



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

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E, - Mechanical Engineering

Semester End Examination; Dec.-2014

Theory of Machines - II

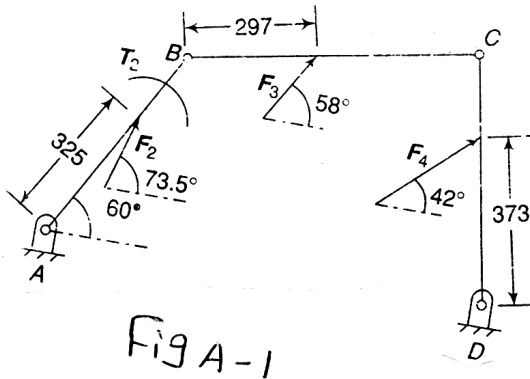
Time: 3 hrs

Max. Marks: 100

Note: i) Answer any **FIVE** full questions, selecting at least **TWO** full questions from each part.
ii) Assume suitable missing data if any.

PART - A

1. a. A four link mechanism is subjected to the external forces as shown in Fig. A-1. Determine the shaft Torque T_2 on the input link AB for static equilibrium of the mechanism. Also find the forces on the bearings A, B, C and D.



$AB = 500 \text{ mm}$
 $BC = 660 \text{ mm}$
 $CD = 560 \text{ mm}$
 $AD = 1000 \text{ mm}$

20

2. a. Obtain the expression for angular acceleration connecting rod. 5
- b. The piston diameter of an internal combustion engine is 125 mm and the stroke is 220 mm. The connecting is 4.5 times the crank length and has a mass of 50 kg. The mass of reciprocating parts is 30 kg. The centre of mass of the connecting rod is 170 mm from the crank pin centre and radius of gyration about an axis through the centre of mass is 148 mm. 15
The engine runs at 320 rpm. Find the magnitude and direction of the inertia force and the corresponding torque on the crank shaft when the angle turned by the crank is 140° from inner dead centre.
3. a. Sketch and explain turning moment diagram for single cylinder double acting steam engine. 5
- b. The turning moment diagram of a four stroke engine is assumed to be represented by four triangles the areas of which from the line of zero pressure are suction stroke = 440 mm^2 compression stroke = 1600 mm^2 , expansion stroke = 7200 mm^2 exhaust stroke = 660 mm^2 . 15
Each mm^2 of area represents 3 N-m of energy. If the resisting torque is uniform, determine the mass of the rim of a fly wheel to keep the speed between 218 and 222 rpm. When the mean radius of rim is to be 1.25 m.

- 4 a. Obtain the expression for acceleration for a tangent cam with roller follower when the roller is on the flank. 5
- b. The following data relate to a symmetrical circular Cam operating a flat faced follower. Minimum radius of the Cam – 40 mm, lift – 24 mm, Angle of Lift - 75°, Nose radius 8 mm, speed of the cam - 420 rpm. Determine the main dimensions of the cam and the acceleration of the follower at the i) Beginning of the lift ii) End of contact with circular flank iii) Beginning of contact with the nose iv) Apex of nose. 15

PART – B

- 5 a. Explain how balancing of several masses in a same plane is done by analytical method? 5
- b. A shaft carries 3 masses in planes A, B and C. Planes B and C are 600 mm and 1200 mm from plane A. Masses in planes A, B and C are 50 kg, 40 kg and 60 kg respectively at a radius of 25 mm. The angular position of mass B and C with A are 90° and 210° respectively. Find the unbalanced force and couple if the shaft revolves at 300 rpm. Also find the position and magnitude of balancing mass required at 100 mm radius in planes L and M mid way between A and B and between B and C. 15
- 6 A four crank engine has two outer cranks set at 120° to each other, and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be complete primary balance, find the reciprocating mass and the relative angular position for each of the inner cranks. If the length of each crank is 300 mm. length of each connecting rod is 1200 mm and speed of rotation is 240 rpm, what is the maximum secondary unbalanced force? 20
- 7 a. Obtain the expression for stiffness of spring used in Hartnell governor with usual notations. 5
- b. Each arm of a porter governor 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 of 50 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed of the governor for extreme radii of rotation of 125 mm and 150 mm. 15
- 8 a. Illustrate the gyroscopic effect on pitching, steering and rolling of a ship with neat sketches. 8
- b. Find the angle of inclination with respect to the vertical of two wheeler negotiating a turn. Given combined mass of the vehicle with its rider 250 kg, moment of inertia of the engine flywheel 0.3 kgm², moment of inertia of each road wheel 1 kgm², speed of engine flywheel 5 times that of road wheels and in the same direction, height of centre of gravity of rider with vehicle 0.6 m, two wheeler speed 90 km/h wheel radius 300 mm, radius of turn 50 m. 12