M.Sc Question Bank

Semester-I

Paper- Classical Mechanics

1. Define the term constraints & generalized coordinates. Classify the two types of constraints with suitable examples. How the use of generalized coordinates does helps in reducing the number of coordinates.
2. If the Lagrangian of a dynamical system in two dimension is-

   $L = \frac{1}{2}mx^2 \dot{+} m\dot{x}\dot{y}$

   Prove that Hamiltonian is

   $$H = \frac{P_x P_y}{m} - \frac{P_y^2}{2m}$$

3. State Hamilton's Principle of motion. Derive Lagrangian equations from D' Alembert's Principal. How will the result be modified? If the forces are non-conservative and conservative prove equation of motion

   $mf = -\frac{\partial V}{\partial x}$ (f=acceleration)

   Using Hamilton's Principle

4. What are action angle variables?
5. Find out the mode of frequencies for the double pendulum. Write general coordinates in terms of normal coordinates.

6. What are canonical transformations? Show that the transformation

$$q = P^2 + Q^2, P = \frac{1}{2} tan^{-1} \frac{(P)}{Q}$$

   Is canonical.

7. If the Hamiltonian H is independent of time t explicitly, prove that it is, a) constant and b) equal to the total energy of the system.

8. (a) Define generalized momentum and cyclic coordinates. Show that the generalized momentum corresponding to a cyclic coordinate remains conserved.

9. (b) What is Δ-variation? Discuss how it differs from δ-variation. State and prove the principle of least action.

Paper- Quantum Mechanics

1. For unitary evolution operator, verify the following condition

$$\hat{U}(t_0, t_0) = 1$$

2. Verity the Hermiticity of Hamiltonian Matrix.
3. What do you mean by completeness or closure relation?
4. Define expectation value in terms of measurement.
5. If $\hat{A}|\varphi> = a|\varphi>$ and $\hat{A}|\chi> = a|\chi>$ and $|\square'> = |\varphi>$ and $|x'> = (|x> - |\varphi>) < \varphi|x>$, then show $< \varphi'|x' >$ are mutually orthogonal.
6. Employing the time independent perturbation theory (degenerate case), derive an expression of wave function and energy eigen value corrected up to first order of λ under the effect of perturbation.
7. Define Eigen states and describe Eigen value of an operator. Also prove if eigen state $l\phi >$ of operator $\hat{A}$ with eigen value of a_φ, then $l\phi >$ is also an eigen state of $\hat{A}^+$with eigen value of a_φ^*
8. What do you mean by expectation value and show that for any quantum mechanical system the expectation value of any operator $\hat{Q}$ is given by $< \varphi|\hat{Q}|\square >$

Paper-Classical Electrodynamics I

1. Give a differential form of Gauss Law.
2. What is another form of field strength?
3. Define electric field strength.
4. What do you understand about the method of electrical images?
5. Find the potential energy of an electric dipole in an external electric field.
6. State Green's Reciprocation theorem and prove it. Evaluate formal solution of electrostatic boundary value problem with Green's function.
7. What do you understand about electrostatic potential energy? The charge density on the surface of the conductor is σ. Find the force per unit area for its surface?
8. For a point charge in the presence of a grounded conducting sphere, calculate
    a) Electric Field Intensity
    b) Surface Charge Density
    c) Total Induced Charge
    d) Force between q and q'
    e) Total energy
9. For a point charge near a conducting sphere at fixed potential, calculate
    a) Potential at an external point P
    b) Electric Field Intensity
    c) Surface Charge Density
    d) Force (with graphical representation)

Paper- Electronics

1. Write the characteristics of an ideal op-amp.
2. What are the conditions which are to be satisfied for the successful operation of phase shift oscillator?
3. What is multivibrator and discuss briefly the types of multivibrators.
4. What do you mean by demultiplexer and decoder? How they are different from each other? Explain with suitable examples.
5. Convert the following BCD number into their decimal equivalents.

a) 0111 0111

b) 1000 0001 0011

c) 0111 0010 0101 1001

d) 0101 0111 1000 0010

6. (a) Why negative Feedback is necessary for op-amp.

   (b) Draw the circuit for dual input balanced out-put differential amplifier and explain their operating points.

   (c) Write the names of feedback configurations and explain the non-inverting amplifier with feedback in detail.
7. (a) What is Wein Bridge oscillator and what are its uses? Derive an expression for the frequency of oscillation of the circuit.

   (b) Design a Wein Bridge oscillator that will oscillate at 2 kHz
8. What do you mean by multiplexer? Write the expression for the data output and also write the truth table for 16:1 multiplexer.

Paper-Computer Programming

1. (a) Write a statement or a set of statements of sum of the odd integers between 1and 99 using a for statement.

   (b) What is the difference between actual and formal parameters?

   (c) What is the difference between a do –while loop and a while loop.

   (d) Explain purpose and syntax of goto statement.

   (e) What is the output of the following?

   If (1) print ("yes"); else printf("No");

2. (a) What is looping? Explain all loop structure with examples.

   (b) Explain various data types in C language.

3. (a) Create a structure to store employee's data {name, department, salary}.

   WAP to print details of the employees having salary greater than Rs.10, 000.

   (b) Explain array with example.

4. What is function? Explain Following:

a) Function prototype

b) Function Call

c) Function Definition