TB252813F

Reg. No :.....

Name :.....

BACHELOR'S DEGREE (C.B.C.S) EXAMINATION, MARCH 2025

2023 ADMISSIONS SUPPLEMENTARY

SEMESTER II - COMPLEMENTARY COURSE 2 PHYSICS

PH2B01B23 - Mechanics and Astrophysics

Time : 3 Hours **Maximum Marks : 60**

Part A

I. Answer any Ten questions. Each question carries 1 marks **(10x1=10)**

1. Explain the features of rigid body.
2. List any two applications of flywheel.
3. Determine torque produced by a person if he applies a force of 12N at 1.0 m away from the pivot point, perpendicularly to the lever arm.
4. A boat engine operating at 90000 Watt is running under the action of torque 120 N-m . Calculate the frequency of the engine.
5. Explain Magnetostriction effect.
6. Define the term amplitude resonance.
7. Find the ratio of maximum acceleration to the maximum velocity of a particle performing S.H.M.
8. A particle is executing simple harmonic motion with amplitude 'a'. Determine the displacement of harmonic oscillator where its kinetic and potential energies are equal.
9. State and explain the principle of superposition of waves. Name a situation when it does not hold true.
10. Write down the relation between apparent magnitude and absolute magnitude of a star.
11. Distinguish between astronomy and astrophysics.
12. Name the spectral classes in which the hottest and coolest stars appear.

Part B

II. Answer any Six questions. Each question carries 5 marks **(6x5=30)**

13. Two circular discs A and B of the same mass and same thickness are made of two different metals whose densities are ρ_A and ρ_B where $\rho_A > \rho_B$. Their moments of inertia about the axes passing through their centres of gravity and perpendicular to their planes are I_A and I_B. Find the disc with the greater moment of inertia.
14. Define torque and deduce the equation of rotational motion.
15. The angular momentum of rotation of a body is 62.8 Js and its rate of rotation is 20 revolutions per second. Compute the moment of inertia of the body.
16. Ultrasonic waves are to be produced by a magnetostriction oscillator using either iron or nickel rod of the same length 10 cm. Which one is suitable for the production of ultrasonic waves. Justify your answer. Given, density of iron = 7.8 x 10^3 Kg/m^3, Young's modulus of iron = 11.5 x 10^10 N/m^2, Density of Nickel = 8.9 X 10^3 Kg/m^3, Young's modulus of Nickel = 20.7x10^10 N/m^2.
17. Derive an expressions for total energy of harmonic oscillator. Prove that it is directly proportional to square of the frequency.
18. A particle executes S.H.M of amplitude 25cm and time period 6s. What is the minimum time required for the particle to move between two points 12.5cm on either side of the mean position.
19. An ambulance moves at 72 km/hour while sounding a siren with a frequency of 1500 Hz. A motor cyclist moves at speeds of 20 m/s in opposite directions with ambulances. If the speed of sound in air is 340 m/s, then obtain the ratio of frequencies heard by motor cyclist when approaching and when moving away from the ambulance.

20. Give a brief note on supernova explosion.

21. Faint "brown-dwarf" stars have absolute magnitudes of around 17.5. How many times fainter than the Sun are these stars? Explain with necessary theory.

Part C

III. Answer any Two questions. Each question carries 10 marks **(2x10=20)**

22. Calculate the moment of inertia of a thin annular ring about (i) an axis passing through its centre and perpendicular to its plane (ii)a diameter.

23. Set up the differential equation for a damped harmonic oscillator and obtain its solution. Hence discuss the condition for oscillatory motion.

24. Deduce using the concept of Doppler effect in sound, the total change in pitch measured by a stationary observer when a moving source crosses him. What will happen if the medium is also moving?

25. Sketch HR diagram. Describe the information that can obtain from it.