

EX/FTBE/ME/T/214/2017(S)
BACHELOR OF FOOD TECHNOLOGY & BIO-CHEMICAL ENGINEERING SUPPLEMENTARY
EXAMINATION 2017
(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. a) Explain (with neat sketches) what is meant by Binary, Ternary and Quaternary link. Prove that the minimum number of binary links in a single degree of freedom planar linkage is 4. In an 8-link chain what is the highest possible order of links? Find out following number synthesis, possible combinations of number of different types of links that can make up the above mentioned 8-link chain. [3+5+1+8]
 b) Derive an expression for mobility (degree of freedom) of a planar mechanism considering compound hinges. Give an example of a planar mechanism, where, Kutzbach criterion predicts incorrect degree of freedom of the mechanism. Provide an explanation why the above-mentioned criterion sometimes gives incorrect results. [5+1+2]

2. a) The dimensions of a 4 bar linkage is given as follows: AB=200 mm, BC=400 mm, CD=450mm and AD=600 mm (where AD is the fixed link). Find out the angle output link makes with the horizontal by an analytical method when the input link is at an angle of 90° with the horizontal. [14]
 b) Define Grashof, Non-Grashof and Transition linkages. What do you understand by straight line mechanism? Give example of a few such mechanisms with neat sketches showing the straight line path. [3+3+5]

3. a) Write down the expression of displacement within the rise part of the cycle, when the follower moves according to Simple Harmonic Motion (SHM). Derive the expressions for velocity, acceleration and jerk from the above expression. Indicate the values of maximum velocity and acceleration. Draw schematic representation of displacement, velocity, acceleration and jerk variation against cam rotation angle for one cycle. Point out the disadvantage associated with such kind of follower motion. [1+4+2+5+2]
 b) With a neat sketch of a radial cam with offset translating roller follower define the following terms: Trace point, Base circle, Pitch curve, Prime circle. [6]
 c) Classify cam-follower mechanism according to the following criterion: (Provide neat sketches for each classification) [5]
 - i. Type of follower motion
 - ii. Type of follower shape

4. a) Prove that in a flat belt drive, the belt tensions are related by the following expression: $\frac{T_1 - mv^2}{T_2 - mv^2} = e^{\mu\theta}$. [12]
 b) Prove that in open belt arrangement, the length of the belt has the following expression:

$$L = 2C + \frac{\pi}{2}(D_1 + D_2) + \frac{(D_1 - D_2)^2}{4C}$$
 (The symbols in the expressions have their usual meaning) [7]
 c) Explain the following terms in relation to a belt drive: Slip, Elastic creep, Crowning of pulley. [6]

5. a) A plate clutch consists of one pair of contacting surfaces. The inner and outer diameters of the friction disk are 100 mm and 200 mm respectively. The coefficient of friction is 0.25 and the permissible intensity of pressure is 1 N/mm^2 . Assuming uniform wear theory, determine the operating force required to engage the clutch. Also calculate the power transmission capacity of the clutch at 720 rpm. Derive the expressions utilized to arrive at the answer. Mention the conditions where uniform pressure theory and uniform wear theory are applicable in relation to clutch operation. [5+9+2]
- b) Explain the following terms: Self-locking and self-energizing brake. Derive the condition of self-locking for a block brake with short shoe. [4+5]
6. Write short notes on the following: [5×5]
- i. Kinematic inversion
 - ii. Coriolis component of acceleration
 - iii. Classification of kinematic pairs
 - iv. Simple and Differential band brakes
 - v. Square jaw clutch
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