KUMARAGURU
college of technology
character is life

B.E/B.TECH DEGREE EXAMINATIONS: APRIL /MAY 2024

(Regulation 2018)

Fourth Semester

MECHANICAL ENGINEERING

U18MET4003**:** Kinematics of Machinery

COURSE OUTCOMES

CO1:   Apply the fundamental concepts in developing various mechanisms.

CO2:   Analyze velocity and acceleration in planar mechanisms.

CO3:   Synthesize simple mechanisms such as 4-bar and slider crank mechanisms.

CO4:   Construct the cam profile for specific follower motion.

CO5:   Determine appropriate gears for requirements.

CO6:   Compute the parameters in gear trains and determine the speeds in gear boxes.

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

1.   Draw the kinematic diagram and determine the degrees of freedom for the mechanism shown   CO1   [K$_2$]
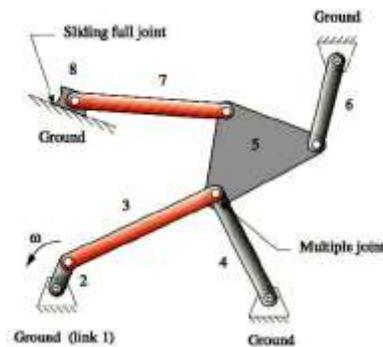in figure 1.

Figure 1

2.   Identify at least three examples each for the following kinematic pairs in machine tools: CO1   [K$_2$]

- Revolute pair
- Prismatic pair
- Helical pair

3. Velocity of point B in the 4-bar mechanism shown in figure 2 is 5 m/s. Find the velocity of point C. Given that, AB=20 mm, BC=35 mm, CD=40 mm, AD=50 mm. Use instantaneous center approach.   CO2   [K₂]
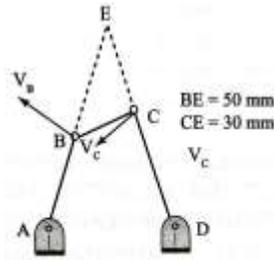

Figure 2

4. Locate Instantaneous centres for the mechanism shown in figure 3   CO2   [K₂]
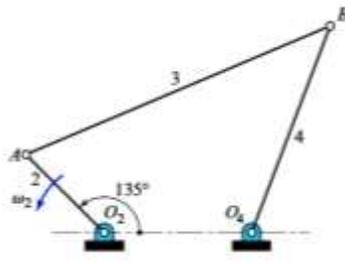

Figure 3

5. Brief types of mechanism synthesis.   CO3   [K₁]

6. Classify cam according to shapes.   CO4   [K₁]

7. Define cam pressure angle.   CO4   [K₁]

8. State law of gearing.   CO5   [K₁]

9. What are the effects of variations in module of a spur gear.   CO5   [K₂]

10. The gearing of a machine tool is shown in figure 4. The motor shaft is connected to gear A and rotates at 975 rpm. The gear wheels B, C, D and E are fixed to parallel shafts rotating together. The final gear F is connected to output shaft. What is the speed of gear F? The number of teeth on gears A to F are 20,50,25,75,26,65 respectively.   CO6   [K₁]
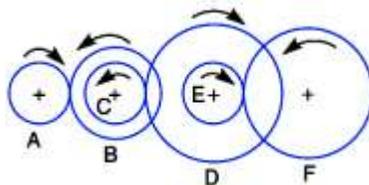

Figure 4

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. a) Identify any two applications each for the following mechanisms and explain briefly:　　6　CO1　[K₂]

      i.   Intermittent motion mechanism

      ii.   Pantograph linkage

      iii.   Toggle mechanism

      iv.   Double rocker mechanism

   b) Explain with neat sketches, the inversions of a four-bar mechanism.　　10　CO1　[K₂]

12. a) Two points A and B located along the radius of a wheel as shown in figure 5, have speeds of 50 and 100 m/s, respectively. The distance between the points AB = 250 mm. Determine the diameter and angular velocity of the wheel.　　6　CO2　[K₃]
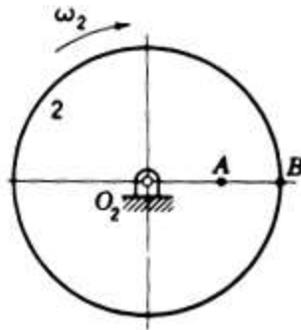

Figure 5

   b) In the four-bar mechanism shown in figure 6, the lengths of the various links are: AB = 190 mm, BC= CD=280 mm, AD= 500 mm, input angle $\theta=55^0$. The crank AB rotates at 10 rad/s in the clockwise direction. Determine (a) the accelerations at B and C, and (b) angular accelerations of BC and CD. Given that, $_bV_c$ = 1.65 m/s (counter clockwise) and $_dV_c$ = 1.1 m/s (clockwise). Refer the following figure for velocity polygon.　　10　CO2　[K₄]

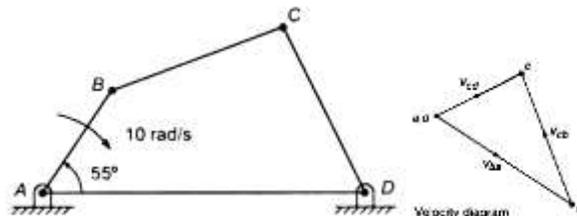Figure 6

13. A four-bar mechanism is to be designed to satisfy the function: $y = x^{1.5}$, $1 \leq x \leq$ 16   CO3   [K₃]
4. Find out the three precision positions using Chebyshev spacing to find accuracy points. Assume θ to vary from 30^0 to 120^0 and ϕ from 60^0 to 130^0. The length of the fixed link is 30 mm.

14. A cam with 30 mm as minimum diameter and 50 mm lift is driving the   16   CO4   [K₃]
reciprocating knife edged follower at a speed of 1200 rpm and has to be given the following motions to the follower :

1. Outward stroke during 120° with SHM

2. Dwell for 60°

3. Return during 90° with SHM

4. Dwell during the remaining period

Draw the cam profile, if the cam axis coincides with the follower axis.

15. a) What is interference in gears? Brief the methods to prevent interference.   6   CO5   [K₂]

    b) Two standard involute gears in a mesh have a pressure angle of 20 degree, the   10   CO5   [K₃]
gear ratio is 3 and the number of teeth on pinion is 24. The teeth have a module of 6 mm. The pitch line velocity is 1.5 m/s. The addendum is equal to one module. Determine the angle of action of pinion and the gear and the maximum velocity of sliding.

16. The figure 7 shows, the pinion *A* having 15 teeth is fixed to motor shaft. $Z_b = 20$,   16   CO6   [K₄]
$Z_c = 15$, where B and C are a compound gear wheel. Wheel E is keyed to the machine shaft. Arm *F* rotates about the same shaft on which *A* is fixed and carries the compound wheel *B, C*. If the motor runs at 1200 rpm counter-clockwise, find (a) the speed of the machine shaft, (b) the torque exerted on the machine shaft if the motor develops a torque of 200 Nm with an efficiency of 90%, (c) ratio of the reduction gear.
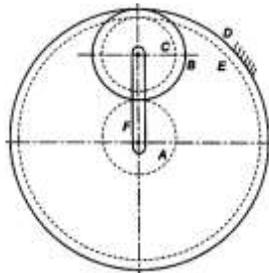

Figure 7

****