Exam Date & Time: 01-Feb-2023 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

THIRD SEMESTER B.TECH END SEMESTER MAKE-UP EXAMINATIONS, JAN-FEB 2023

KINEMATICS OF MACHINERY [MME 2151]

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

A

Answer all the questions.

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

1)   Automobile steering gear mechanism play a vital role during driving, differentiate the significant
            aspects of Ackermann and Davis steering gear mechanisms.

                                                                                                          (4)

A)

B)   For the mechanisms used in various industrial applications as presented in figure a to d, examine whether
     these are kinematic chains or not.

                                                                                                          (4)
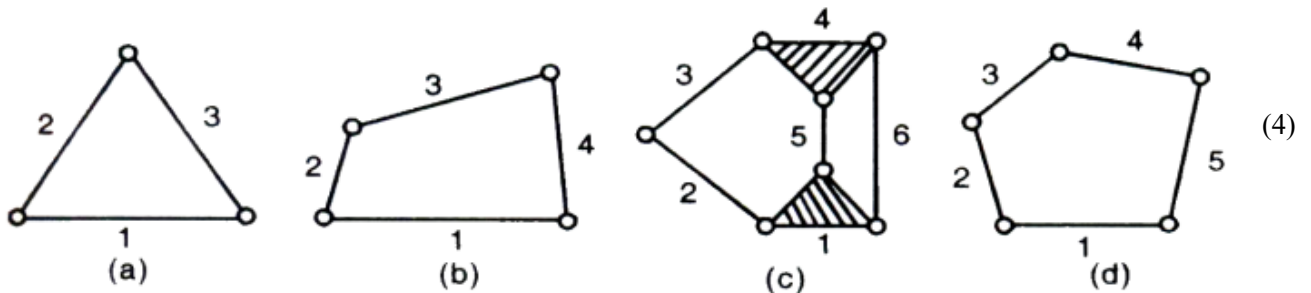
C)   Discuss the significance of three centre inline theorem with a visual representation.

                                                                                                          (2)

2)   In a four bar chain ABCD, AD is fixed and is 15 cm long. The crank AB is 4 cm long and rotates at
            120 rpm clockwise, while the link CD = 8 cm oscillates about D. BC and AD are of equal length.
            Find the velocity and angular velocities of all the links, when angle BAD = 60˚. Use relative

A)   velocity approach. Use graph sheet. All dimensions are in cm.

                                                                                                          (4)
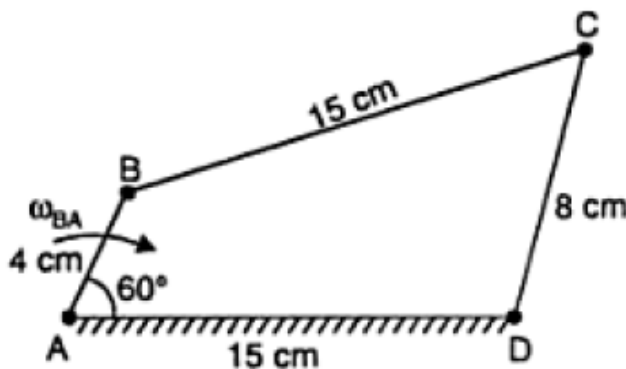
B)   For the four bar mechanism as shown in figure 2b, the angle AP_1P_2 is 60˚ and the angular velocity   (4)
            is 10 rad/s and angular acceleration is 30 rad/s^2 both in clockwise direction. The velocities Vap_1=
            3m/s, Vba= 2.1m/s, Vbp_2= 2.25m/s. Determine the angular and total acceleration of all links. Use
            relative acceleration graphical approach. Use graph sheet. All dimensions are in mm.
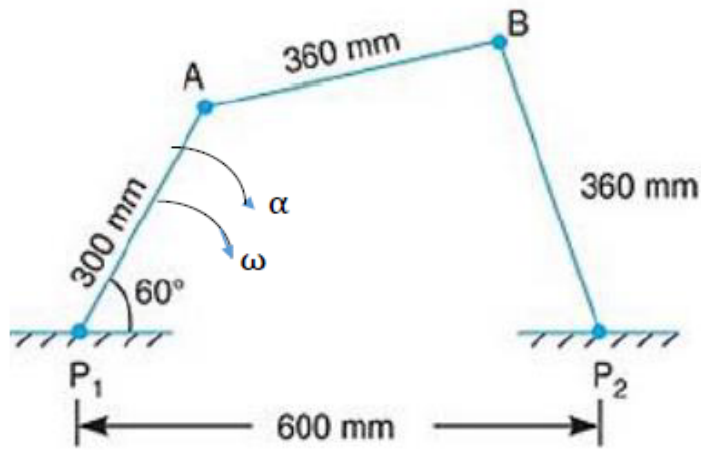
All dimensions are in mm

Figure 2b

C)   Discuss the significant steps involved for determining the velocity of a four bar mechanism using instantaneous centre approach.   (2)

3)   Two mating gears have 40 and 20 involute teeth of module 10 mm and 20° pressure angle. The addendum is one module. Does the interference occur? If pinion is the driving member and rotating clockwise.   (3)

A)

B)   Elucidate the significance of law of gearing for a pair of gears in mesh, prove its statement and deriving the expression for the same with appropriate visual representation.   (3)

C)   A pinion having 25 teeth drives a gear having 60 teeth. The tooth profile is involute with pressure angle of 20°, module 8 mm and addendum equal to 1 module. Determine: (i) length of the path of contact, (ii) arc of contact and (iii) the contact ratio.   (4)

4)   With a neat visual mapping, discuss the significance of reverted gear train mechanism used in lathe machine tools.   (3)

A)

B)   An epicyclic gear train is as shown in figure 4b, consists of an arm and two gears A and B having 30 and 40 teeth respectively. The arm rotates about the centre of the gear A at a speed of 80 rpm counter clockwise. Determine the speed of the gear B if (a) the gear A is fixed.   (3)
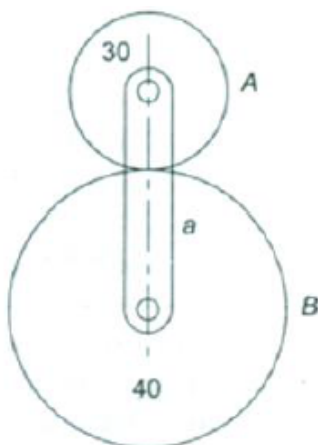

Figure 4b

C)   A flat belt drive transmits 10 kW of power from a shaft rotating at 300 rpm to another shaft rotating   (4) at 150 rpm. The belt is 10 mm thick. The diameter of the smaller pulley is 500 mm and the two

shafts are 6 m apart. The coefficient of friction is 0.25. If the maximum stress in the belt is limited to 3.2 N/mm^2, find the width of the belt for (a) an open belt drive, and (b) a cross belt drive.

5)

A)   A cam with 40 mm minimum radius is rotating clockwise at 250 rpm and imparts the following motion to knife edge follower. The conditions are as follows: Lift = 35 mm; follower rises 120° of cam rotation with simple harmonic motion (SHM); follower dwells for 60° of cam rotation; follower returns during 90° of cam rotation with uniform acceleration and retardation motion (UAR); follower dwells for the remaining period; the axis of the follower is offset towards the right by 10 mm. Draw the profile of the cam and follower. Use graph sheet.   (5)

B)   With neat visual details, discuss the significance of cylindrical cams and spherical cams with suitable application.   (3)

C)   Derive from first principles an expression for the frictional torque of collar thrust bearing with neat visual. Assume uniform intensity of pressure.   (2)

-----End-----