Total Pages—4

(Set-$R_1$)

# 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 : $2 \times 10$

   (*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*)

(*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. 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

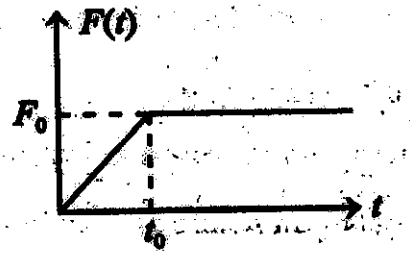


Fig 4

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

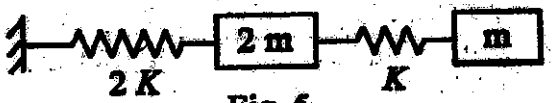


Fig. 5

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 bond and wide band random process.

(*d*) Frequency response function.