

2020

PHYSICS (Honours)

Paper Code : VII

[Old Syllabus]

Full Marks : 90

Time : Four Hours

The figures in the margin indicate full marks.

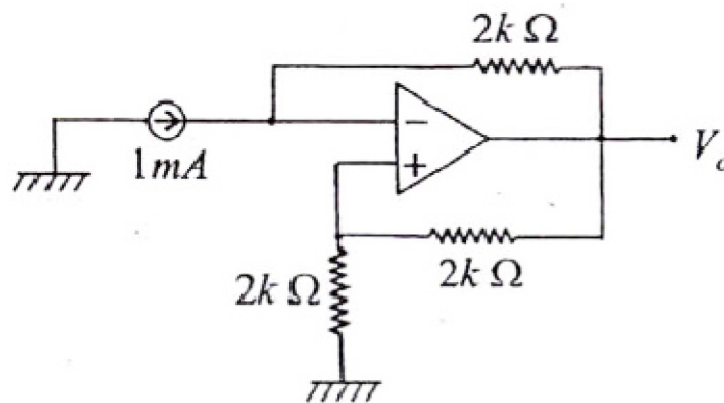
Answer question no. 1 and any *five* from the rest, taking at least one from Group - A, one from Group - B, two from Group - C and the rest one from any group.

1. (a) Find the number of possible arrangements of two particles in three cells. In each case assuming that the particles obey —
 - (i) M-B statistics
 - (ii) B-E statistics
 - (iii) F-D statistics 3

- (b) If $L = \frac{1}{2}m\dot{x}^2 - \beta x\dot{x} - \frac{kx^2}{2}$, find Lagrange's equation of motion. 2

- (c) For a particle executing small oscillation show that its potential about stable equilibrium position is approximately parabolic. 4

- (d) Find the output voltage for the circuit shown below. 3

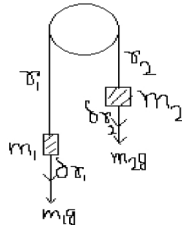


- (e) Write down Hamilton's canonical equations and express them in Poisson bracket representation. 1+2

Group - A

(Classical Mechanics-II and Fluid Mechanics)

2. (a) Derive Lagrange's equations for conservative system from D'Alembert's Principle.
 (b) Find the equation of motion of a simple pendulum using Lagrangian formulation. 9+6
3. (a) What is the basic difference between rheonomic and scleronomic constraints?
 (b) Using D'Alembert's principle obtain the relation $\ddot{r}_1 = \left\{ \frac{m_1 - m_2}{m_1 + m_2} \right\} \vec{g}$



- (c) Prove that the conjugate momentum of a cyclic co-ordinate is conserved.
 (d) Prove that the Hamiltonian is the total energy of a conservative system. 3+5+3+4
4. (a) State and prove Bernoulli's theorem for the steady streamline flow of a liquid.
 (b) Using Hamiltonian formulation prove that the areal velocity of a particle moving under central force field is constant of motion. 9+6

Group - B

(Statistical Mechanics)

5. (a) Mentioning the necessary conditions, obtain the Boltzmann distribution function for an ensemble of fermions.
 (b) State and deduce Stirling's approximation formula. 9+6
6. (a) Using F-D distribution function for an electron gas, obtain Richardson – Dushman Equation for thermionic emission.
 (b) Obtain the phase space diagram of one-dimensional harmonic oscillator. 9+6

Group - C
(Electronics - II)

7. (a) Describe the construction of an enhancement- type MOSFET and explain its operation.

(b) Describe the advantages of negative feedback in transistor amplifier. 10+5

8. (a) Draw the circuit diagram of a Hartley oscillator and explain its working.

(b) Write a short note on A/D converter. 10+5

9. (a) How is an RS flip-flop converted into a JK flip-flop? Give its truth table and explain how it is obtained.

(b) Draw the block diagram of a general purpose CRO and indicate its basic components. 10+5

10. (a) What is phase modulation? Obtain an expression for a phase modulated wave, when the modulating signal is sinusoidal. Hence show that the maximum frequency deviation in a phase modulated wave is proportional to both the amplitude and the frequency of the modulating signal. 2+5+2

(b) What is the difference between half-adder and full-adder? Give the truth table of a full adder and hence show that a full adder can be constructed using two half adders and an OR gate. 2+4
