

Roll No.

Total No. of Pages : 03

Total No. of Questions : 09

**B.Tech. (Automobile Engineering) (Sem.-4)**  
**KINEMATICS AND THEORY OF MACHINES**

Subject Code : BTAE-402-18

M.Code : 77528

Date of Examination : 07-07-22

Time : 3 Hrs.

Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

**SECTION-A**

**1. Answer briefly :**

- a) State Grashof's law for four bar mechanism.
- b) Write all the Degrees of Freedom for an unconstrained link in a 2D mechanism, where all members lie in a single plane.
- c) Calculate the degrees of freedom for a plane mechanism with 5 number of links, where one link is fixed, while the others are connected through 5 revolute joints.
- d) The input shaft of a universal joint is rotating at 100 RPM. Calculate the maximum angular velocity of the output shafts while it makes an angle of  $15^\circ$  with the input shaft.
- e) With the help of a diagram, show the effect of follower offset on the pressure angle in a cam-follower system.
- f) Draw any four shapes of cam followers.
- g) For an involute drawn on a base circle of  $R_b=30\text{mm}$ , calculate the pressure angle ( $\phi$ ) at radius,  $R = 34\text{mm}$ .
- h) Enlist any two advantages of cycloidal gears over involute gears.

- i) A vertical shaft 120 mm in diameter, rotating at 1200 RPM and carrying a downward axial thrust of 5000N is supported on a flat end footstep bearing. Assuming uniform pressure distribution, estimate the power lost due to friction. Given: coefficient of friction between the shaft and bearing,  $\mu = 0.05$ .
- j) What is the difference between self-energizing and self-locking brakes?

### SECTION - B

2. In an automobile transmission system, the driving and driven shafts are connected through universal coupling while their axes are inclined at an angle of  $8^\circ$ . The driving shaft runs at a uniform speed of 2200 RPM. The driven shaft is connected to wheels, whose radius of gyration is 20cm and total mass is 32 kg. Calculate the maximum angular acceleration of the driven shaft and corresponding maximum torque.
3. With the help of a labelled diagram of a 4-bar linkage ABCD, comprising of links 1 (AB), 2 (BC), 3 (CD) and 4 (DA) in counter-clockwise sense, where link number 1 is fixed, explain the concept of fixed, permanent and neither fixed nor permanent instantaneous centres.
4. Calculate the magnitude of follower acceleration for a uniform acceleration/retardation cam, which is having  $90^\circ$  angle of rise during which it displaces the follower through 20mm. The cam is rotating at an angular velocity of 120 RPM.
5. A planetary gear drive comprises of a driving sun gear (Gear A) having 11 teeth, a fixed annular gear (Gear C) having 46 teeth and a planet carrier carrying three planetary gears (Gear B) having 17 teeth each. The planetary gears mesh externally with the sun gear and internally with the fixed annular. Calculate the reduction ratio when output is obtained from the planet carrier.
6. A person weighing 80 kg is riding a bicycle and moving at 18 km/h on a level road. The bicycle itself weighs 20kg and is equipped with 200mm diameter disc brakes having coefficient of friction,  $\mu = 0.4$ . The wheels have a diameter of 0.80m, while their moment of inertia can be neglected. The rider applies the brakes to the rear wheel with a force of 500N. Calculate the distance in which he will come to rest.

### SECTION - C

7. Writing various steps in the construction, construct the displacement diagram for a DRDR cam, which has to displace the follower by 30mm through SHM over a rise angle of  $90^\circ$ , followed by dwell of  $30^\circ$  and then return through uniform acceleration/retardation over a cam angle of  $60^\circ$ . The follower remains at rest for the remaining rotation of the cam. Also, draw the cam profile if the cam has a least circle of 50mm diameter and is supposed to operate a knife-edge follower, whose line of stroke is offset by 20mm from the cam axis.

8. Determine the contact ratio for a pair of standard full depth,  $20^\circ$  pressure angle involute gears, having metric module of 2.5mm. The pinion and gear have PCD of 80mm and 200mm, respectively.
9. Determine the length of a flat belt for connecting two parallel shafts, which are 4m apart and carrying pulleys of diameters 0.4m and 1.2 m. Also, determine the diameter of an additional set of pulleys, which are to be designed for providing a velocity ratio of 1:1 to these shafts.

**NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.**