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**REG NO:**

**SIR ISSAC NEWTON COLLEGE OF ENGINEERING AND TECHNOLOGY**  
Mechanical Engineering  
**ME 6505 — DYNAMICS OF MACHINES**  
Time: Three hours Maximum: 100 Marks

**SINCET/III MECH/ MODEL/DOM/SET-2/NOV-DEC 2015//AU-MJ 2013/21568//**

Answer ALL questions

**PART A — (10 × 2 = 20 Marks)**

1. Distinguish between static force and inertia force.

2. What is engine shaking force?

3. Write the expressions for primary and secondary unbalanced forces of reciprocating masses.

4. Unbalanced effects of shafts in high speed machines are to closely look into. Why?

5. Determine the natural frequency of mass of 10 kg suspended at the bottom of two springs (of stiffness:

5N/mm &N/mm) in series.

6. Give the limit beyond which damping is detrimental. Why?

7. Define transmissibility.

8. Show that for effective isolation of vibration, frequency ratio r >√ 2.

9. What is mean by isochronous condition in governors?

10. What will be the effect of the gyroscopic couple on a disc fixed at a certain angle to a rotating shaft?

**PART B — (5 × 16 = 80 Marks)**

11. (a) A shaft fitted with a flywheel rotates at 250 r.p.m and drives a machine. The torque of machine varies in a cyclic manner over a period of 3 revolutions. The torque rises from 750 N/m uniformly during 1/2 revolution and remains constant for the following revolution .It then falls uniformly to 750 N-m during the next 1/2 revolution and remains constant for one revolution, the cycle being thereafter.

Determine the power required driving the machine and percentage fluctuation in speed, if the driving torque applied to the shaft is constant and the mass of the flywheel is 500kg with radius of gyration 600 mm. **(16)**

**(or)**

(b) A horizontal steam engine running at 240 r.p.m has a bore of 300 mm & stroke 600 mm. The connecting rod is 1.25m long and the mass of reciprocating parts is 60kg.When the crank is 60 degree past its inner dead center, the steam pressure on the cover side of the piston is 1.125 N/mm2.Neglecting the area of the piston rod, determine:

(i)The force on the piston rod, and **(8)**

(ii)The turning moment on the crankshaft. **(8)**

12. (a) A shaft has 3 eccentrics, each 75 mm diameter &25 mm thick, machined in one piece with the shaft. The central planes of the eccentric are 60 mm Apart. The distance of the centers from the axis of rotation are 12 mm,18 mm and 12 mm and their angular positions are 120(degree) apart. The density of metal is 7000 kg/m^3.find the amount of out-of-balance force and couple at 600 r.p.m. If the shaft is balanced by adding two masses of a radius of 75 mm and at a distance of 100 mm from the central plan of the middle eccentric, find the amount of the masses and their angular positions. **(16)**

**(or)**

(b) The 3 cranks of a 3 cylinder locomotive are all on the same axle and are set at 120(degree).The pitch of the cylinders is 1 meter and the stroke of each position in 0.6 m. The reciprocating masses are 300kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, find:

(i) The magnitude and the position of the balancing masses required at a radius of 0.6m;and **(8)**

(ii)The hammer blow per wheel when the axle makes 6 r.p.s **(8)**

**13.**(a) A vertical shaft of 5mm diameter is 200mm long and is supported in long bearings at its ends .A disc of mass 50kg is attached to the center of the shaft. Neglecting any increase in stiffness due to the attachment of the disc to the shaft, find the critical speed of rotation and the maximum bending stress when the shaft is rotating at 75% of the critical speed. The center of the disc is 0.25 mm from the geometric axis of the shaft. E=200 GN/m^2. **(16)**

**(or)**

(b) A machine of mass 75 kg is mounted on springs and is fitted with a dashpot to damp out vibrations. There are 3 springs each of stiffness 10 N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine:

(i) The resistance of the dashpot at unit velocity; **(6)**

(ii) The ratio of the frequency of the damped of the damped vibration to the frequency of the undamped vibration; and **(6)**

(iii) The periodic time of the damped vibration. **(4)**

**14.**(a) A mass of 10 kg is suspended from one end of a helical spring, the other end being fixed .The stiffness of the spring is 10N/mm. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in 4 complete oscillations. If a periodic force of 150 cos 50 t N is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance? **(16)**

**(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 0.5mm from the axis of rotation. The motor is mounted on 5 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 5 springs.

Determine:

(i) Stiffness of each spring. **(6)**

(ii) Dynamic force transmitted to the base at the operating speed. **(6)**

(iii) Natural frequency of the system. **(4)**

**15.** (a) A Proell governor has equal arms of the length 300 mm. The upper & lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10kg and the mass of

The central load is 100 kg. Determine the range of speed of the governor. **(16)**

**(or)**

(b) The turbine rotor of a ship has a mass of 3500kg.it has a radius of gyration of 0.45 mm 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 100m radius at a speed of 36km/h.

(ii)When the ship is pitching in 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. **(16)**