

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Dynamics of Machinery

Time: 3 hrs.

Max. Marks: 100

Note: Answer FIVE full questions, selecting atleast TWO questions from each part.

PART – A

- 1 a. Explain the principle of virtual work with an example. (04 Marks)
 b. Fig.Q1(b) shows a quaternary link ABCD under the action of forces F_1 , F_2 , F_3 and F_4 acting at A, B, C and D respectively. The link is in static equilibrium. Determine the magnitude of forces F_2 and F_3 and direction of F_3 . (05 Marks)

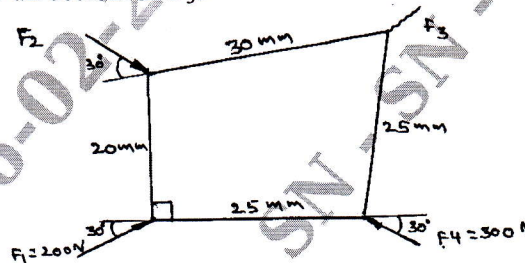
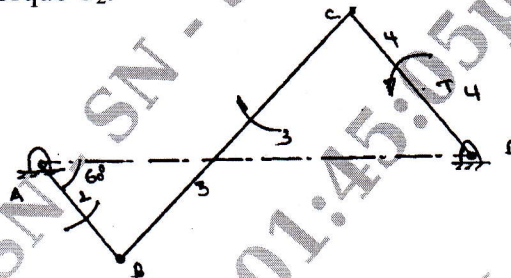


Fig.Q1(b)

- c. In 4-bar chain mechanism shown in Fig.Q1(c), the torques T_3 and T_4 have magnitudes of 50 Nm and 40 Nm respectively. For static equilibrium of the mechanism, determine the required input torque T_2 . (11 Marks)



AB = 30 mm
 BC = 74 mm
 CD = 35 mm
 AD = 70 mm

Fig.Q1(c)

- 2 a. Explain turning moment diagrams of 4-stroke IC engine and multi cylinder engine. (05 Marks)
 b. A punching press is required to punch 40 mm dia holes in a plate of 15 mm thick at the rate of 30 holes per minute. It requires 6 Nm of energy per mm^2 of sheared area. If the punching takes $\frac{1}{10}$ of second and the rpm of the flywheel varies from 160 rpm to 140 rpm, determine the mass of the fly wheel having radius of gyration of 1 meter. (15 Marks)
- 3 a. Establish an expression for ratio of tensions in flat belt drive. (06 Marks)
 b. 2.5 kW of power is transmitted by an open belt drive. The linear velocity of the belt is 3 m/s. The angle of lap on the smaller pulley is 160° . The coefficient of friction is 0.28. Determine the effect on power transmission in the following cases: (i) Initial tension in the belt is increased by 8%. (ii) Initial tension in the belt is decreased by 8%. (iii) Angle of lap is increased by 8% by the use of an idler pulley, for the same speed and tension on the tight side. (iv) Coefficient of friction is increased by 8% by suitable dressing to the friction sample of the belt. (14 Marks)

- 4 a. Explain static balancing and dynamic balancing. (04 Marks)
- b. Four masses $M_1 = 100$ 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 planes 1, 2, 3 and 4 respectively. The angular position of the planes 2, 3 and 4 with respect to 1 are 75° , 135° and 240° taken in the same sense. Distances 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 radius 600 mm in planes L and M located in the middle of 1 and 2 and in the middle of 3 and 4 respectively. (Graphical method) (16 Marks)

PART - B

- 5 a. In a 4 cylinder in line reciprocating engine, the masses of the reciprocating parts per cylinder are 1 kg. The stroke is 12 cm. The length of connecting rod is 22 cm. The cylinders are spaced at 12 cm pitch. If the cylinders are numbered from 1 to 4 from one end then in the end view, the cranks appear at successive intervals of 90° in the order 1, 4, 2, 3. Find with reference to the central plane of the engine, the maximum value of any primary and secondary out of balance effects when the engine is running at 2000 rpm. (15 Marks)
- b. Write a short note on direct and reverse crank method of balancing. (05 Marks)
- 6 A spring loaded governor of the Hartnell type has arms of equal length. The masses rotate in a circle of 120 mm diameter when the sleeve is in the mid position and the ball arms are vertical. The equilibrium speed for this position is 550 rpm, neglecting friction. The maximum sleeve movement is to be 25 mm and the maximum variation of speed taking in account the friction to be 6 per cent of the mid position speed. The mass of the sleeve is 5 kg and the friction may be considered equivalent to 35 N at the sleeve. The power of the governor must be sufficient to overcome the friction by two percent change of speed either way at mid-position. Determine, neglecting obliquity effect of arms;
- The value of each rotating mass
 - The spring stiffness in N/mm and
 - The initial compression of spring. (20 Marks)
- 7 a. A disc with radius of gyration 60 mm and a mass of 4 kg is mounted centrally on a horizontal axle of 80 mm length between the bearings. It spins about the axle at 800 rpm CCW when viewed from the right hand side bearing. The axle processes about a vertical axis at 50 rpm in the CCW direction, when viewed from above. Determine the resultant reaction at each bearing due to the mass and gyroscopic effect. (12 Marks)
- b. Discuss the stability of an automobile while moving in a curved path considering effect of weight of vehicle (W), gyroscopic couple (C) and centrifugal force (C_F). (08 Marks)
- 8 A tangent cam with straight working faces tangential to a base circle of 120 mm diameter has a roller follower of 48 mm diameter. The line of stroke of the roller follower passes through the axis of the cam. The nose circle radius of the cam is 12 mm and the angle between the tangential faces of the cam is 90° . If the speed of the cam is 180 rpm, determine the acceleration of the follower when
- during the lift, the roller just leaves the straight flank.
 - the roller is at the outer end of its lift, i.e., at the top of the nose. (20 Marks)
