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2203N269

Candidate's Seat No :_____

M.Sc. Sem.-1 Examination
402
Physics
March 2022

Time : 2-00 Hours] **[Max. Marks : 50**

Instructions: All questions in **Section – I** carry equal marks.
Attempt any **Three** questions in **Section – I.**
Questions in **Section – II** is **COMPULSORY.**

Section – I

Q-I	A.	When is Hamilton-Jacobi theory more valuable? Explain the harmonic oscillator problem using Hamilton-Jacobi method.	7
	B.	Describe how the problem of motion of a body in a central force field is divisible in polar coordinates but not in cartesian coordinates.	7

Q-II	A.	What are the action-angle variables? Describe how they can be used to get the frequencies of periodic motion. Also, find the frequency of linear harmonic oscillator.	7
	B.	Prove that the Poisson brackets of two constants of motion is itself a constant of motion even when the constants depend upon time clearly.	7

Q-III	A.	Get values of eigen frequencies of oscillations and their related eigen vectors for the system of three molecules.	7
	B.	Express normal coordinates. What do you mean by stable, unstable and neutral equilibrium? Write example of each.	7

Q-IV	A.	What is orthogonality? Show that the Eigen vectors corresponding to the two distinct Eigen frequencies are orthogonal.	7
	B.	If vibrating string of length L is fixed at both the ends, find Lagrangian equation of motion. Describe how frequencies of different mode of oscillations can be obtained.	7

Q-V	A.	Define Brownian motion. Explain Einstein theory of Brownian motion.	7
	B.	State the origin of Shot noise. Obtain an expression for RMS shot noise current.	7

Q-VI	A.	Derive Langevin theory of Brownian motion. State its physical significance.	7
	B.	Define Johnson noise. State and prove Nyquist theorem.	7

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Q-VII	A.	Giving examples, explain 2nd order phase transitions.	7
	B.	Discuss Bragg-William's approximation for magnetic phase transition.	7

Q-VIII	A.	Differentiate between 1st and 2nd order phase transition. Show that during the 1st order phase transition the latent heat is non-zero.	7
	B.	Explain critical exponents. Give its physical significance.	7

Section – II

Q-IX	MCQs				8
1.	The contact transformation is				
	A.	the transformations of older to new coordinates.	B.	the coordinates remain the same.	
	C.	the transformations of newer to older coordinates.	D.	the coordinates are not transformed.	
2.	The Hamiltonian of a system with n degrees of freedom is given by $H = H(q_1, \dots, q_n, p_1, \dots, p_n, t)$ with an explicit dependence on time t. Which of the following is correct?				
	A.	The equations of motions are not valid since H has explicit dependence on time.	B.	Different phase trajectories cannot intersect each other.	
	C.	H always represents the total energy of the system and is a constant of motion.	D.	Any initial volume in phase space remains unchanged is in magnitude under time.	
3.	Two bodies of mass m and 2m are coupled by a spring constant k. The frequency of the normal mode is				
	A.	$\sqrt{\frac{3k}{2m}}$	B.	$\sqrt{\frac{2k}{3m}}$	
	C.	$\sqrt{\frac{k}{m}}$	D.	$\sqrt{\frac{k}{2m}}$	
4.	In case of two coupled identical pendulums, oscillating in a plane				
	A.	each pendulum always executes simple harmonic motion.	B.	each pendulum always doesn't execute simple harmonic motion.	
	C.	the general motion can be	D.	the general motion can be expressed	

		expressed as a superposition of two simple harmonic motions of the same frequency.		as a superposition of two simple harmonic motions of the different frequency.
5.	If the measured time of particle motion, $t >> \tau_e$ then, one expects			
	A.	Steady state motion of particles	B.	Brownian motion of particles
	C.	Either the Brownian motion or steady state motion	D.	Combined steady state and Brownian motion
6.	At 17 °C, the noise voltage generated by 5 kΩ resistor, operating over a bandwidth of 20 kHz is			
	A.	1.28 pV	B.	1.28 nV
	C.	1.28 μV	D.	1.28 mV
7.	In which of the following phase transition, there is no latent heat involved			
	A.	Liquid metal condenses in to solid metal	B.	Boling water converted into vapour
	C.	Paramagnetic iron converted to ferromagnet	D.	It depends on material
8.	Which one of the following is an example of first order phase transition			
	A.	Crystal structure of BaTiO3	B.	Ice melts into water
	C.	Superconducting phase transition	D.	Paramagnet to ferromagnet