator with neat circuit diagram and obtain the condition for sustained oscillations. **(13,09,08**
4. What do you mean by the amplitude modulation? Define the term modulation index and derive ration in frequency modulation. (13
5. What is multi vibrator? Give the circuit diagram of an astable multi vibrator and explain its action. What are factors that governs the frequency of output? **(13,11,07**
6. Derive the Rechardson equation and discuss its experimental verification. (12,10,08
7. State and explain Schotty effect. (12,08
8. Define NAND and NOR logic gates and write down their truth tables. Obtain the Boolean expression for the output of such gates. (12,10
9. What are inductively coupled circuits? Explain the working of mutually coupled circuit under resonance condition. (12
10. Discuss with circuit diagram, the principal and working of negative feedback amplifier. Explain its advantage. (12
11. Discuss the principle and working of *BJT* and draw suitable diagram. Explain the mechanism of current flow in *PNP* and *NPN* transistor. Compare the performance of BJT and FET. **(11,09,07**
12. Define OR gate and *AND* gate. Write down their truth tables. Obtain Boolean expression for the output of such gates. (11
13. Discuss the concept of hardware and software in context to computer system. What are bits and bytes? **(11,09,07**
14. What is field effect transistor? Describe the construction of *JFET* and explain its working with suitable diagram and draw its a.c. equivalent circuit. (10,08
15. Discuss the principal of amplitude modulation. Describe with diagram that how amplitude modulated signals can be produced. (10
16. Explain construction, working and use of photovoltaic cell. (08
17. Explain briefly with block diagram the working of a radio transmitter and receiver. (08
18. Write short notes on any two of the following :
    i. Reciprocity theorem (13
    ii. *AND* and *OR* gate **(13,09,07**
    iii. Zenor-diode (13,09
    iv. Demodulation (13
    v. Thevenin theorem (12,10
    vi. *FET* (12
    vii. Amplitude modulation (12
    viii. LDR (12,10
    ix. Astable multi vibrator (11
    x. Superposition theorem **(11,09,07**
    xi. Push-pull power amplifier (11
    xii. Input and output devices of computer (11,08
    xiii. BITS & BIT (10
    xiv. P-N-junction diode (10,07
    xv. Feed Back amplifier (10,08
    xvi. *BASIC* computer programming (09
    xvii. Maximum power transfer theorem (08
    xviii. *NAND or NOR* logic gates (08

Physics (Hons.) Paper – VII

Answer six questions, selecting two questions from each group.

Group – A

1. What is **plasma**? Discuss its main characteristics. Derive an expression for plasma oscillation frequency. What is two categories of occureence of plasma? **(13,11,09,07**
2. Give **Saha'a theory** of thermal ionization and derive ionization formula and mention its application. **(13,11,09,07**
3. Discuss the propagation of electromagnetic wave in isotropic plasma. Why the waves are reflected ionosphere? (13,10,08
4. Define retarted and advanced electromagnetic potentials. Obtain an expression for electric and magnetic field due to uniformly moving point charge by using Linard - Wiechert potentials. (13,10,08
5. Discuss the condition for the existence of plasma. Derive expressions for Debye length and potential. (12,10
6. Describe the theory of pinch effect. Discuss briefly instability of pinched plasma column. (12,10,08
7. Establish the covariance of Maxwell's electromagnetic field equations under Lorentz transformation. (12,09
8. Obtain expression for the radiation fields due to electric oscillating dipole. (12 ,07
9. Write short notes on any two of the following :
   i. Retarted and advanced potential (11
   ii. Covariance of Maxwell's field equations under Lorentz transformation (11,07
   iii. Current element (11,09
   iv. Alfven wave (11,08
   v. **Lenard – Wiechert potential** (09,07
   vi. Magnetic field due to oscillating dipole (09
   vii. Debye potential (09,08

Group – B

1. Derive Laue's condition for x-ray diffraction. Show that Bragg's law is special case of it. (13,07
2. Describe the ionic bond in solids and obtain an expression for cohesive energy for ionic crystal. Establish Mdulung constant for the NaCl crystal. (13
3. Give Sommerfield theory of electrical conductivity. How it differ from classical theory of Drude? (13
4. What is **Hall effect**? Find the expression for hall voltage and hall coefficient. How the Hall coefficient is determined experimentally? **(13,11,09,07**
5. What is one dimensional K.P. model? Discuss the propagation of electron wave in this model leads to band structure of electronic energy level. (12,10,08
6. Give an account of free electron theory of metals. Discuss the success and failure of the theory. (12,10,08
7. Discuss the position of Fermi level in an intrinsic semiconductor. How does its position change when (a) donors and (b) accepters are added to the semiconductor? What happens if the temperature is raised? (12
8. Derive Boltzmann transport equation and obtain an expression for electric conductivity of metals. **(11,09,07**
9. Explain reciprocal lattice. Obtain Bragg's equation in terms of reciprocal lattice. **(11,09,07**

10. What are Modelung's energy and Modelung's constant? Derive expression for those. (11
11. Explain different types of bonds in crystalline solids. Give suitable examples of each. (10,08
12. Write short notes on following :
    i. Blosch's theorem (12,10,08
    ii. Brag's law (12
    iii. Symmetry element of a crystal (12
    iv. Ewal construction and Brillouin Zones (12,09,07
    v. Bravis lattice and miller indices (10,08
    vi. Transistors (10
    vii. Mental and insulator (10
    viii. Modelung energy and Modelung constant (09
    ix. Symmetry elements of a crystal (09
    x. (Fermi level) Intrinsic and extrinsic semiconductors (09,07
    xi. Van der wall's binding (08
    xii. Crystal structure (07

Group – C

1. Explain theoretically fine structure of H_α – line in hydrogen spectrum. **(13,10,08**
2. Differentiate normal and anomalous Zeeman effect. Describe the anomalous Zeeman pattern in the case of D_1 and D_2 lines of sodium. (13
3. What is liquid drop model? Obtain Weizsacker semi-empirical mass formula on the basis of liquid drop model. Discuss the stability and binding energy of nuclei. **(13,11,10,08**
4. Discuss **Bohr's theory** of hydrogen spectrum. What are its short-comings? (12,09
5. Give an account of nuclear shell model. Discuss the prediction of this model. **(12,09,07**
6. Give an account of rotation vibration spectra of diatomic molecules. **(12,11,10,09,08**
7. What is normal Zeeman effect? Give the theory of normal Zeeman effect for a single valence electron system. Draw its transition. (11
8. What is **Paschen-Back effect**? Derive expression for change in energy in the presence of external magnetic field. Draw its transition. **(11,09,07**
9. Discuss the Bohr-Sommerfeld theory of hydrogen atom. (07
10. Write short notes on any two of the following :
    i. NMR (13
    ii. Magic number (13
    iii. Rotational molecular spectra (13
    iv. Paschen-Back Effect (13
    v. **Mosely law** (12,10,08
    vi. ESR (12
    vii. Laser (12
    viii. Rutherford scattering (12,10,08
    ix. Laser spectroscopy (10,08
    x. Vector model of atom (10
    xi. Electronic spin resonance (07
    xii. Stern-Gerlach experiment (07

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