BACHELOR OF FOOD TECHNOLOGY & BIO-CHEMICAL ENGINEERING SUPPLEMENTARY EXAMINATION 2018

(2nd Year, 1st Semester)

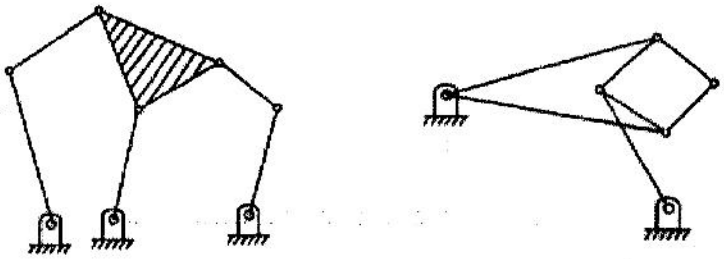
BASICS OF MECHANISMS

Time: **3 hours** Full Marks: **100**

Missing data, if any, are to be reasonably chosen.
All parts of a question must be answered together.
Give sketches wherever applicable.
Answer any Four (4).

1. Write Short Notes on the following topics: [5×5]
   (*i*). Grashof criterion
   (*ii*). Scotch Yoke mechanism
   (*iii*). Straight line mechanism
   (*iv*). Centrifugal clutch
   (*v*). Elastic creep

2. (*a*). Define lower pair and higher pair with examples. Classify different types of lower pairs along with representative sketches and write down the type of relative motion allowed in these pairs, their degrees of freedom and respective pair variables. [2+8]
   (*b*). Define: Kinematic chain. Explain kinematic inversion. Write down the names of the mechanisms which are inversions of a slider crank chain and describe any one of them with neat sketch. [2+2+2+3]
   (*c*). Determine the mobility of the mechanisms shown in Figure Q2. [6]



(*i*) (*ii*)

Figure Q2

3. (*a*). Write down the expression of displacement within the rise part of the cycle, when the follower moves according to Parabolic motion. Also deduce the expressions for velocity, acceleration and jerk from the above expression. Indicate the values of maximum velocity and acceleration. Draw schematic representation of each of the above mentioned parameters for one cycle of cam rotation. [2+6+2+6]
   (*b*). Classify cam-follower mechanism according to the following criterion: Type of follower motion. [4]
   (Provide neat sketches for each classification)
   (*c*). Prove that for translating flat face follower: (Symbols have their usual meaning) [5]

$$F_n = \frac{F_s}{1 - 2\mu\frac{\epsilon}{l_g}}$$

[Turn over

4. (*a*). What do you understand by Coriolis component of acceleration? Derive an expression for the Coriolis component of acceleration. [2+5]

(*b*). O_2ABO_4 is a four bar chain with O_2O_4 as the fixed link. The link lengths are given as follows: O_2A = 60 mm, AB = O_4B = 70 mm and O_2O_4 = 120 mm. Points A and B (A is to the right of B) lie in the same side of the fixed link. The crank O_2A rotates in the clockwise direction at 10 rad/s. Following an analytical method find out the angular velocity of the coupler and the output link corresponding to the configuration when the input link (crank) makes an angle of 60^0 with the horizontal. Derive the expressions used in the process. [18]

5. (*a*). Write down the desirable properties of a good friction material for a clutch. [4]

(*b*). A multi disk clutch consists of 5 disks on the driven shaft and 4 disks on the driving shaft. The inner and outer diameters of the friction disk are 75 mm and 150 mm, respectively. The coefficient of friction is 0.10 and the intensity of pressure on the friction lining is limited to 0.30 N/mm^2. Assuming uniform wear theory, calculate the required actuating force to engage the clutch and power transmission capacity at 750 rpm. Using the same set of data calculate the power transmission capacity of the clutch following uniform pressure theory. [9]

(*c*). A differential band brake is shown in Figure Q5. The width and thickness of the steel band are 100 mm and 3 mm, respectively. Maximum allowable tensile stress in the band is 50 N/mm^2. The coefficient of friction between the friction lining and the brake drum is 0.25. Calculate: the tensions in the band, the actuating force and the torque capacity of the brake. Also determine whether the brake is self-locking. [12]

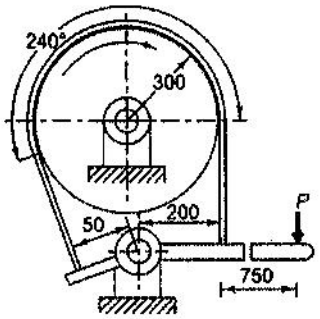


Figure Q5

6. (*a*). An open belt drive is required to transmit 10 kW power from a motor running at 600 rpm. Diameter of driving pulley is 250 mm. Speed of the driven pulley is 220 rpm. The belt is 12 mm thick and has a mass density of 0.001 g/mm^3. Maximum stress in the belt is limited to 2.5 N/mm^2. The center distance between the two pulleys is 1.25 m. Coefficient of friction between the pulley and belt material is considered to be 0.25. Determine the width of the belt with and without considering the effect of centrifugal tension. [15]

(b). Derive the condition for maximum power transmission by a belt drive considering the effect of centrifugal tension. [7]

(*c*). What do you understand by crowning of pulley? Why is it provided? [3]
