Code No:R2022032 **R20** **SET - 1**

**II B. Tech II Semester Supplementary Examinations, December - 2022**
**DYNAMICS OF MACHINERY**
(Mechanical Engineering)

**Time: 3 hours** **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks

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**UNIT-I**

1 a) Find the force required to move a load of 300N up a rough plane, the force being applied parallel to the plane. The inclination of the plane is such that a force of 60N inclined at 30º to a similar smooth plane would keep the same load in equilibrium. The coefficient of friction is 0.3. [7M]

b) Describe with a neat sketch a centrifugal clutch and deduce an equation for the total torque transmitted. [7M]

**Or**

2 a) Which of the two assumptions-uniform intensity of pressure or uniform rate of wear, would you make use of in designing friction clutch and why? [7M]

b) Describe with sketches one form of torsion dynamometer and explain with detail the calculations involved in finding the power transmitted. [7M]

**UNIT-II**

3 a) What is the function of a flywheel? How does it differ from that of a governor? [7M]

b) In a slider crank mechanism, the crank AB = 200 mm and the connecting rod BC = 750 mm. The line of stroke of the slider is offset by a perpendicular distance of 50 mm. If the crank rotates at an angular speed of 20 rad/s and angular acceleration of 10 rad/s$^2$, find at an interval of 30° of the crank, i) the linear velocity and acceleration of the slider, and ii) The angular velocity and acceleration of the connecting rod. [7M]

**Or**

4 a) A single cylinder double acting steam engine delivers 185 kW at 100 r.p.m. The maximum fluctuation of energy per revolution is 15 percent of the energy developed per revolution. The speed variation is limited to 1 percent either way from the mean. The mean diameter of the rim is 2.4m. Find the mass and cross-sectional dimensions of the flywheel rim when width of rim is twice the thickness. The density of flywheel material is 7200 kg/m$^3$. [7M]

b) Derive the expressions for displacement, velocity and acceleration of a four-bar mechanism. [7M]

**UNIT-III**

5 a) State the different types of governors. What is the principal difference between centrifugal and inertia type governors? Why is the former preferred to the latter? [7M]

b) A wheel of a locomotive, travelling on a level track at 90 km /h, falls in a spot hole 10 mm deep and rises again in a total time of 0.8 seconds. The displacement of the wheel takes place with simple harmonic motion. The wheel has a diameter of 3 m and the distance between the wheel centers is 1.75m. The wheel pair with axle has a moment of inertia of 500 kg-m$^2$. Determine the magnitude and the effect of gyro couple produced in this case. [7M]



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Or

6 a) A spring-loaded governor of the Hartnell type has arms of equal length. The masses rotate in a circle of 130 mm diameter when the sleeve is in the mid position and the ball arms are vertical. The equilibrium speed for this position is 450 r.p.m., neglecting friction. The maximum sleeve movement is to be 25 mm and the maximum variation of speed taking in account the friction to be 5 percent of the mid position speed. The mass of the sleeve is 4 kg and the friction may be considered equivalent to 30N at the sleeve. The power of the governor must be sufficient to overcome the friction by one percent change of speed either way at mid-position. Determine, neglecting obliquity effect of arms; i) The value of each rotating mass: ii) The spring stiffness in N/mm ; and iii) The initial compression of spring. [7M]

b) The turbine rotor of a ship has a mass of 20 tonnes and a radius of gyration of 0.75 m. Its speed is 2000r.p.m. The ship pitches 6° above and below the horizontal position. One complete oscillation takes 18seconds and the motion is simple harmonic. Calculate: i) the maximum couple tending to shear the holding down bolts of the turbine, ii) the maximum angular acceleration of the ship during pitching, and iii) the direction in which the bow will tend to turn while rising, if the rotation of the rotor is clockwise when looking from rear. [7M]

**UNIT-IV**

7 a) How the different masses rotating in different planes are balanced ? [7M]

b) A, B, C and D are four masses carried by a rotating shaft at radii 100 mm, 150 mm, 150 mm and 200 mm respectively. The planes in which the masses rotate are spaced at 500 mm apart and the magnitude of the masses B, C and D are 9 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. [7M]

**Or**

8 a) Explain the method of balancing of different masses revolving in the same plane. [7M]

b) A shaft is supported in bearings 1.8 m apart and projects 0.45 m beyond bearings at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The mass of end pulleys is 48 kg and 20 kg and their center of gravity are 15 mm and 12.5mm respectively from the shaft axis. The center pulley has a mass of 56 kg and its center of gravity is 15 mm from the shaft axis. If the pulleys are arranged so as to give static balance, determine :i) relative angular positions of the pulleys, and ii) dynamic forces produced on the bearings when the shaft rotates at 300 r.p.m. [7M]

**UNIT-V**

9 a) Derive the expression for natural frequency of free transverse vibrations due to uniformly distributed load acting over a simply supported shaft. [7M]

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 2kg 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 exciting force, iii) the force transmitted to the foundation, and iv) the phase angle of transmitted force with respect to the exciting force. [7M]

**Or**

10 a) Explain the term Critical or Whirling Speed of a Shaft? Derive the equation for it. [7M]

b) 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 cos50t N is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance? [7M]