DO NOT WRITE ANYTHING ON QUESTION PAPER EXCEPT YOUR NAME, DEPARTMENT AND ENROLMENT No.

POSSESSION OF MOBILE, SMART WATCH ETC, IN EXAMINATION IS A UFM PRACTICE

Name of Student --- Enrolment No. ----------------

Department /School ------------------------------------

BENNETT UNIVERSITY, GREATER NOIDA
Mid-Term Examination, SPRING SEMESTER 2022-23

COURSE CODE: EPHY108L   MAX. DURATION: ONE HOUR

COURSE NAME: Mechanics   Weightage: 20

COURSE CREDIT: 3   MAX. MARKS: 20

Note

- Programable calculator is not allowed.
- All questions are compulsory.

1. **A)** A particle of mass 4 units moves in a force field depending on time t given by
$$\vec{F} = 48t^2\hat{\imath} + (72t + 16)\hat{\jmath} - 24t\hat{k}.$$
Assuming that at $t = 0$ the particle is located at $\vec{r}_0 = 3\hat{\imath} - \hat{\jmath} + 4\hat{k}$ and has velocity $\vec{v}_0 = 6\hat{\imath} + 15\hat{\jmath} - 8\hat{k}$. Find the momentum and position at any time t.

4 marks

B) Consider a bead moving along the spoke of a rotating wheel as shown in the figure. Assume both u and ω are constant. Calculate the velocity and acceleration of the bead in plane polar coordinates.   3 marks
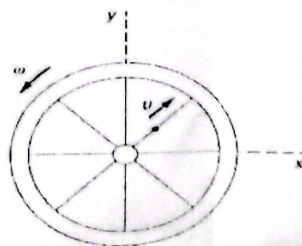
2. **A)** A force applied on a system is given by $\vec{f} = 3\hat{\imath} + z\hat{\jmath} + y\hat{k}$. Determine whether the given force is conservative. Find the potential energy function, if it exits.   3 marks

B) Verify Stokes' theorem for a given vector field, $f = y\hat{\imath} - x\hat{\jmath} + z\hat{k}$ taken around a hemispherical surface $x^2 + y^2 + z^2 = a^2$ with $z \geq 0$.   4 marks

Given the surface element is $d\vec{S} = a^2 \sin\theta \, d\theta d\phi \hat{r}$

3. **A)** A mass is vibrating at the end of a spring of force constant 225 N/m. Figure below shows a graph of its position x as a function of time t.

    a. At what times is the mass not moving?
    b. How much energy did this system originally contain?
    c. How much energy did the system lose between $t = 1s$ and $t = 4s$? where did this energy go?

4 marks
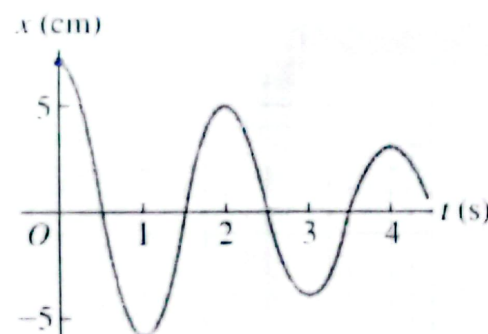
B) A paperweight suspended from a hefty rubber band has a period of 1.2 s and the amplitude of oscillation decreases by a factor of 2 after three periods. What is the estimated Q of this system?

2 marks

$$A_0 e^{-\frac{\gamma}{2}t}$$

$$\omega = ?$$

$$\frac{1}{1.2}$$