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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Mechanical Engineering

Semester End Examination; February / March - 2022

Dynamics of Machinery

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. State the conditions for a member to be in equilibrium; 6

i) When two forces act ii) When three forces act iii) When two forces and torque acts

b. Determine the various forces on the links and Torque T_2 shown in the Fig. Q.1.b. AB = 20 mm, BC = 370 mm, AD = 215 mm, CD = 350 mm and CE = 100 mm. 14

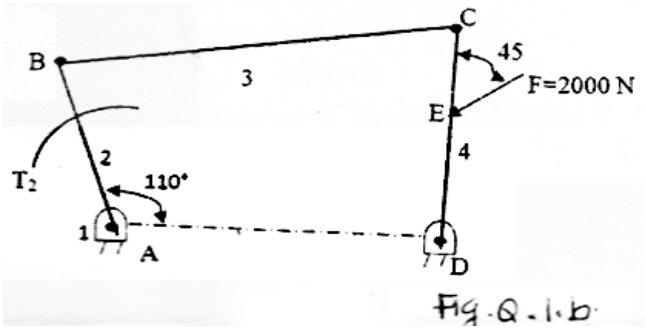

Fig.Q.1.b

2 a. Define free body diagram with an example. 5

b. For the static equilibrium of the mechanism shown in Figure-2, find the required input torque. The dimensions are AB = 150 mm, BC = AD = 500 mm, DC = 300 mm, CE = 100 mm and EF = 450 mm. 15

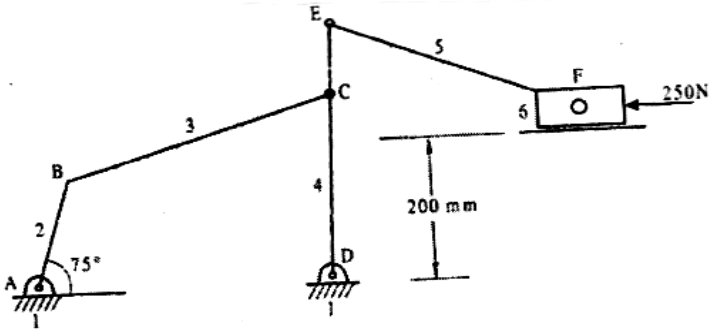

Figure-2

UNIT - II

3. The connecting rod of a vertical reciprocating engine is 2 m long between centres and weighs 250 kg. The mass centre is 800 mm from the big end bearing. When suspended as a pendulum from the gudgeon pin axis, it makes 8 complete oscillations in 22 seconds. Calculate the radius of gyration of the rod about an axis through the mass centre. The crank is 400 mm long and rotates at 200 rpm. Find the inertia torque exerted on the crankshaft, when the crank has turned through 40° from the top dead centre and the piston is moving downwards. 20

Contd... 2

4 a. State and explain D'Alembert's principle. 5

b. The crank and the connecting rod of a vertical petrol engine running at 1800 rpm are 60 mm and 270 mm respectively. The diameter of the piston is 100 mm and the mass of the reciprocating part is 1.2 kg. During the expansion stroke, when the crank has turned 20° from the top dead centre, the gas pressure is 650 kN/m^2. Determine; 15

i) Net force on the piston

ii) Net load on the gudgeon pin

iii) Thrust on the cylinder walls

iv) Speed at which the gudgeon pin load is reversed in direction

UNIT - III

5 a. Obtain an expression for the hoop stress developed in the rim of a flywheel. 8

b. The turning moment diagram for an engine consists of two isosceles triangles. Maximum height for each triangle represents T.M. of 1000 Nm. The base of each triangle is equal to π radians. If the engine runs at 200 rpm and total fluctuation of speed is not to exceed 3%. Find; 12

i) Power of Engine

ii) Mass of rim type flywheel concentrated at 0.25 m radius

6 a. With a neat sketch, explain the working principle of porter governor. 5

b. A shaft fitted with flywheel rotates at 240 rpm and drives a machine. The torque of the machine varies in a cyclic manner over a period of three revolutions. The torque rises from 1000 Nm to 4000 Nm uniformly during half revolution and remains constant during the following one revolution, it then falls uniformly to 1000 Nm during the next half revolution and remain constant for one revolution. This being repeated there after determine; 15

i) Power required to drive the machine

ii) Percentage fluctuation of speed. The driving torque applied to the shaft is constant and the mass of flywheel is 520 kg with radius of gyration 625 mm.

UNIT - IV

7 a. Explain the terms static balancing and dynamic balancing. 4

b. A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes at which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 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. 16

8. A five cylinder inline engine has successive crank 144° apart, the distance between cylinder lines being 375 mm. The reciprocating mass for each cylinder is 15 kg. The piston stroke is 225 mm and the ratio of the connecting rod to the crank is 4. The engine runs at a speed of 750 rpm. Examine the engine for balances of primary/secondary forces and couples. 20

Contd... 3

UNIT - V

9 a. Obtain an expression for the gyroscopic couple. 6

b. The turbine rotor of a ship has a mass of 2500 kg and rotates at 3200 rpm counter clockwise when viewed from the stern. The radius of gyration of rotor is 0.4 m, determine the gyroscopic couple and state the effect when;

i) The ship steer to the left at a speed of 7.75 m/s in a curve of radius 80 m

ii) The ship pictures 5° above and 5° below the horizontal position and the bow is descending with its maximum velocity. The pitching motion is SHM with a periodic time of 40 seconds 14

iii) The ship rolls and at a certain instant it has an angular velocity of 0.04 rad/s clock wise when viewed from stern.

10 a. Obtain an expression for heel angle of motor cycle to avoid skidding. 10

b. Each wheel of a motor cycle is 600 mm diameter has a moment of inertia of 1.2 kg-m^2. The total mass of the motor cycle and the rider is 180 kg and the combined centre of mass is 580 mm above the ground level when the motor cycle is upright. The moment of inertia of rotating parts of the engine is 0.2 kgm^2. The engine speed is 5 times the speed of the wheel and is in the same sense. Determine the angle of heel necessary when the motor cycle takes a turn of 35 m radius at a speed of 54 km/h. 10

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