Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth semester B.Tech degree examinations (S) September 2020

Course Code: ME301

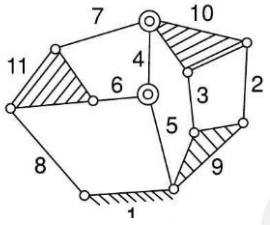
Course Name: MECHANICS OF MACHINERY

Max. Marks: 100 Duration: 3 Hours

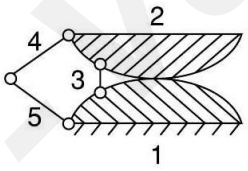
PART A

Answer any three full questions, each carries 10 marks. Marks

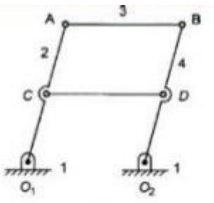
1 Find the degrees of freedom of the following cases.



a)

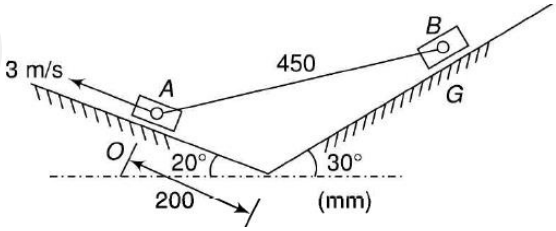


b) (10)



c) A planar link d)

2 For the position of the mechanism shown in figure, find the velocity of the slider B for the given configuration if the velocity of the slider A is 3m/s.



(10)

3 PQRS is a four-bar chain with link PS fixed. The lengths of the links are PQ = 62.5 mm; QR = 175 mm; RS = 112.5 mm; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of link QR. (10)

4 a) Draw the displacement, velocity and acceleration diagrams of simple harmonic motion (4)

b) Derive equation for velocity, acceleration, max. velocity and max. acceleration for simple harmonic motion. (6)

PART B

Answer any three full questions, each carries 10marks.

5 A cam is to be designed for a knife edge follower with the following data :

1) Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion.
2) Dwell for the next 30°.
3) During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. (10)
4) Dwell during the remaining 180°.

Draw the profile of the cam when the line of stroke is offset 20 mm from the axis of the cam shaft. The radius of the base circle of the cam is 40 mm.

6 Following is the data for a circular arc cam working with a flat faced reciprocating follower: Minimum radius of the cam = 40 mm; angle of lift = 75°; lift= 24 mm; Nose radius = 8 mm; Speed of the cam = 420rpm. Determine the main dimensions of the cam and the acceleration of the follower at the (i) beginning of the lift (ii) end of contact with the circular flank (iii) beginning of contact with the nose (iv) apex of nose. (10)

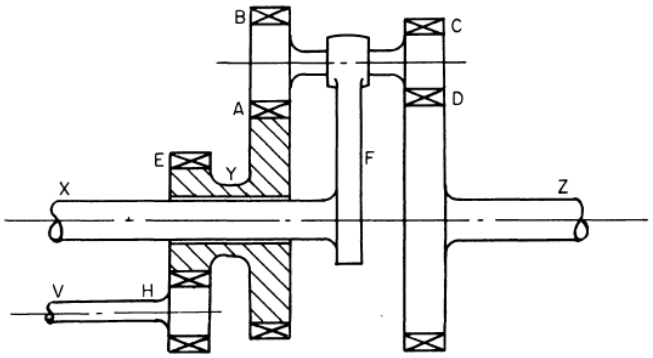
7 Derive equation for path of contact and arc of contact of mating gears. (10)

8 Two 20° involute spur gears mesh externally and give a velocity ratio of 3. The module is 3mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine the minimum number of teeth on each wheel to avoid interference and the contact ratio. (10)

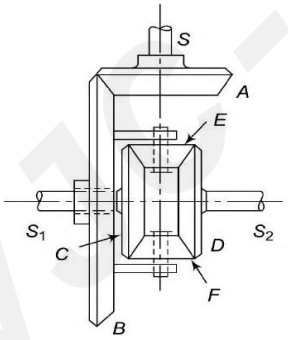
PART C

Answer any four full questions, each carries 10marks.

9 In the epicyclic train shown in figure, the wheels A and E (30 teeth) are fixed to a sleeve Y which is free to rotate on spindle X. B (24 teeth) and C (22 teeth) are keyed to a shaft which is free to rotate in a bearing on arm F. D (70 teeth) is attached to the output shaft Z. All teeth have the same pitch. The shaft X makes 300 rev/min and the shaft V 100 rev/min in the same direction. The wheel H has 15 teeth. Determine the speed and direction of rotation of Z. (10)



10 In the differential gear of a car shown in figure, the number of teeth on the pinion A on the propeller shaft is 18 whereas the crown gear B has 90 teeth. If the propeller shaft rotates at1200 rpm and the wheel attached to the shaft S_2 has a speed of 255 rpm, while the vehicle takes a turn, determine the speed of the wheel attached to shaft S_1. (10)



11 Design a slider crank mechanism to coordinate three positions of the input crank and the output slider for the following data using graphical method and explain the procedure. $\theta_{12} = 30°$, $S_{12} = 40$mm, $\theta_{13} = 60°$, $S_{13} = 96$mm (10)

12 Synthesize a four-bar linkage using Freudenstein's equation to satisfy in one of its positions. The specification of position θ, velocity ω and acceleration α are as follows: $\theta_2 = 60°$, $\omega_2 = 5$ rad/s; $\alpha_2 = 2$ rad/s^2; $\theta_4 = 90°$; $\omega_4 = 2$ rad/s; $\alpha_4 = 7$ rad/s^2. (10)

13 Synthesize a four-bar mechanism to generate a function $y = 2 \log x$ for $2 \leq x \leq 12$. The range of the output crank may be chosen as 70° while that of input crank be 90°. Assume three precision points which are to be obtained from Chebyshev spacing. Assume fixed link to be 30 mm long and $\theta_s = 30°$ and $\varphi_s = 60°$. (10)

14 Explain the procedure for any one of the methods to design a four link mechanism to coordinate two positions of the input crank and the output rocker. (10)