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Question Paper Code : 80665

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Fifth Semester

Mechanical Engineering

ME 6505 — DYNAMICS OF MACHINES

(Common to Fourth Semester Mechanical Engineering (Sandwich and Mechatronics Engineering))

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define inertia and inertia force.

2. What is the purpose of flywheel used in an engine?

3. A flywheel has an unbalanced mass of 0.15 kg at a radius of 0.4 m from the axis of rotation. Calculate the unbalanced force if the shaft rotates at 200 rpm.

4. What is hammer blow in locomotives?

5. What are the different types of damped vibrations?

6. Define logarithmic decrement.

7. Define vibration isolation.

8. Write down the equation for forced vibrations.

9. Define sensitivity of governors.

10. Find the angular precession of a disc spinning on its axis at 20 rad/s, when a torque 100 N-m is applied about an axis normal to it. Mass moment of inertia of the disc is the 1 kg-m^2.

PART B — (5 × 16 = 80 marks)

11. (a) The crank and the connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240mm respectively. The diameter of the piston is 80 mm and the mass of the reciprocating parts is 1.2 kg. At a point during the power stroke when the piston has moved 20 mm from the top dead centre, the pressure on the piston is 800 kN/m^2. Determine the

(i) Net force on the piston

(ii) Thrust in the connecting rod

(iii) Thrust on the sides of the cylinder walls

(iv) The engine speed at which the above values are zero.

Or

(b) The turning moment diagram for a multicylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows:

+ 52, –124, + 92, –140, + 85, –72 and +107 mm^2, when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5 m.

12. (a) (i) Differentiate between static and dynamic balancing. (4)

(ii) A circular disc mounted on a shaft carries three attached masses 4 kg, 3 kg and 2.5 kg at radial distances 75 mm, 85 mm and 50 mm and at the angular positions of 45°, 135° and 240° respectively. The angular positions are measured counter-clockwise from the reference line along x-axis. Determine the amount of the counter mass at a radial distance of 75 mm required for the static balance. (12)

Or

(b) An inside cylinder locomotive has its cylinder centre lines 0.7 m apart and has a stroke of 0.6 m. The rotating masses per cylinder are equivalent to 150 kg at the crank pin, and the reciprocating masses per cylinder to 180 kg. The wheel centre lines are 1.5 m apart. The cranks are at right angles. The whole of the rotating and 2/3 of the reciprocating masses are to be balanced by masses placed at a radius of 0.6 m. Find the magnitude and direction of the balancing masses.

13. (a) A gun is so designed that on firing, the barrel recoils against a spring. A dash pot at the end of the recoil, allows the barrel to come back to its initial position within the minimum time without any oscillation. The gun barrel has a mass of 500 kg and a recoil spring of 300 N/mm. The barrel recoils 1 m on firing. Determine:

(i) The initial recoil velocity of the gun barrel, and (8)

(ii) The critical damping co-efficient of the dash pot engaged at the end of the recoil stroke. (8)

Or

(b) The following data relate to a shaft held in long bearings.

Length of the shaft –1.2 m

Diameter of the shaft –14 mm

Mass of a rotor at midpoint – 16 kg

Eccentricity of centre of mass of rotor from centre of rotor – 0.4 mm

Modulus of Elasticity of shaft material – 200 GN/mm^2

Permissible stress in shaft material - 70×10^6 N/m^2

Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Assume the shaft to be massless.

14. (a) A single cylinder vertical diesel engine has a mass of 400 kg and is mounted on a steel chassis frame. The static deflection owing to the weights of the chassis is 2.4 mm. The reciprocating mass of the engine amounts to 18 kg and the stroke of the engine is 160 mm. A dashpot with a damping coefficient of 2 Ns/mm is also used to dampen the vibrations. In the steady-state of the vibrations, determine:

(i) The amplitude of the vibrations if the driving shaft rotates at 500 rpm

(ii) The speed of the driving shaft when the resonance occurs.

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 :

(i) stiffness of each spring;

(ii) dynamic force transmitted to the base at the operating speed; and

(iii) natural frequency of the system.

15. (a) In a porter governor, each of the four arms is 400mm long. The upper arms are pivoted on the axis of the sleeve, whereas the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 60 kg. What will be the equilibrium speeds for the two extreme radii of 250 mm and 300 mm of rotation of the governor balls?

Or

(b) A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5 m and height of centre of gravity 500 mm above the ground level and lies at 1 m from the front axle. Each wheel has an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m^2. The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of road wheel, in a clockwise direction when viewed from the front, and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60km/h, find the load on each wheel.