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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//ME6505/SET-3/NOV-DEC 2015**

Answer ALL questions

**PART A — (10 × 2 = 20 Marks)**

1. Define crank effort and crank pin effort.

2. Define D’alembert’s Principle.

3. Differentiate: Dynamics and static balancing

4. When is a system said to be completely balanced?

5. Define logarithmic decrement

6. What is the natural frequency of simple spring-mass system?

7. Define harmonic force.

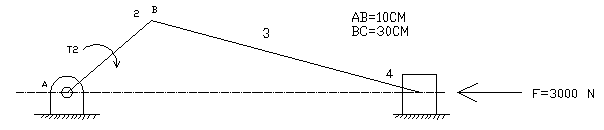
8. Define Transmissibility

9. Define gyroscopic couple and gyroscopic effect.

10. What is the effect of friction on governors?

**PART B — (5 × 16 = 80 Marks)**

1. a)A slider crank mechanism is shown in fig. The value of the force applied on slider 4 is 3000 N. Determine the force on various links. Also calculate the driving torque T2. The crank is rotating at 3000 rpm clockwise.



**(Or)**

b) The torque delivered by two-stroke engine is represented by T= (1000+300 sin 2θ – 500 cos 2θ) N-m. Where θ is the angle turned by the crank from the inner dead center. The engine speed is 250 rpm. The mass of the flywheel is 400 kg and radius 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˚ from the inner dead center; and (iv) the maximum angular acceleration and retardation of the wheel.

2. (a) A shaft carries four masses in parallel planes, A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100˚ and that between the masses at B and A is 190˚, both being measured in the same direction. The axial distance between the planes A and B is 100 m and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determined:

(i) The magnitude of the masses of A and D,

(ii) The distance between planes A and D, and

(iii) The angular position of the mass at D.

**(Or)**

(b) The following data apply to an outside cylinder uncoupled locomotive: Mass of a rotating parts per cylinder = 360 kg; mass of reciprocating parts per cylinder = 300 kg; angle between cranks = 90˚; crank radius = 0.3 m; cylinder cantres = 1.75 m; radius of balance masses = 0.75 m; wheel centres = 1.45 m. If whole of the rotating and two- thirds of reciprocating parts are to be balanced in planes of the driving wheels, find:

(i) Magnitude and angular positions of balance masses,

(ii) speed in kilometers per hour at which the wheel will lift of the rails when the load on each driving wheel is 30kN and the diameter of tread of driving wheels is 1.8 m, and

(iii) Swaying couple at speed arrived at in (ii) above.

3. (a) A body of mass of 50 kg is supported by an elastic structure of stiffness 10 kN/m. The motion of the body is controlled by a dashpot such that the amplitude of vibration decreases to one-tenth of its original value after two complete cycles of vibration. Determine (i) the damping force at 1 m/s; (ii) the damping ratio, and (iii) the natural frequency of vibration.

**(Or)**

(b) The flywheel of an engine driving a dynamo has a mass of 180 kg and a radius of gyration of 30 mm. The shaft at the flywheel end has an effective length of 250 mm and is 50 mm diameter. The armature mass is 120 kg and its radius of gyration is 22.5 mm. The dynamo shaft is 50mm diameter and 200 mm effective length. Calculate the position of node and frequency torsional oscillation. C = 83 kN/mm2.

4. (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 10 N/mm. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four 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?

**(Or)**

(b) A machine of mass 75 kg is mounted on springs of stiffness 1200 kN /m and with an assumed damping factor of 0.2. A piston within the machine of mass 2 kg has a reciprocating motion with a stroke of 80 mm and a speed of 3000 cycles/min. Assuming the motion to be simple harmonic, find (i) the amplitude of motion of the machine, (ii) its phase angle with respect to the existing force, (iii) the force transmitted to the foundation and (iv) the phase angle of transmitted force with respect to the exciting force.

5. (a) A porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speed and range of speed of the governor.

**(Or)** (b) A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions:

(i) The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.

(ii) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.

(iii) the ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case.