Question Paper

Exam Date & Time: 21-Nov-2019 (09:00 AM - 12:00 PM)

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

THIRD SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2019
MECHANICAL ENGINEERING
KINEMATICS OF MACHINERY [MME 2151]

Marks: 50 **Duration: 180 mins.**

Instructions to Candidates:
* Answer ALL questions
* Missing data may be suitably assumed

1) A) A rope drive transmits 125 kW at 225 rpm. The ropes are 2.5 cm in diameter and have a mass of 0.6 kg/m. The maximum tension in the rope is 13.6 kN, and the drive is designed for maximum power condition. The angle of contact is 160°, and the coefficient of friction is 0.25. If the groove angle is 45°, determine the diameter of the pulley and the number of ropes required to transmit the power. (3)

B) A plain collar type thrust bearing having an inner and outer diameter of 20 cm and 45 cm respectively is subjected to an axial thrust of 39240 N. Assuming the coefficient of friction between the thrust surface as 0.25 find, power absorbed in overcoming friction at a speed of 120 rpm. The rate of wear is considered to be proportional to the pressure and rubbing speed. (3)

C) The slider C in the mechanism shown in figure 1 has a velocity of 6 m/s (downward direction). At the position shown, determine the angular velocities of the links AB and BC using instantaneous centre method. (4)

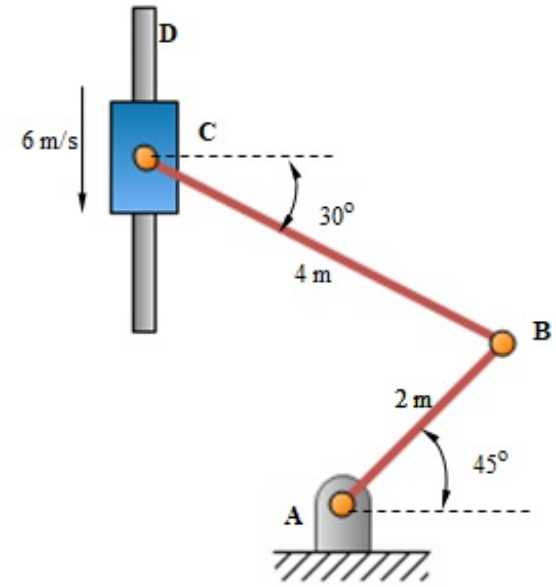

Figure 1

2) One of the inversions of a kinematic chain is used to draw an ellipse. What is the name of this inversion and to which chain does it belong? With a neat sketch explain the construction and working of this inversion. (3)

A)

B) With the help of a neat sketch explain Whitworth quick return motion mechanism and also show that the time of return stroke is less than that of the forward stroke. (3)

C) A pinion having 18 teeth of involute profile, 20° pressure angle and 6 mm module drives a gear having 44 teeth. Find, the length of the path of contact, contact ratio, and angle made by the gear if the addendum on both the gears is 25% more than the module. (4)

3) Draw the cam profile for the following conditions: (6)

A) Follower type = Knife edge, in-line; lift = 50 mm; base circle radius = 50 mm; out stroke with Simple harmonic motion (SHM), for 60° cam rotation; dwell for 45° cam rotation; return stroke with SHM, for 90° cam rotation; dwell for the remaining period. Determine maximum velocity and acceleration during out stroke and return stroke if the cam rotates at 1000 rpm in the clockwise direction.

B) An epicyclic gear is arranged, as shown in figure 2. The pinion A has 15 teeth and is coupled to the motor shaft. The wheel B has 20 teeth and gears with A and also with the annular fixed wheel D. Pinion C has 15 teeth and is integral with B (B-C being a compound gear wheel). The gear C meshes with the annular wheel E, which is keyed to the machine shaft. If the gear A runs at 1200 rpm, find the speed of the gear E. (4)

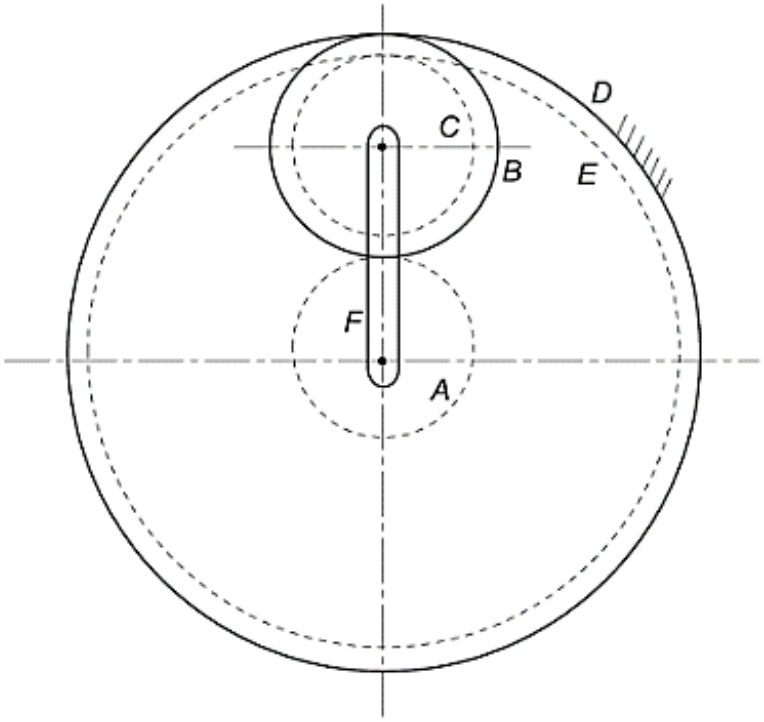

Figure 2

4) The number of teeth on a 20° full depth involute (FDI) gear is 22 and module is 12 mm. calculate pitch circle radius, thickness of the tooth at the pitch circle, base circle radius, thickness of tooth at the base circle. (3)

A)

B) State Kennedy's theorem. Explain Klein's construction to determine the acceleration of a slider crank mechanism. (3)

C) Derive the equation for the minimum number of teeth on the pinion to avoid interference between two involute gears. (4)

5) Derive an expression to determine the torque transmitted in epicyclic gear trains. (3)

A)

B) For the linkages shown in figure 3, the angular velocity of link OA is 100 rad/s (clockwise), and the corresponding angular acceleration is 1700 rad/s^2 (counter clockwise direction). For the given position shown in figure 3, using the graphical method find the angular velocity of link AC and the velocity of point B (using relative velocity method only). Also, find angular acceleration of link CD and the acceleration of point B. (7)

The dimensions of the link are, AO = 120 mm, AC = 160 mm, AB = BC = 120 mm, CD= 120 mm.

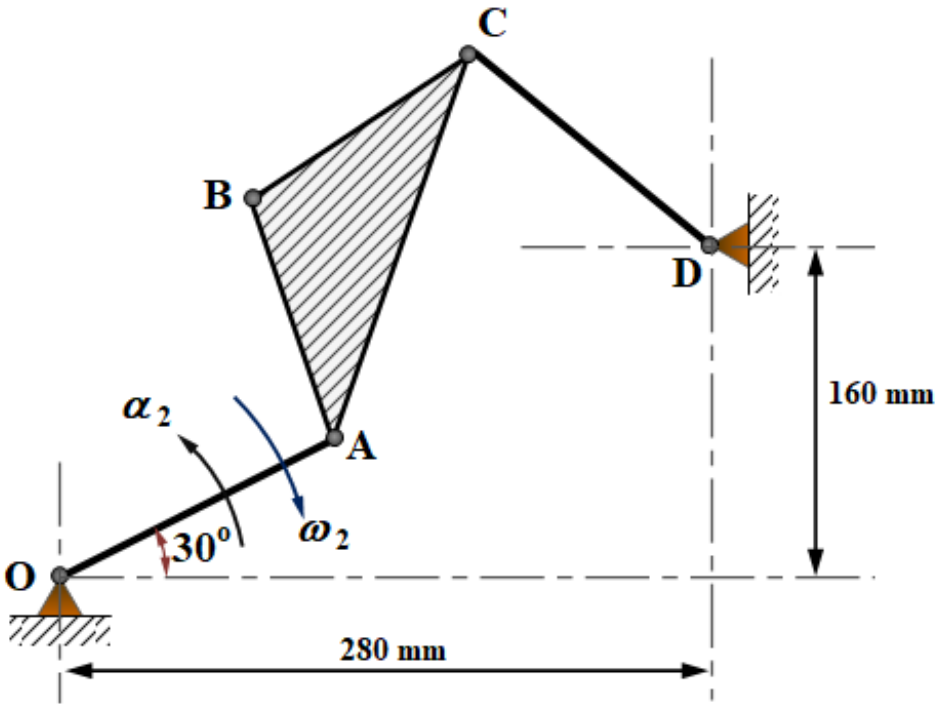

Figure 3

-----End-----