

Total Pages--4

(Set-R₁)

M.Tech-2nd (CE-SE)
Structural Dynamics

Full Marks : 70

Time : 3 hours

Answer Q. No. 1 and any five from the rest

The figures in the right-hand margin indicate marks

Any missing data may be suitably assumed

1. Answer the following : 2 × 10
- (i) What is resonance ?
 - (ii) What is critical damping ?
 - (iii) What do you mean by rotary inertia ?
 - (iv) Define basic degree of freedom for vibration of a string and torsional vibration of a rod.
 - (v) What is model analysis ?

(Turn Over)

(2)

- (vi) Explain Dahamel integral expression.
- (vii) What do you mean by orthogonality condition?
- (viii) What do you mean by Impulse load?
- (ix) Provide examples of few loads where random vibration analysis is necessary.
- (x) What is proportional damping (Rayleigh type)?
2. (a) A SDOF system (mass, $m = 9100$ kg) with viscous damping is displaced from its position of rest by a distance $u_0 = 30$ mm. If the maximum displacement on return swing is 20 mm on 0.5 sec, determine the spring constant and damping. 4
- (b) A SDOF system has spring constant $K = 6000$ N/m critical damping of 0.3 N/mm and a damping ratio of 0.3. If the system is given an initial velocity at 1.0 m/sec, determine the maximum displacement of the system. 6

(3)

3. A machine of 100 kg mass is supported on spring of total stiffness 700 kN/m and has an unbalanced rotating element which results in a disturbing force of 350 N at a speed of 300 rev/min assume damping $\xi = 0$. Determine (a) amplitude of motion due to unbalance and (b) force transmitted to support. 10
4. Obtain the expression of displacement of an undamped SDOF system subjected to force $F(t)$ as shown in the Fig 4. Use Dahamel's integral. 10

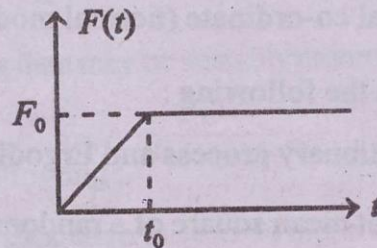


Fig 4

5. For the two degree of freedom system shown in Fig. 5, find the angular frequencies and the corresponding mode shapes. 10

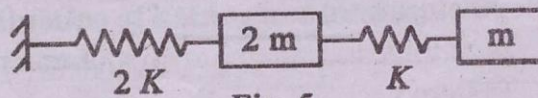


Fig. 5

(4)

6. (a) Derive the equation of motion of axial vibration of a rod. 5
- (b) Obtain the expression of frequency for clamped-free boundary conditions of the vibrating rod as derived above. 5
7. Starting from the basic dynamic equilibrium equation of beam under simple flexure, obtain the decoupled equation of motions using principal co-ordinate (normal modes). 10
8. Explain the following : $2\frac{1}{2} \times 4$
- (a) Stationary process and Ergodic process.
- (b) Root mean square of a random process $x(t)$.
- (c) Narrow band and wide band random process.
- (d) Frequency response function.