Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

IV SEMESTER B.TECH. (MECHANICAL ENGINEERING) END SEMESTER EXAMINATIONS, JUNE 2017

SUBJECT: DYNAMICS OF MACHINERY [MME 2203]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. For the four bar mechanism as shown in figure 1A, determine the torque " T " that must be applied on the OA (input crank) to maintain static equilibrium. If a force P = 500 N acting at the mid-point of the BQ (output crank). Crank OA rotates in clockwise direction. Take OA = link 2, AB = link 3 and BQ = link 4. All dimensions are in mm. (Draw the configuration, free body and analysis diagrams) **05**

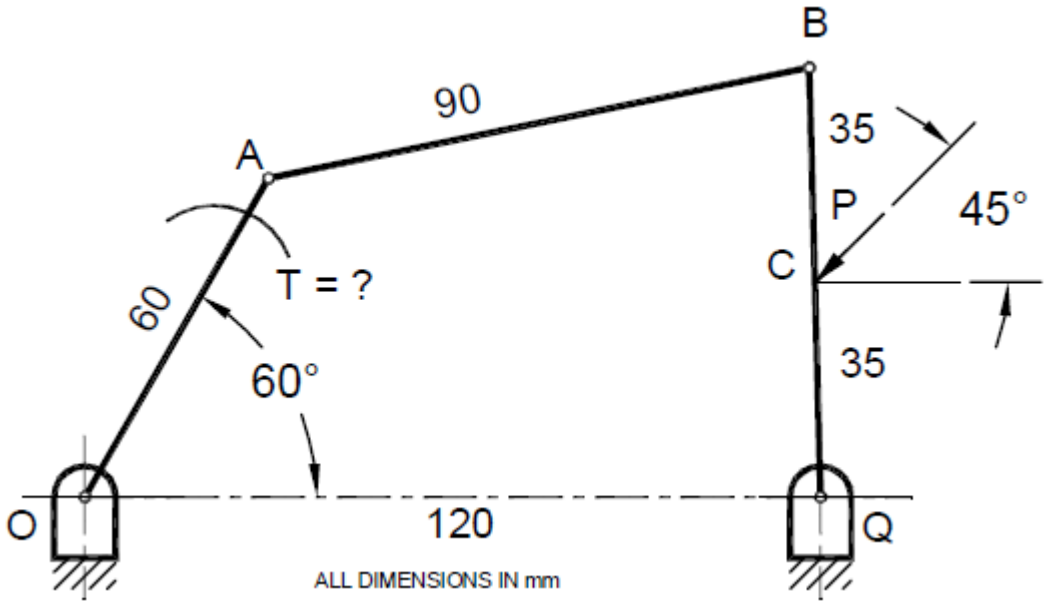

Figure. 1A

1B. Figure 1B shows a cam shaft link mechanism. Determine the torque that must be applied to the cam shaft to overcome a horizontal force P acting at the mid-point of link 05. Take $O_5D = 50$, $O_5E = 25$, $AB = 15 = O_3B$ (Draw the configuration, free body and analysis diagrams). All dimensions are in mm. **05**

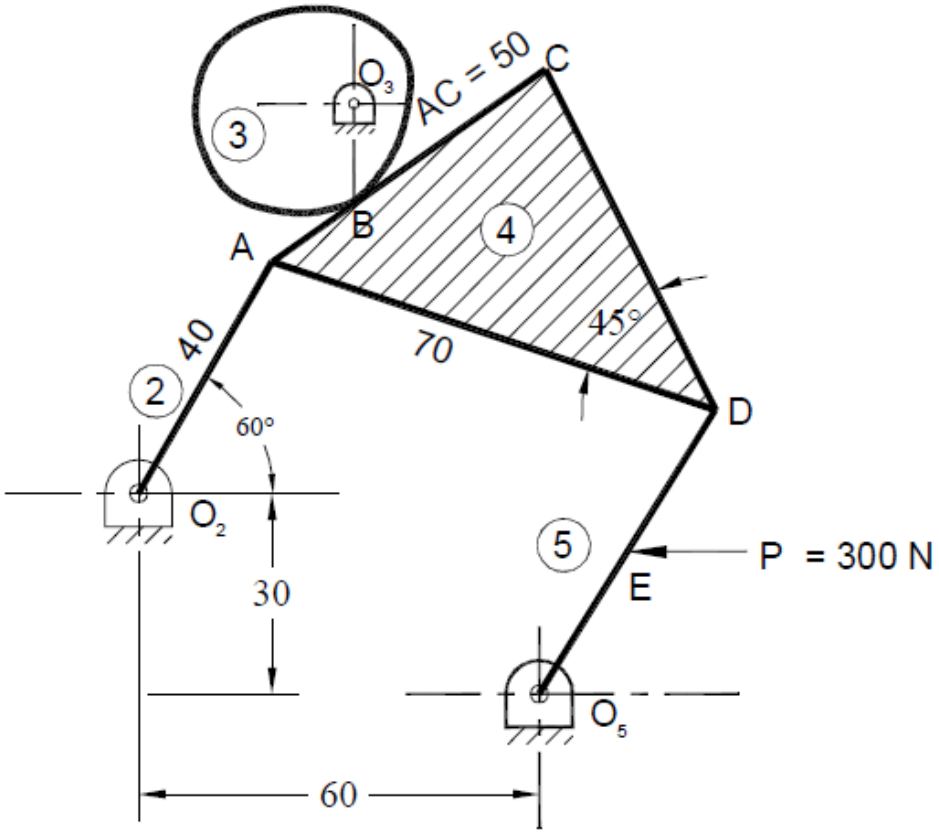

Figure. 1B

2A. Derive an expression to determine the spring stiffness for a hartnell governor. **05**

2B. In a Porter governor, each of the four arms is 400 mm long. The upper arms are pivoted on the axis of the sleeve whereas the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 60 kg. Determine the equilibrium speeds and the range of speed for the two extreme radii of 250 mm and 300 mm of rotation. **03**

2C. State and explain the significance of the following with respect to a centrifugal governor: (i). Stability (ii). Isochronism **02**

3A. With neat sketches describe the effect of various forces acting on the turning moment diagram of a single cylinder I.C. engine. **05**

3B. A multi-cylinder engine runs at a speed of 1500 rpm. The turning moment diagram repeats itself for every revolution of the crankshaft. The scale of the turning moment is 1 cm = 3,000 N-m and the crank angle is plotted to a scale of 1cm = 60°. The areas below and above the mean turning moment line, taken in order are as follows: - 0.3, + 4.1, - 2.8, + 3.2, - 3.3, + 2.5, -2.6, + 2.8 and -3.6 cm^2. Find out the fluctuation of energy. Also find out the coefficient of fluctuation of speed if the weight of the rotating parts is 4000 N, and the radius of gyration is 0.3 m. **03**

3C. Explain the turning moment diagram of a multi cylinder engine **02**

4A. Derive an expression to determine the gyroscopic couple for a circular disc rotating about horizontal axis. Show planes of rotation, precession and couple planes if it rotates anticlockwise as seen by observer and then moves right. **05**

4B. The propeller shaft of an aero plane rotates at 3000 rpm. The direction of rotation is clockwise when looking from the front end of the aircraft. The rotary engine of the aircraft has a mass of 300 kg. Determine gyroscopic couple acting on the aero plane when the plane travels at a speed of 360 KMPH and takes a turn to the right along a circular path of 100 m radius. Also explain the effect of gyroscopic couple on the aircraft. Take radius of gyration of the rotating parts = 0.314 m. **05**

5A. A shaft carries four rotating masses A, B, C and D along its axis. The mass A may be assumed concentrated at a radius of 12 cm, B at 15 cm, C at 14 cm and D at 18 cm. The masses A, C and D are 15 kg, 10 kg and 8 kg respectively. The planes of rotation of A and B are 15 cm apart and of B and C are 18 cm apart. The angle between the radii of A and C is 90°. If the shaft is in complete dynamic balance, determine: **05**

i) the angles between the radii of A, B and D
ii) the distance between the planes of revolution of C and D, and
iii) the mass B.

5B. Explain the procedure for balancing of several masses revolving in different planes. **03**

5C. Four masses are attached to a shaft at planes A, B, C and D at equal radii. The distance of the planes B, C and D from A are 40 cm, 50 cm and 120 cm respectively. The masses at A, B and C are 60 kg, 45 kg and 70 kg respectively. If the system is in complete balance, determine the mass at D and the position of masses B, C and D with respect to A. **02**