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Fourth Semester B.E. Degree Examination, June/July 2019 Theory of Machines

Time: 3 hrs.

Max. Marks: 100

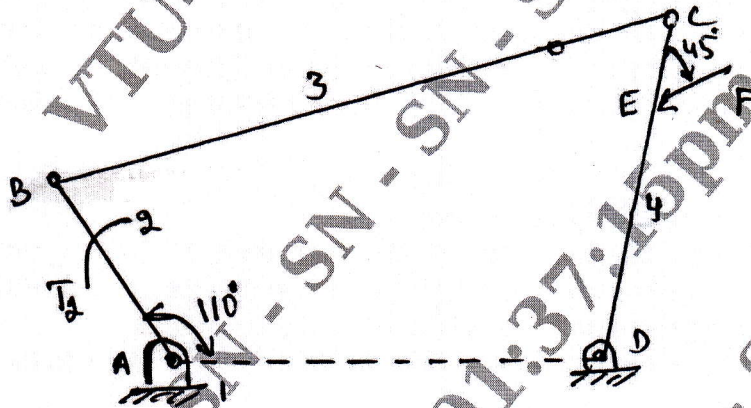
Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define the following:
 - i) Link ii) Kinematic chain iii) Degree of freedom iv) Inversion (06 Marks)
- b. Explain with neat sketch beam engine and Whitworth quick return mechanism. (08 Marks)
- c. Explain Crubler's criterion for plane mechanisms. (06 Marks)

OR

- 2 a. Explain principle of virtual work. (08 Marks)
- b. In the four bar mechanism as shown in Fig.Q2(a), calculate the required value of T_2 and various forces on links for the equilibrium of the system.



$F = 2000 \text{ N}$
 $AD = 215 \text{ mm}$
 $AB = 200 \text{ mm}$
 $BC = 370 \text{ mm}$
 $DC = 350 \text{ mm}$
 $CE = 100 \text{ mm}$

Fig.Q2(a)

- c. What is free body diagram? List any two advantages of free body diagram. (04 Marks)

Module-2

- 3 a. Explain the inertia force and inertia torque. (10 Marks)
- b. When the crank is 45° from the inner dead centre on the down stroke, the effective steam pressure on the piston of a vertical steam engine is 2.5 bar. The diameter of the cylinder = 0.75 m, stroke of the piston = 0.50m and length of connecting rod = 1 m. Determine the torque on the crank shaft, if the engine runs at 350 rpm and the mass of reciprocating parts is 200 kg. (10 Marks)

OR

- 4 a. Derive an expression for the ratio of belt tensions. (08 Marks)
- b. Define friction. What are the types of friction on belt drives? (04 Marks)
- c. A belt drive is required to transmit 10 KW from a motor running at 600 rpm. The belt is 12 mm thick and has a mass density of 0.001 gram/mm^3 . Safe stress in the belt is not to exceed 2.5 N/mm^2 . Diameter of the driving pulley is 250 mm whereas the speed of the driven pulley is 220 rpm. Two shafts are 1.25 m apart. The coefficient of friction is 0.25. Determine the width of the belt. (08 Marks)

Module-3

- 5 a. Explain balancing of several masses rotating in the same plane. (10 Marks)
 b. A shaft carries 4 rotating masses A, B, C and D in this order along the axis. The mass A may be assumed to be concentrated at 160 mm radius, B at 180 mm, C at 200 mm, and D at 120 mm radius. The masses B, C and D are 40, 30 and 50 kg respectively. The planes containing B and C are 300 mm apart. The angular spacings of C and D are 90° and 210° respectively. With respect to B measured in the same direction. If the shaft and masses are to be in complete dynamic balance, determine: (i) Mass and angular positions of A, (ii) Positions of planes A and D. (10 Marks)

OR

- 6 a. Explain partial primary balancing with neat sketch and expression. (10 Marks)
 b. A 5 cylinder inline engine running at 500 rpm has successive cranks at 144° apart. The distance between the cylinder centre line is 300 mm. Piston stroke = 240 mm, length of CR = 480 mm. Examine the engine for balance of primary and secondary forces and couples. Find the maximum value of these and position of central crank at which these maximum values occur. The reciprocating mass for each cylinder is 150 N. (10 Marks)

Module-4

- 7 a. Define: i) Controlling force ii) Governor power iii) Sensitiveness iv) Stability (08 Marks)
 b. A porter governor has all four arms 300 mm long, the upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance 35 mm from axis. The mass of each ball is 7 kg and the load on the sleeve is 540 N. Determine the equilibrium speed for the two extreme radii of 200 mm and 260 mm of rotation of governor balls. (12 Marks)

OR

- 8 a. What is gyroscopic couple? Briefly explain. (08 Marks)
 b. A ship is propelled by a turbine rotor which has a mass of 5000 kg and has a speed of 2100 rpm. The rotor has a radius of 0.5 m and rotates in clockwise direction when viewed from stern. Find the gyroscopic effect in the following conditions.
 i) The ship runs at a speed of 16 knots (knot = 1860 m/hr). It steers to the left in a curve of 60 m radius.
 ii) The ship pitches 6° above and 6° below the horizontal position. The bow descends with its maximum velocity. The motion due to pitching is SHM and the periodic time is 20 secs.
 iii) The ship rolls at a certain instant has an angular velocity of 0.03 rad/sec clockwise when viewed for the stern. (12 Marks)

Module-5

- 9 a. Write a note on types of followers used in Cam's. (06 Marks)
 b. Drive an expression for displacement, velocity and acceleration of follower when the roller is in contact with straight flank. (14 Marks)

OR

- 10 Draw the full size profile of cam which will give a lift of 38 mm to a follower carrying a roller of 25 mm diameters. The axis of the follower is off-set by 18 mm to the right of the axis of cam. Ascent of the follower takes place with SHM in 0.05 second followed by a period of rest 0.0125 sec. The follower by then descent with UARM during 0.125 second, the acceleration being $3/5$ times retardation. The cam rotates in clockwise direction at a constant speed of 240 rpm and the base circle radius is 50 mm. (20 Marks)
