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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; Dec - 2017/Jan - 2018

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 for the following cases : 4

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

b. For the static equilibrium of the mechanism shown in Fig.1, 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. 16

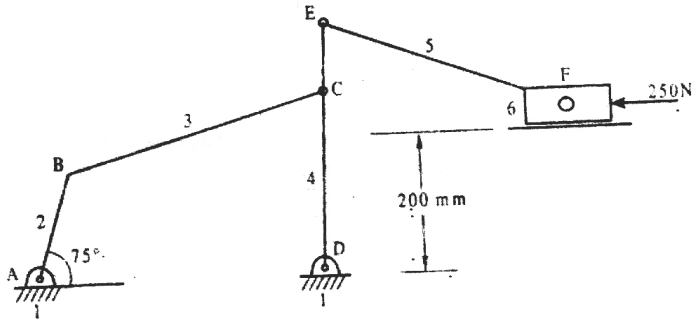

Figure-1

2 a. Define free body diagram with an example. 6

b. A four bar mechanism under the action of two external forces is as shown in Fig. 2 Determine the torque to be applied on the link AB for static equilibrium. The dimensions of the links are AB = 50 mm, BC = 66 mm, CD = 55 mm, CE = 25 mm, CF = 30 mm, BAD = 60° and AD =100 mm. 14

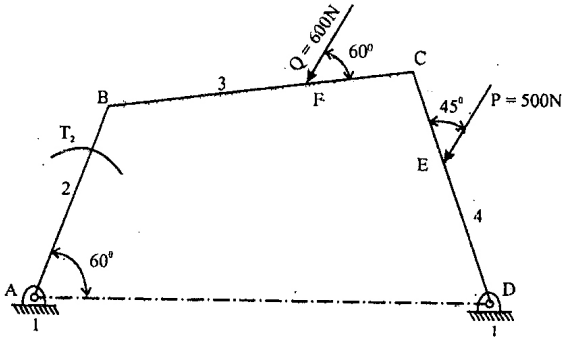

Figure-2

UNIT - II

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

Contd…2

b. In a vertical double acting steam engine. The connecting rod is 4.5 times the crank. The weight of the reciprocating parts is 120 kg and the stroke of the piston is 440 mm. The engine runs at 250 rpm. If the net load on the piston due to steam pressure is 25 kN when the crank has turned through an angle of 120° from the top dead centre, determine; 15

(i) Thrust in the connecting rod (ii) Pressure on the slide bars

(iii) Tangential force on the crank pin (iv) Thrust on the bearing

(v) Turning moment on the crank shaft.

4. The piston diameter of an internal combustion engine is 125 mm and the stroke is 220 mm. The connecting rod is 4.5 times the crank radius and has a mass of 50 kg. The mass of the reciprocating parts is 30 kg. The centre of mass of connecting rod is 170 mm from the crank pin centre and the radius of gyration about an axis through the centre of mass is 148 mm. The engine runs at 320 rpm. Find the magnitude and the direction of the inertia force and the corresponding torque on the crank shaft when the angle turned by the crank is 140° from the inner dead centre. 20

UNIT - III

5 a. Prove that the maximum fluctuation of 'C' is given by C = 0.02 qE for a flywheel where E = Mean. K.E. of flywheel and q = total percentage fluctuation of speed. 6

b. A single cylinder single acting 4 stroke gas engine develops 18.4 kW at 300 rpm with work done by the gases during the expansion stroke is 3 times the work done on the gases during the compression stroke. The work done during the suction and exhaust being negligible and the total fluctuation is 2% of mean. The TMD during expansion is assumed to be triangular in shape. Find the moment of inertia of the flywheel. 14

6 a. Obtain an expression for the hoop stress developed in the rim of a fly wheel. 7

b. A shaft fitted with a flywheel rotates at 240 rpm and drives a machine. The torque of the machine varies in cyclic manner over 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; 13

(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. Obtain an expression for balancing of several masses in single plane by analytical method. 5

Contd…3

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 in 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 setting of the four masses so that the shaft shall be in complete balance. 15

8 a. The firing order in a six cylinder vertical four stroke in-line engine is 1-4-2-6-3-5. The piston stroke is 100 mm and the length of the connecting rod is 200 mm. The pitch distance between the cylinder centre lines are 100 mm, 100 mm, 150 mm, 100 mm and 100 mm respectively. The reciprocating mass per cylinder is 1 kg and the engine runs at 3000 rpm. Determine the out of balance primary and secondary forces and couple on this engine, taking a plane midway between cylinder 3 and 4 as the reference plane. 20

UNIT - V

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

b. The turbine rotor of a ship has a mass of 2500 kg and rotates at a speed of 3200 rpm counter clockwise when viewed from the stem. 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/sec in a curve of radius 80 m 10

(ii) The ship pitches 5° above and 5° below the horizontal position and the bow is descending with its maximum velocity

The motion due to pitching is SHM of periodic time 40 secs.

10 a. Explain the stability of a four wheeler automobile negotiating a curve and drive the necessary condition for stability. 12

b. Each wheel of a motorcycle is of 600 mm diameter and has a moment of inertia of 1.2 kgm^2. The total mass of the motorcycle and the rider is 180 kg and the combined centre of mass is 580 mm above the ground level when the motorcycle is upright. The moment of inertia of rotating parts of the engine is 0.2 kg m^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 motorcycle takes a turn of 35 m radius at a speed of 54 km/h. 8

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