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Reg. No. : .....

Name : .....

Sixth Semester B.Tech. Degree Examination, May 2018
(2013 Scheme)
13.602 : DYNAMICS OF MACHINERY (MP)

Time : 3 Hours

Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **2** marks.

1. What is the principle of virtual work ?
2. Differentiate inertia force and inertia torque.
3. What are shaking forces and moments ?
4. Define isochronism and stability of governors.
5. What is the effects of gyroscopic couple on an automobile taking a left turn ?
6. Define Hammer Blow with respect to locomotives.
7. Define coefficient of fluctuation of energy.
8. What is vibration isolation ? What are the various types of isolating materials used for isolation ?
9. What is meant by dynamic magnifier or magnification factor ?
10. Define torsionally equivalent shaft. **(10×2=20 Marks)**

P.T.O.

PART – B

Answer **any one** question from **each** Module. **Each** question carries **20** marks.

Module – I

11. The dimensions of a Four-Link mechanism are AB = 500 mm, BC = 660 mm, CD = 560 mm and AD = 1000 mm. The link AB has an angular velocity of 10.5 rad/s counter-clockwise and an angular retardation of 26 rad/s^2 at the instant when it makes an angle of 60° with AD, the fixed link. The mass of the links BC and CD is 4.2 kg/m length. The link AB has a mass of 3.54 kg, the centre of which lies at 200 mm from A and a moment of inertia of 88500 kg.mm^2. Neglecting gravity and friction effects, determine the instantaneous value of the drive torque required to be applied on AB to overcome the inertia forces.

12. The length of crank and connecting rod of a horizontal steam engine are 300 mm and 1.2 m respectively. When the crank has moved 30° from the inner dead center, the acceleration of piston is 35 m/s^2. The average frictional resistance to the motion of piston is equivalent to a force of 550 N and net effective steam pressure on piston is 500 kN/m^2. The diameter of piston is 0.3 m and mass of reciprocating parts is 160 kg. Determine (i) Reaction on the cross-head guides; (ii) Thrust on the crank-shaft bearings; and (iii) Torque on the crank shaft.

Module – II

13. 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 range of speed, sleeve lift, governor effort and power of the governor in the following cases :
    i) When the friction at the sleeve is neglected and
    ii) When the friction at the sleeve is equivalent to 10 N.

14. A ship is propelled by a turbine rotor which has a mass of 5 tons 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 : The ship sails at a speed of 30 km/hr and steers to the left in a curve having 60 it radius. 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. 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.

Module – III

15. A shaft is rotating at a uniform angular speed. Four masses m1, m2, m3 and m4 of magnitudes 300 kg, 950 kg, 360 kg, 390 kg respectively are attached rigidly to the shaft. The masses are rotating in the same plane. The corresponding radii of rotation are 200 mm, 150 mm, 250 mm and 300 mm, respectively. The angles made by these masses with horizontal are 0°, 45°, 120° and 255° respectively. If the system is to be balanced by adding two balancing mass, Find
    i) The magnitude of these balancing masses and
    ii) The position of the balancing mass if its radius of rotation is 200mm.

16. The turning moment diagram for a petrol engine is drawn to a vertical scale of 1 mm to 6 N.m and a horizontal scale of 1 mm to 1°. The turning moment diagram repeats itself after every half revolution of engine. The areas above and below mean torque line are : 305, 710, 50, 350, 980 and 275 mm^2. The rotating parts amount to mass of 40 kg at a radius of gyration of 140 mm. Calculate the coefficient of fluctuation of speed, if the speed of the engine is 1500 rpm.

Module – IV

17. In a single degree of damped vibration system a suspended mass of 8 kg makes 30 oscillations in 18 seconds. The amplitude decreases in 18 seconds. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine (i) the spring stiffness (ii) logarithmic decrement (iii) damping factor (iv) Damping coefficient.

18. A single cylinder vertical petrol engine has a mass of 200 kg and is mounted upon a steel chassis frame. The vertical static deflection of the frame is 2.4 mm due to the weight of the engine. The reciprocating parts of the engine have a mass of 9 kg and move through a vertical stroke of 160 mm with simple harmonic motion. A dashpot with a damping co-efficient of 1 N/mm/s is used to dampen the vibrations. Considering that the steady-state of vibration is reached determine : (i) amplitude of the forced vibration if the driving shaft rotates at 500 rpm and (ii) the speed of the driving shaft at which resonance will occur.