B.Tech. 5th Semester (Mechanical Engg.) VII

Examination December–2013

DYNAMICS OF MACHINES

Paper–ME-301-F

Time allowed : 3 hours] *[Maximum marks :100*

Note : *Attempt **five** questions in total by selecting at least **one** question from each section. **Question No. 1 is compulsory.***

1. (i) Write an expression for stiffness of spring in a Hartnell governor.
   (ii) Explain stability of governor
   (iii) Explain partial balancing of primary forces
   (iv) What is meant by dynamically equivalent system.
   (v) Name different types of mechanical brakes
   (vi) What do you mean by self energized brake
   (vii) Define inertia force and inertia torque
   (viii) Write general expression for gyroscopic couple.

8×2.5=20

Section-A

2. The length of the connecting rod of a vertical double acting steam engine is 1.5 m. The diameter of cylinder is 400 mm and stroke of engine is 600 mm. The crank is rotating at 200 r.p.m. in clockwise direction. The crank has turned through 40° from top dead centre

and piston is moving downwards. The steam pressure above piston is 0.6 N/mm^2 and below the piston is 0.05 N/mm^2. The mass of reciprocating parts is 200 kg. The diameter of piston rod is given as 50mm. Find the thrust on guide bars and crank shaft bearing. 20

3. The length of crank and connecting rod of a vertical reciprocating engine are 400 mm and 2m respectively. The crank is rotating clockwise at a speed of 400 r.p.m. The mass of reciprocating rod is 250 kg and distance of its centre of gravity from the cross head pin centre is 1.2 m. Find the torque exerted on the crank shaft due to the inertia of moving parts analytically when crank has turned through 40° from top dead centre and piston is moving downwards. The radius of gyration of connecting rod about an axis passing through its centre of gravity is 900mm. 20

Section-B

4. A shaft carries four rotating masses D, C, B and A is this order along its axis. The mass D may be assumed concentrated at a radius of 18 cm, C at 14 cm, B at 15 cm and A at 12 cm. The masses A, C and D are 15 kg, 10 kg and 8 kg respectively. The planes of rotation of A and B are 15 cm apart and of B and C are 18 cm apart. The angle between radii of A and C is 90°. If the shaft is in complete dynamic balance, determine :

(i) The angle between the radii of A, B and D

(ii) The distance between the planes of revolution of C and D

(iii) the mass B. 20

5. A 90° V engine has two cylinders which are placed symmetrically. The two connecting rods operate on a common crank. The lengths of connecting rods are 320 mm each and crank radius is 80 mm. The reciprocating mass per cylinder is 12 kg. If engine speed is 600 r.p.m. then find the resultant primary and resultant secondary forces. Also find the maximum resultant secondary f. 20

Section-C

6. The lengths of the upper and lower arms of a Porter governor are 200 mm and 250 mm respectively. Both the arms pivoted on the axis of rotation. The central load is 150 N, the weight of each ball is 20 N and friction of the sleeve together with the resistance of the operating gear is equivalent to a force of 30 N at the sleeve. If the limiting inclinations of the upper arm to the vertical are 3° and 40°, determine the range of speed of governor. 20

7. (a) What is the principle on which a torsion dynamometer works ? Explain with details the calculations involved in finding the power transmitted. 10

(b) Differentiate between brakes and dynamometer. 10

Section-D

8. (a) Derive expression of gyroscopic couple. 10

(b) Explain the terms spin and precession. How do they differ from each other ? 10

9. A car is of total mass 3000 kg. It has wheel base equal to 2.5 m and track width equal to 1.5 m. The effective diameter of each wheel is 80 cm and moment of inertia of each wheel is 1.0 kg m^2. The rear axle ratio is 4. The mass moment of inertia of engine rotating parts is 3 kg m^2 and spin axis of engine parts is perpendicular to the spin axis of wheels. Determine the reaction at each wheel if car takes right turn of 100 m radius at 108 km/hr speed. Also determine critical speed. The height of C.G. is 0.5 m from ground and it is placed on the vertical line through geometric centre of wheels. 20