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

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Automobile Engineering

Make-up Examination; Jan/Feb - 2017

Theory of Machines - II

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Graphical solutions must be drawing on drawing sheet only.
iii) Missing data, if any, may be suitably assumed and stated.

UNIT - I

1. In a four link mechanism as in Fig. Q N. 1, torque T_3 and T_4 have magnitudes of 30 Nm and 20 Nm respectively. The link lengths are AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm. For the static equilibrium of the mechanism, determine the required input torque T_2. 20

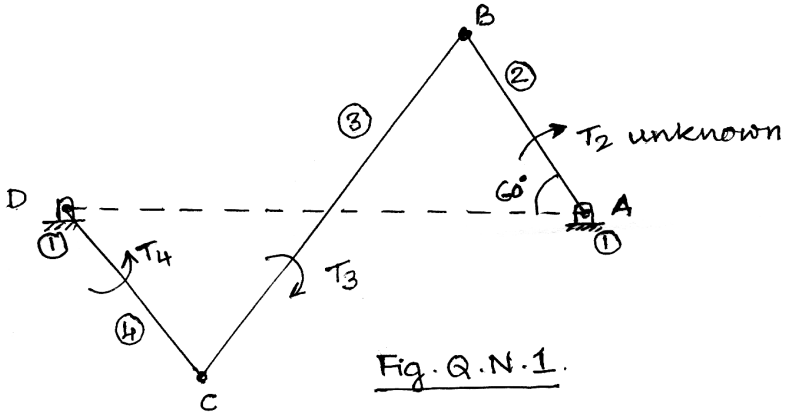

Fig. Q.N.1.

2 a. Sketch the general FBD of single slider crank mechanism. 6

b. In Fig. Q. N. 2(b) a four bar mechanism is shown. Calculate the required value of T_2 and various forces on links for equilibrium of the system. 14

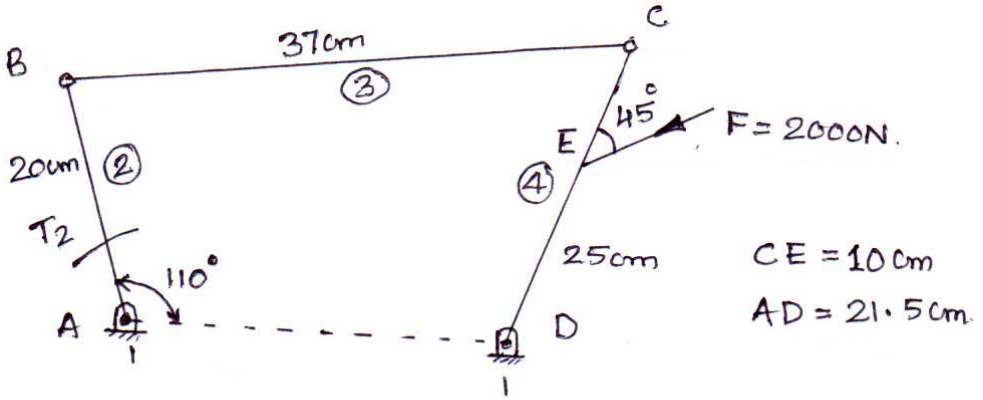

Fig. Q.N.2.b.

Contd.....2

UNIT - II

3 a. Define D'Alembert's principle and correction couple. 6

b. A horizontal steam engine running at 240 rpm, has a bore of 20 cm and stroke of 36 cm. The piston rod is 2 cm in diameter and connecting rod length is 90 cm. The mass of the reciprocating parts is 7 kg and the frictional resistance is equivalent to a force of 500 N. Determine the following when the crank is at 120º from the IDC, the mean pressure being $50x10^2$ N/m^2 on the cover side and $1x10^2$ N/m^2 on crank side : 14

i) Thrust on the connecting rod ii) Thrust on the cylinder wall

iii) Load on the bearings iv) Turning moment on the crank shaft.

4 a. Define the followings :

i) Flywheel ii) TMD 4

iii) Coefficient of fluctuation of energy iv) Coefficient of fluctuation of speed.

b. In a TMD, the areas above and below the mean torque line taken in order are 395, 785, 140, 440, 1060, and 370 mm^2, having scale of 1 mm = 5 Nm and 1 mm = 10º along Y and X axes respectively. Find mass of flywheel at a radius of gyration 150 mm and maximum fluctuation of speed is limited to ± 1.5% of mean speed which is 1800 rpm. 16

UNIT - III

5 a. Define the static and dynamic balancing. 5

b. The four masses m_1, m_2, m_3 and m_4 having their radii of rotation as 200 mm, 150 mm, 250 mm and 300 mm are 200 kg, 300 kg, 240 kg and 260 kg in magnitude respectively. The angles between the successive masses are 45º, 75º and 135º respectively. Find the position and magnitude of the balance mass required, if its radius of rotation is 200 mm. 15

6. A rotating shaft carries four unbalanced masses 18 kg, 14 kg, 16 kg, 12 kg at radii 5 cm, 6 cm, 7 cm and 6 cm respectively. The 2nd, 3rd and 4th masses revolve in planes 8 cm, 16 cm and 28 cm respectively, measured from the plane of the first mass and are angularly located at 60º, 135º and 270º respectively measured anticlockwise from the first mass looking from this mass end of the shaft. The shift is dynamically balanced by two masses, both located at 5 cm radii and revolving in planes mid way between those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine the magnitudes of the masses and their respective angular positions. 20

UNIT - IV

7. The stroke of each piston of a six-cylinder two stroke in-line engine is 320 mm and the connecting rod is 800 mm long. The cylinder centre lines are spaced at 500 mm. The cranks are at 60º apart and the firing order is 145236. The reciprocating mass per cylinder is 100 kg and the rotating parts are 50 kg per crank. Determine the out-of-balance forces and couples about the mid plane if the engine rotates at 200 rpm. 20

Contd.....3

8 a. Explain the terms : 6

i) Variation of tractive force ii) Swaying couple iii) Hammer blow.

b. The axes of a three cylinder air compressor are at 120º to one another and their connecting rods are coupled to a single crank. The length of each connecting rod is 240 mm and the stroke is 160 mm. The reciprocating parts have a mass of 2.4 kg per cylinder. Determine the primary and secondary forces if the engine runs at 2000 rpm. 14

UNIT - V

9 a. Explain the terms : 6

i) Hunting ii) Isochronism iii) Sensitiveness of a governor.

b. In a Hartneu type governor the two masses are 4 kg each and load on the sleeve is 40 N. If with the weight arms vetical, the path radius is 8 cm and equilibrium speed neglecting friction 420 rpm, find the corresponding compression force in the spring. Find also the friction force at the sleeve which can be overcome in this position for an increase in speed of 1%. If the sleeve movement is to be 1 cm for increase in speed of 5% from the 420 rpm. Position, find the required spring stiffness, if gravity effect on the masses is neglected. 14

10 a. Explain the effect on stability of two wheeler when it takes a turn. 10

b. The turbine rotor of a ship is of mass 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm, clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship;

i) When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/hr 10

ii) When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12º.

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