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FOURTH SEMESTER (CUFYUGP) DEGREE EXAMINATION, APRIL 2026

APPLIED PHYSICS/ PHYSICS

APH4CJ204/PHY4CJ204: Mechanics II

2024 Admission onwards

Maximum Time :2 Hours **Maximum Marks :70**

Section A

All Questions can be answered. Each Question carries 3 marks (Ceiling : 24 Marks)

1	Define central force? Show that motion is confined to a plane in central force motion
2	Define Gravitational potential energy. Using the relationship between force and potential energy, obtain the expression for gravitational potential energy
3	Describe Kepler's second law and its significance in understanding the equal area law of planetary motion
4	Define SHM. Show that for small angle of oscillation, the motion of a simple pendulum is SHM
5	Define Q-factor. Explain its physical significance
6	Fourier theorem. What are the conditions of its applicability
7	Using the general expression for one dimensional travelling wave, show that $y=A \sin(kx-\omega t)$ represents a travelling wave.
8	A reference frame is accelerating linearly relative to an inertial frame. Can we express newton's laws in this accelerated frame? Explain
9	Explain the terms centrifugal force and Coriolis force in rotating frames
10	Give the expression for effective potential for the motion of planet around sun. Give the significance of positive and negative terms in it.Draw the graph representing variation of effective potential with radial distance

Section B

All Questions can be answered. Each Question carries 6 marks (Ceiling : 36 Marks)

11	A particle is in a circular orbit under the action of an inverse cubed attractive central force given by $f(r) = -k/r^3$. Obtain an expression for the angular momentum and show that it is constant.
12	The perihelion of Halley's Comet is 88×10^6 km and it has an eccentricity e = 0.961. (a) Determine the aphelion. (b) What is the speed of the comet when it is at perihelion?(Given: Mass of Sun $=1.989 \times 10^{30}$kg)
13	A mass of 5 kg is attached to a spring of stiffness 2000 N/m. It is displaced by 20 mm from equilibrium and released from rest. Find

	(a) Natural angular frequency (b) Natural frequency (c) Maximum velocity (d) Total energy of the system
14	An underdamped harmonic oscillator has k=2N/m, m=1 kg and b=0.1kg/s. How many oscillations does the system makes before the amplitude decrease to 1/e of its initial value?
15	A string of 6m length is stretched and fixed at both ends. Its mass is 0.1 kg and tension in the string is 50N. (a) What is the wavelength of the longest possible standing wave in this string? (b) What is the frequency of that wave?
16	Discuss the formation of standing wave in a string.Derive the expression for total energy in that wave
17	A cannon is fired due north from the equator with a speed of 200m/s at an angle of projection 45° above the horizontal.Calculate the deflection of the projectile due to the Coriolis force.Discuss how this deflection changes with colatitude.
18	A Foucault's pendulum is installed in a science center at a colatitude of 45°. (Given: angular velocity of Earth $\Omega=7.29\times10^{-5}$rad/s) 1. Calculate the angular precession rate of the pendulum. 2. Through what angle will the plane of oscillation rotate in 12 hours? 3. How long will it take to complete one full rotation?
Section C	
Answer any ONE .Each Question carries 10 marks (1x10=10 Marks)	
19	State Kepler's laws of planetary motion. Prove second and third law
20	Obtain the complete solution of the equation of damped free vibration and discuss the physical behavior of all damping cases with sketches