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B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Fifth Semester

Mechanical Engineering

080120026 — DYNAMICS OF MACHINERY

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Why complete 'balancing of reciprocating masses is not possible in a single cylinder engine – Justify.

2. Explain the terms : Primary disturbing force and secondary disturbing force.

3. Explain the terms spin and precession. How do they differ from each other?

4. What is the significance of controlling force in Governors?

5. Establish the expression to determine the frequency of torsional vibration of a geared system.

6. What is meant by transmissibility?

7. Define 'Hunting' in Governors.

8. Write a short note on Degrees of freedom'.

9. What is a gyroscopic couple?

10. Specify the difference between static force and dynamic force analyses?

PART B — (5 × 16 = 80 marks)

11. (a) A Single cylinder vertical engine has a bore of 300mm and a stroke of 400 mm. The connecting rod is 1m long. The mass of the reciprocating parts is 140 kg. On the expansion stroke with the crank at 30. from the top dead centre ,the gas pressure is 0.7 MPa. If the engine runs at 250 r.p.m., Determine :

(i) Net force acting on the piston

(ii) Resultant load on the gudgeon pin,

(iii) Thrust on the cylinder walls, and

(iv) The speed above which, other thing remaining same, the gudgeon pin load would be reversed in direction.

Or

(b) The areas above and below the mean torque line for an I.C. engine are -25. +200, -100, +150,-300,+ 150 and -75 mm^2 taken in order. The scale for the turning moment diagram is 1 mm vertical scale = 10 Nm and 1 mm horizontal scale 1 .5°. The mass of the rotating parts are 45 kg with a radius of gyration of 150mm. If the engine speed is 1500 r.p.m., Find the co-efficient of fluctuation of speed.

12. (a) A shaft carries four rotating masses A, B, C and D in this order along its axis. The mass A may be assumed to be concentrated at radius of 18 cm, B of 24 cm. C of 12 cm and D of 15 cm. The masses of B, C and D are 30 kg, 50 kg and 40 kg respectively. The planes containing B and C are 30 cm apart. The angular spacing of the planes containing C and D are 90° and 210° respectively relative to B measured in the same plane. If the shaft and masses are to be in complete dynamic balance, Find:

(i) The mass and the angular position of mass A

(ii) The position of planes A and D.

Or

(b) The cranks of a two-cylinder uncoupled inside cylinder locomotive are at right angles and are 300 mm long. The distance between the centre lines of the cylinder is 650 mm. The wheel centre lines are 1.6 m apart. The reciprocating mass per cylinder is 300 kg. The driving wheel diameter is 1.8 m. If the hammer blow is not to exceed 45 kN at 100 km/hr, Determine:

(i) The fraction of the reciprocating masses to be balanced,

(ii) The variation in tractive effort

(iii) The maximum swaying couple.

13. (a) The lengths of the upper and lower arms of a Porter governor are 200 mm and 250 mm respectively. Both the arms are pivoted on the axis of the rotation. The central load is 150 N, the weight of each ball is 20 N and the friction of the sleeve together with the resistance of the operating gear is equivalent to a force of 30N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°. Determine the range of the speed of the governor.

Or

(b) The mass of the motor cycle along with the rider is 180 kg. The height of the centre of gravity of total mass is 60 cm above the ground when it moves straight. Each wheel has diameter equal to 70 cm and polar mass moment of inertia of each wheel is 2 kgm^2. The engine rotates at a speed 5 times the road wheel and engine rotating parts have polar mass moment of inertia equal to 0.2 kgm^2. Determine the angle of heel required if motor cycle negotiates a curve of radius 100 m at a speed of 108 km/hr.

14. (a) A machine mounted on springs and fitted with a dashpot has a mass of 60kg. There are three springs, each of stiffness 12N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity, Determine

(i) The damping coefficient

(ii) The ratio of frequencies of damped and damped vibrations, and

(iii) The periodic time of damped vibrations.

Or

(b) 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 weight of the chassis is 2.4mm. The reciprocating mass of the engine amounts to 18 kg and the stroke is 160mm. A dash pot with a damping coefficient of 2N/mm/s 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.

15. (a) A shaft 1.5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the center of the shaft and the other at distance of 375 mm from the center towards left. The shaft is hollow of external diameter 75mm and internal diameter 40 mm. The density of the material is 7700kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft.

Or

(b) An electric motor is to drive a centrifuge, running vat four times the motor speed through a spur gear and pinion. The steel shaft from the motor to the gear wheel is 54 mm diameter and L meter long; the shaft from the pinion to the centrifuge is 45 mm diameter and 400 mm long. The masses and radii of gyration of motor and centrifuge are respectively 37.5 kg, 100 mm; 30 kg and 140 mm.

Neglecting the inertia effect of the gears, find the value of L if the gears are to be at the node for torsional oscillation of the system and hence determine the frequency of torsion oscillation. Assume modulus of rigidity for material of shaft as 84 GN/m^2.The modulus of rigidity for the shaft material is 80 GN/m$^{2.}$
