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

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Automobile Engineering

Semester End Examination; Dec. - 2019

Theory of Machines -II

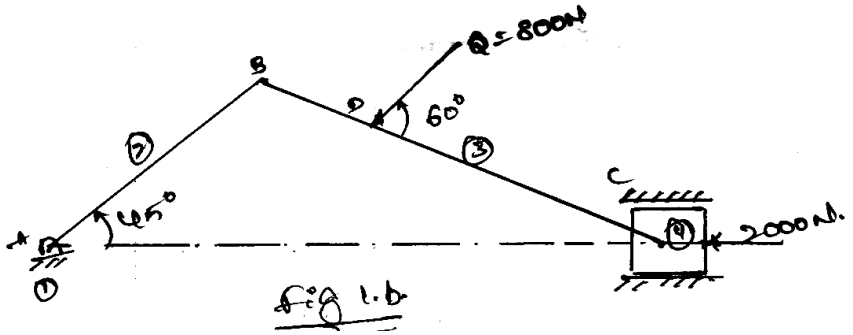
Time: 3 hrs *Max. Marks: 100*

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

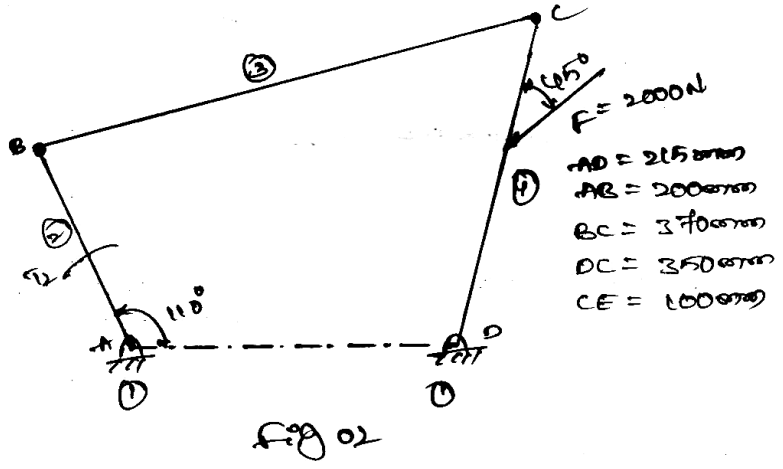
UNIT - I

1 a. Discuss Equilibrium of three force members, two force members and torque using force vector diagram. 8

b. In a four stroke petrol engine, the slider crank mechanism piston subjecting a force of 2000 N due combustion of charge and also a mechanism subjecting a force as shown in the Fig. 1b. Calculate all the force and drive couple of crank. 12



2. In the Fig.2, four bar mechanism is shown. Calculate the required value of T_2 and the all the forces on links for equilibrium of mechanism. 20



UNIT - II

3 a. Describe D'Alembert's principal, inertia force and inertia torque. 4

b. A single cylinder acting 4 stroke gas engine develop 18.4 kW at 300 rpm with WD by the gases during the expansion stroke is 3 times the WD on the gases during compression stroke. The WD during suction and exhaust being negligible and total fluctuation id 2% of mean. The TMD during the expansion is assumed triangular in shape. Find the moment of inertia of flywheel. 16

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4. The equation of TMD for a 3 crank engine is given by, T = 25000 − 7500$sin3\theta$ Nm. Where θ = crank angle from TDC. Moment of inertia of the flywheel = 400 kg m^2 and mean speed = 600 rpm. Calculate; 20

   i) Power of the engine

   ii) Percentage fluctuation of speed, if

   I) If the resisting torque is constant II) The resisting torque is 25000 + 3600$sin\theta$.

UNIT - III

5. Four M_1 = 100 kg, M_2 = 175 kg, M_3 = 200 kg and M_4 = 125 kg are fixed to the crank of 200 mm radius and revolve in the planes 1, 2, 3 and 4 respectively, the angle position of the planes with respect to plane 1 are 75°, 135°, and 240° taken in the same sense. The distance of the planes 2, 3, and 4 from 1 are 600 mm, 1800 mm and 2400 mm. Determine the magnitude and position of the balancing masses at the radius of plane 'L' and 'D' located in the middle of plane 1 and 2, and in Middle of 3 and 4 respectively. 20

6. A 3.6 m long shaft carries 3 pulleys, tow at its two ends 3rd pulley at the midpoint. The two end pulleys have masses 79 and 40 kg respectively and CG are 3 mm and 5 mm from the axis of the shaft respectively. The middle has masses of 50 kg and its CG is 8 mm. The pulleys are so keys to the shaft that the assembly is in static balance. The shaft rotates at the 3000 rpm in two bearings, 4.2 m apart with equal overhangs on either side. Determine; 20

   i) Relative angular positions of the pulleys

   ii) Dynamics reactions on the two bearing

UNIT - IV

7. The following data refers to 4 cylinder symmetrical engine which is in complete primary balance mass of reciprocating parts attached to the intermediate crank = 500 kg. The angle between intermediate crank = 90°. Distance between centerlines of intermediate crank = 50 cm. Distance centerlines of extreme cranks = 200 cm. Length of each crank = 25 cm. CR length = 100 cm. Estimate reciprocating masses attached at the extreme cranks and their relative angular position. If the engine runs at 300 rpm what magnitude of secondary forces and couples about the centerline of the system with arrangement arrived for complete primary balance. 20

8. The firing order in a 6 cylinder vertical 4 stroke in line engine is 1-4-2-6-3-5, the piston stroke is 100 mm. length of each cylinder = 200 mm. The pitch distance between cylinder centerlines are 100 mm, 100 mm, 100 mm, 150 mm, 100 mm and 100 mm. Determine the out of balance primary and secondary forces and couples on this engine taking a plane midway between cylinder 3 and 4 as reference plane. The reciprocating masses per cylinder are 2 kg's and engine runs at 1500 rpm. 20

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UNIT - V

9 a. Derive an expression for height of porter governor runs at speed 'N'. 5

b. The arems of porter governor are 300 mm long. The upper arm is pivoted to axis of rotation and the lower arm attached to the sleeve at a distance of 35 m from the axis of rotation. The sleeve is 54 kgs and masses of each ball are 7 kg. Determine the equilibrium speed when the radius of rotation is 225 mm. 5

c. The radius of roation of balls of harnell governor is 8 cm at the minimum speed of 300 rpm. Neglecting gravity effect detrmine the speed after the sleeve is lifted by 6 cm, also determine initial compression of the spring, governor effort and power. The particulers of the governors are, length of the ball arm = 15 cm, length of sleeve arm = 10 cm, mass of each ball = 4 kg and stiffness = 2500 N/m. 10

10 a. Discuss the effect of gyroscopic couple on an airplane, when it takes;

i) Left turn with engine routing CCW when viewed from rear

ii) Right turn with engine roating CCW when viewed from noise of the airplane

Make suitable diagram to support your answers 6

b. Deduce the matematical model for reaction load on each wheel of car moving in a curved path consudering gyroscopic effect. Centrifugal effect into consideration. 14

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