NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR
ENGINEERING MECHANICS (ME 1101)
Second Semester (All Branch)
ASSIGNMENT – 17

1. Forces act upon a particle during short intervals of time as shown by the force-time diagram given in Fig. A. Find the velocity and displacement of the particle at any time $t > t_3$. Assume $x_0 = 0$ and $\dot{x}_0 = 0$ when $t = 0$.

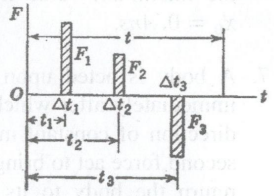

FIG. A

2. A particle initially at rest is submitted to the action of force $X = kt$. Prove that the ratio $\frac{x}{\dot{x}}$ increases as a linear function of time. *Ans.* $\frac{x}{\dot{x}} = \frac{t}{3}$

3. The magnitude of a force acting upon a body of mass $\frac{W}{g}$ is initially zero and increases uniformly with time, being equal to W at the end of the first second. Find the velocity and displacement of the body after 6 seconds, assuming $x_0 = 0$ and $\dot{x}_0 = 1\frac{m}{sec}$. *Ans.* $(\dot{x})_{t=6} = 176.58\ \frac{m}{sec}, (x)_{t=6} = 363.16\ m$

4. A particle of mass m moves rectilinearly under the action of a force $X = F(t)$ as represented by the force-time diagram OCB in Fig. B. If this curve is a parabola, find the displacement at time t_1. *Ans.* $x = \frac{Pt_1^2}{3m}$

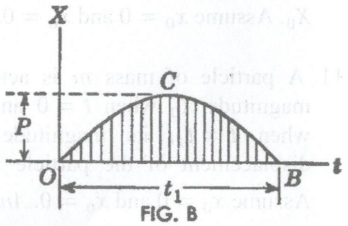

FIG. B

5. A particle of weight W moves rectilinearly under the action of a force $X = P \sin \omega t$. Derive the general displacement-time equation, assuming $x_0 = 0$ and $\dot{x}_0 = 0$. *Ans.* $x = \frac{Pg}{W\omega^2}(\omega t - \sin \omega t)$

[Turn over]

6. The magnitude of the force acting on a body of weight $W = 3.14\ N$ is given by the equation $X = X_0 \sin \omega t$, in which $\omega = 8\ \frac{rad}{sec}$. If after one complete force cycle the displacement of the body is $10\ m$, find the maximum value X_0 of the acting force. Assume $x_0 = 0$ and $\dot{x}_0 = 0$. *Ans.*

7. A body is acted upon for $5\ sec$ by a constant force $X_1 = 10\ N$, immediately after which it is acted upon by a force in the opposite direction of constant magnitude $X_2 = 3\ N$. What time t_1 must this second force act to bring the body to rest? What time t_2 must it act to return the body to its starting point? Assume $x_0 = 0$. *Ans.* $t_1 = 16.7\ sec;\ t_2 = 35.7\ sec$

8. Under the action of a force $X = X_0 - kt$ a particle starts from rest at the origin and moves along the $x\ axis$. At what instant t will it again be at the origin? Assume $X_0 = 12\ N$ and $k = 2\ \frac{N}{sec}$. *Ans.* $t = 18\ sec$

9. A particle of weight W moves rectilinearly under the action of a force $X = P \cos \omega t$. Develop the velocity-time and displacement-time equations if $x_0 = 0$ and $\dot{x}_0 = 0$. *Ans.* $x = \frac{Pg}{W\omega^2}(1 - \cos \omega t)$

10. Find the velocity and displacement at any time t for a particle of weight W moving rectilinearly under the action of a constant force X_0. Assume $x_0 = 0$ and $\dot{x}_0 = 0$. *Ans.* $\dot{x} = at,\ x = \frac{1}{2}at^2$

11. A particle of mass m is acted upon by a force that has initial magnitude X_0 when $t = 0$ and decreases at a uniform rate until, when $t = t_1$, its magnitude is zero. Find the velocity and displacement of the particle when $t = t_2$, assuming that $t_2 > t_1$. Assume $x_0 = 0$ and $\dot{x}_0 = 0$. *Ans.* $(x)_{t_2} = \frac{X_0}{m}\frac{t_1}{2}\left(t_2 - \frac{t_1}{3}\right)$

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