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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

Semester End Examination; Dec - 2016/Jan - 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 drawn on drawing sheet only.
iii) Missing data, if any, may be suitably assumed and stated.

UNIT - I

1. Determine the shaft torque T_2 on the input link AB for static equilibrium of the mechanism shown below. Use the principle of superposition while obtaining the solution. Given; AB = 500 mm, BC = 660 mm, CD = 560 mm, AD = 1000 mm, F_2 = 80 N, F_3 = 144 N, F_4 = 60 N. The angle between AB and AD is 60º.

   The force F_2 acts at a point 325 mm from A (measured along AB)

   The force F_3 acts at a point 297 mm from B (measured along BC)

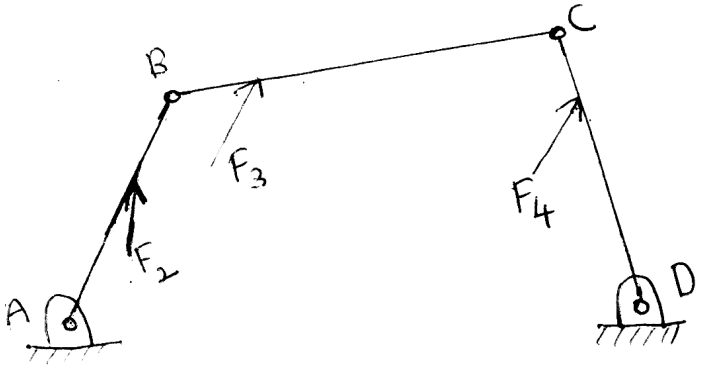
   The force F_4 acts at a point 373 mm from D (measured along CD)

   The force F_2 acts at an angle at 73.5º (measured from the direction of AD)

   The force F_3 acts at an angle of 58º (measured from the direction of AD)

   The force F_4 acts at an angle of 42º (measured from the direction of AD)

   The direction of AD may be assumed to be horizontal. 20



2 a. With neat sketches, explain the conditions for static equilibrium of two force member, three force member, and member with two forces and a torque. 10

b. With sketches, explain the effect of sliding friction and the friction in pin joints as applied to static force analysis. 10

Contd.....2

UNIT - II

3. The dimensions at a four link mechanism are AB = 500 mm, BC = 660 mm, CD = 560 mm and AD = 1000 mm. The link AB has an angular velocity of 10.5 rad/s counter-clockwise and an angular retardation of 26 rad/s^2 at the instant when it makes an angle of 60º with AD, fixed link. The mass of the links BC and CD is 4.2 kg/m length. The link AB has a mass at 3.54 kg, the centre of which lies at 200 mm from A and a moment at inertia at 88500 kg-mm^2. Neglecting gravity and friction effects, determine the instantaneous value of the drive torque required to be applied on AB to overcome the inertia forces. 20

4 a. Derive an expression for determining the size of a fly wheel. 5

b. Explain "Turning moment diagram". 5

c. A punching machine carries out 6 holes per minute. Each hole of 40 mm diameter in 35 mm thick plate requires 8 Nm of energy /mm^2 of the sheared area. The punch has a stroke of 95 mm. Find the power of the motor required, if the mean speed at the fly wheel is 20 m/s. If total fluctuation of speed is not to exceed 3% of the mean speed, determine the mass of the fly wheel. 10

UNIT - III

5. Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90º and 195º respectively with B in the same sense. The rotating masses have following properties:

m_b = 25 kg	r_a = 150 mm
m_c = 40 kg	r_b = 200 mm
m_d = 35 kg	r_c = 100 mm
	r_d = 180 mm

Planes B and C are 250 mm apart. Determine; 20

i) The mass A and its angular position

ii) The positions of planes A and D.

6 a. With a neat sketch, explain how a force can be transferred from one plane to another? 6

b. Explain static balancing (with equations and sketches). 7

c. With equations and sketches, explain "Dynamic balancing". 7

UNIT - IV

7. The cranks of a four-cylinder marine oil engine are arranged at angular intervals of 90º. The engine speed is 70 rpm and the reciprocating mass per cylinder is 800 kg. The inner cranks are 1 m apart and are symmetrically arranged between the outer cranks which are 2.6 m apart. Each crank is 400 mm long. Determine the firing order of the cylinders for the best balance of reciprocating masses and also the magnitude of the unbalanced primary couple for that arrangement. 20

Contd.....3

8 a. How the radial engine is balanced. 10

b. The following data relate to a single-cylinder reciprocating engine:

Mass of reciprocating parts = 40 kg

Mass of revolving parts = 30 kg at 180 mm radius

Speed = 150 rpm, stroke = 350 mm 10

If 60% of the reciprocating parts and all the revolving parts are to be balanced, determine;

i) The balance mass required at a radius of 320 mm

ii) The unbalanced force when the crank has turned 45º from the top-dead centre.

UNIT - V

9. Each wheel of a motorcycle is at 600 mm diameter and has a moment of inertia at 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 motor cycle is upright. The moment of inertia of the rotating parts of the engine is 0.2 kgm^2. The engine speed is 5 times the speed of the wheels 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 at 54 km/h. 20

10. Each arm of a Porter governor is 250 mm long. The upper and lower arms are pivoted to links of 40 mm and 50 mm respectively from the axis of rotation. Each ball has a mass of 5 kg and the sleeve mass is 50 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed at the governor for extreme radii of rotation of 125 mm and 150 mm. 20

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