B.E/B.TECH DEGREE EXAMINATIONS: NOV / DEC 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:   Synthesise 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.   Infer the degrees of freedom for the given kinematic linkages.   CO1   [K_2]

2.   Define Grashof's law.   CO1   [K_1]

3.   Relate and prove the 'Aronhold Kennedy's Theorem' of three instantaneous centres   CO2   [K_2]

4.   Compare the centripetal and tangential acceleration of a mechanism   CO2   [K_2]

5.   What do you mean by dimensional synthesis of a mechanism ?   CO3   [K_1]

6.   What is a displacement diagram ? why is it necessary to draw it before drawing a cam profile   CO4   [K_2]

7. How are the cams classified   CO4   [K$_1$]

8. The number of teeth on each of the two equal spur gears in mesh are 40. The teeth have 20°   CO5   [K$_2$]
involute profile and the module is 6 mm. calculate the circular pitch of the gear.

9. Define law of gearing   CO5   [K$_1$]

10. What do you understand by 'gear train'? Outline the list of various types of gear trains.   CO6   [K$_2$]

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

11. a) How are the kinematic pairs classified ? Explain any two with examples   8   CO1   [K$_2$]

    b) Sketch and explain the Oldham's coupling   8   CO1   [K$_2$]

12. In the toggle mechanism shown in Fig, The crank OA rotates at 210 rpm counter-   16   CO2   [K$_3$]
clockwise increasing at the rate of 60 rad/s^2. For the given configuration,
determine

      (a) Velocity of slider D and the angular velocity of link BD

      (b) Acceleration of slider D and the angular acceleration of link BD

13. Design a slider-crank mechanism to coordinate three positions of the input link   16   CO3   [K₃]
and the slider for the following angular and linear displacements of the input link
and the slider respectively:

14. Design a cam for operating the exhaust valve of an oil engine. It is required to   16   CO4   [K₃]
give equal uniform acceleration and retardation during opening and closing of the
valve each of which corresponds to 60° of cam rotation. The valve must remain
in the fully open position for 20° of cam rotation. The lift of the valve is 37.5 mm
and the least radius of the cam is 40 mm. The follower is provided with a roller
of radius 20 mm and its line of stroke passes through the axis of the cam.

15. The following data relate to a pair of 20° involute gears in mesh : Module = 6   16   CO5   [K₃]
mm, Number of teeth on pinion = 17, Number of teeth on gear = 49 ; Addenda
on pinion and gear wheel = 1 module. Find : 1. The number of pairs of teeth in
contact ; 2. The angle turned through by the pinion and the gear wheel when one
pair of teeth is in contact, and 3. The ratio of sliding to rolling motion when the
tip of a tooth on the larger wheel (i) is just making contact, (ii) is just leaving
contact with its mating tooth, and (iii) is at the pitch point.

16. In a reverted epicyclic gear train, the arm A carries two gears B and C and a   16   CO6   [K₃]
compound gear D - E. The gear B meshes with gear E and the gear C meshes
with gear D. The number of teeth on gears B, C and D are 75, 30 and 90
respectively. Find the speed and direction of gear C when gear B is fixed and the
arm A makes 100 r.p.m. clockwise.

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