

**B.E., DEGREE EXAMINATIONS MAY/JUNE 2013**

Fifth Semester

**MECHANICAL ENGINEERING**

MEC113: Dynamics of Machinery

**Time: Three Hours**

**Maximum Marks: 100**

**Answer ALL Questions:-**

**PART A (10x1=10 Marks)**

1. Inertia force is also called as
  - A. reversed effective force
  - B. reversed shaking force
  - C. reversed radial force
  - D. Reversed tangential force
2. Coefficient of steadiness is the reciprocal of
  - A. co-efficient of fluctuation of energy
  - B. fluctuation of speed
  - C. fluctuation of energy
  - D. co-efficient of fluctuation of speed
3. Unbalanced force is also called as
  - A. Tangential force
  - B. shaking force
  - C. circular force
  - D. radial force
4. The secondary unbalanced force is maximum when crank angle is equal to
  - A.  $45^{\circ}$
  - B.  $270^{\circ}$
  - C.  $360^{\circ}$
  - D.  $120^{\circ}$
5. When a body is subjected to transverse vibrations, the stress induced in a body will be
  - A. torsion
  - B. shear stress
  - C. tensile stress
  - D. compressive stress
6. A shaft carrying two rotors at its ends will have
  - A. no node
  - B. one node
  - C. two nodes
  - D. Three nodes
7. If the roots of the equation of motion for a vibrating system with viscous damping are real, then the system will be
  - A. overdamping
  - B. underdamping
  - C. critical damping
  - D. equaldamping
8. If the roots of the equation of motion for a vibrating system with viscous damping are equal, then the system will be
  - A. underdamping
  - B. overdamping
  - C. critical damping
  - D. logarithmic damping



of gyration 400 mm. Determine (i) the power developed (ii) the total percentage fluctuation of speed (iii) the angular acceleration of flywheel when the crank has rotated through an angle of  $60^\circ$  from the inner dead centre (iv) the maximum angular acceleration and retardation of the flywheel.

22. a) Four masses A, B, C and D are completely balanced. Masses C and D make angles of  $90^\circ$  and  $195^\circ$  respectively with B in the same sense. The rotating masses A, B and C are having the masses of 25 kg, 40 kg and 35 kg respectively. The radius of rotation of masses A, B, C and D are 150 mm, 200 mm, 100 mm and 180 mm respectively. The planes B and C are 250 mm apart. Determine (i) the mass A and its angular position (ii) the position of planes A and D.

**(OR)**

- b) A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm and 200 mm respectively from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find the mass of the reciprocating parts for the third cylinder and the relative angular positions of the cranks in order that the engine may be in complete primary balance.

23. a) Determine the equivalent spring stiffness and the natural frequency of the vibrating systems when (i) the mass ( $m_1$ ) is suspended to a spring of stiffness  $s_1$  (ii) the mass ( $m_1$ ) is suspended at the bottom of two springs in series of stiffness  $s_1$  and  $s_2$  (iii) the mass ( $m_1$ ) is fixed in between two springs of stiffness  $s_1$  and  $s_2$  (iv) the mass ( $m_1$ ) is fixed to the midpoint of a spring of stiffness  $s_1$ . Take  $s_1 = 5 \text{ N/mm}$ ,  $s_2 = 8 \text{ N/mm}$  and  $m = 10 \text{ kg}$ . Also sketch the arrangements.

**(OR)**

- b) A vibrating system consists of a mass of 50 kg, a spring of stiffness 30 kN/m and a damper. The damping provided is only 20% of the critical value. Determine (i) the damping factor (ii) the critical damping coefficient (iii) the natural frequency of damped vibration (iv) the logarithmic decrement (v) the ratio of two consecutive amplitudes.
24. a) A shaft 1.5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external

diameter 75 mm and internal diameter 40 mm. The density of the shaft material is  $7700 \text{ kg / m}^3$  and its modulus of elasticity is  $200 \text{ GN / m}^2$ . Find the lowest whirling speed of the shaft, taking into account the mass of the shaft.

**(OR)**

b) The mass of an electric motor is 120 kg and it runs at 1500 r.p.m. The armature mass is 35 kg and its C.G. lies 0.5 mm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs. Determine : 1. stiffness of each spring; 2. dynamic force transmitted to the base at the operating speed; and 3. natural frequency of the system.

25. a) The mass of each ball of a Proell governor is 7.5 kg and the load in the sleeve is 80 kg. Each of the arms is 300 mm long. The upper arms are pivoted on the axis of rotation, whereas the lower arms are pivoted to links of 40 mm from the axis of rotation. The extensions of the lower arms to which the balls are attached are 100 mm long and are parallel to the governor axis at the minimum radius. Determine the equilibrium speeds corresponding to extreme radii of 180 mm and 240 mm.

**(OR)**

b) (i) An aeroplane makes a complete half circle of 50 metres radius, towards left, when flying at 200 km per hr. The rotary engine and the propeller of the plane has a mass of 400 kg and a radius of gyration of 0.3 m. The engine rotates at 2400 r.p.m. clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. (4)

(ii) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: (i) when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. (ii) when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees. (10)

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