

ME 281/ ME 9203 KINEMATICS OF MACHINES

Time : 3 hr

Max Mark : 100

Drawing sheet will be provided on request

Part A (10 X 2 = 20 mark)

Answer all questions

1. Define the terms "link' and 'kinematic pair' with one example for each case.
2. Obtain the degree freedom of a basic 4- bar mechanism using Kutzbach mobility criterion
3. Derive an expression for the velocity of the slider of the single slider reciprocating mechanism in terms of crank angle , crank radius and angular speed of the crank.
4. Under what situation Coriolis acceleration occurs?
5. Compare roller and flat face type followers of a cam. Give one application for each.
6. Sketch the displacement , velocity and acceleration plot of a follower having constant acceleration and deceleration . What is the main limitation of this type of motion ?
7. Define transverse module and normal module of a helical gear.
8. Why differential gear train is required in the case four wheeled vehicle?
9. Briefly explain the term self-locking in the case of screws. Under what condition does it occur ?
10. Derive an expression for the virtual coefficient of friction in V-thread.

Part B (5 X 16 mark = 80 mark)

11.) In the mechanism shown in Fig Q 11 (a) , the crank OA rotates at 30 rpm ccw and gives motion to the sliding blocks B and D . The dimensions of the various links are OA = 300 mm, AB =1200 mm, BC = 450 mm, and CD = 450 mm. For the given configuration , determine

- i. acceleration the sliders B and D (10 mark)
- ii. Angular acceleration of CD. (6mark)

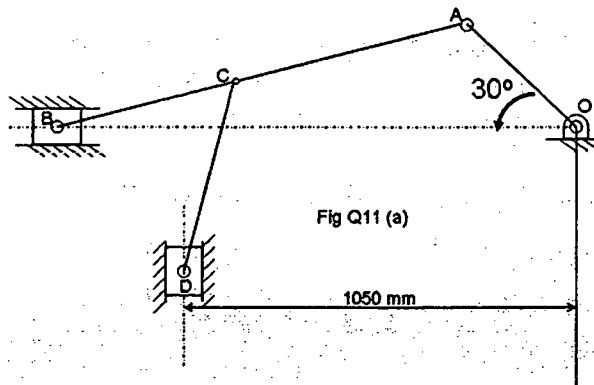


Fig Q 11 (a)

- 12.a (i) Explain the working of a crank slotted lever quick return mechanism with a neat sketch. (10 mark)
(ii) Sketch and explain the working of a differential screw mechanism. State its application.(6mark)

OR

- 12 (b) i. Explain the terms mechanical advantage and toggle positions in four bar linkage (6mark)

ii. The following are related to slider –crank mechanism :

crank radius : 150 mm, length of connecting rod = 600 mm, crank angle from IDC = 45° ,
crank speed 300 rpm cw. Determine the acceleration of the piston for this configuration.

(10mark)

13(a) A cam with 30 mm minimum radius is rotating clockwise at 1200 rpm to give the following motion to a roller follower of 20 mm radius, with a lift of 20 mm.

1. follower rises during 120° of cam rotation with SHM
2. to dwell for 60° of cam rotation
3. to return during 90° of cam rotation with uniform acceleration and deceleration
4. to dwell for the remaining period..

Draw the profile of the cam with 1: 1 scale.

OR

13(b) In a symmetrical tangent cam operating a roller follower , the least radius of the cam is 30 mm and the roller radius is 15 mm. The angle of accent is 75° and the total lift is 20 mm. The speed of the cam is 600 rpm .. Calculate the principal dimensions of the cam and sketch the profile of the cam

14(a) i. State and prove law of gearing . (8mark)

ii. Two gear wheels of module 4.5 mm have 24 teeth and 33 teeth respectively. The pressure angle is 20° and each wheel has a standard addendum of one module.

Find the length of arc of contact.

(8mark)

OR

14(b)) In an epicyclic gear train shown in Fig Q 14 (b) ,the wheel C is keyed to the shaft B and the wheel F is keyed to shaft A. The wheels D and E rotates together on a pin fixed to the arm G. The number of teeth on wheels C,D E and F are 35, 65, 32 and 68 respectively. If the shaft A rotates at 60 rpm and shaft B rotates at 28 rpm in the opposite direction, find the speed and direction of rotation of arm G.

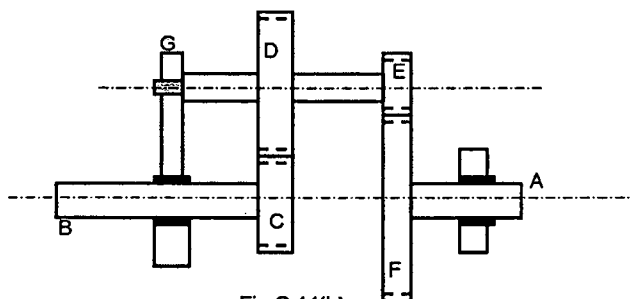


Fig Q 14(b)

15.(a). A single plate friction clutch with both sides effective is to transmit 40 k W at 2000 rpm. The maximum pressure that the clutch surface can withstand is limited to 0.08 MPa. The outer diameter of the clutch plate is 300 mm. Assuming uniform wear condition and $\mu = 0.35$, determine the following :

i. the inner diameter of the clutch plate (10 mark)

ii. Axial force required to engage the clutch. (6mark)

OR

15(b)The initial tension given to flat belt drive is 1800 N . The angle of lap on the smaller pulley is 160° . The coefficient of friction between belt and pulley surface is 0.0.30. The smaller pulley has a diameter of 0.9 m and runs at 540 rpm. Neglecting centrifugal tension , determine the power that can be transmitted at the above speed.

@@@@@@@@