



**B.E DEGREE EXAMINATIONS: NOV/DEC 2022**

(Regulation 2018)

Fifth Semester

**AUTOMOBILE ENGINEERING**

U18AUT5103: Mechanics of Machines

**COURSE OUTCOMES**

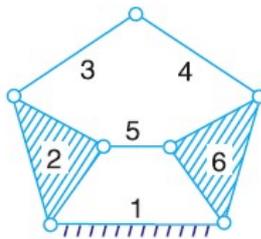
- CO1:** Calculate the velocity and acceleration of simple mechanisms.  
**CO2:** Create the cam profile for different follower motions.  
**CO3:** Identify the different gear trains and calculate the gear ratio.  
**CO4:** Solve and draw the plots for the static and dynamic balancing of various mechanical systems.  
**CO5:** Evaluate the free and forced vibrations for different applications.  
**CO6:** Summarize the kinematic aspect of the mechanisms in automotive applications

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**  
**PART A (10 x 2 = 20 Marks)**  
**(Answer not more than 40 words)**

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|---|-----------------------|
| 1. Differentiate between a Machine and a Structure                                    | CO6 [K <sub>2</sub> ] |
| 2. Determine the mobility (degrees of freedom) of the mechanism shown in given figure | CO1 [K <sub>2</sub> ] |



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|--|-----------------------|
| 3. Classify the cam follower according to their shape and motion.              | CO2 [K <sub>1</sub> ] |
| 4. Draw free hand sketch of displacement diagram for a simple harmonic motion. | CO2 [K <sub>2</sub> ] |
| 5. Classify the various types of gear trains.                                  | CO3 [K <sub>2</sub> ] |
| 6. What is Epicyclic gear train?   | CO3 [K <sub>2</sub> ] |
| 7. Why is balancing of rotating parts necessary for high-speed engines?        | CO4 [K <sub>1</sub> ] |
| 8. Define Hammer blow.   | CO4 [K <sub>1</sub> ] |
| 9. What is meant by free vibration and forced vibrations?                      | CO5 [K <sub>2</sub> ] |
| 10. How can we measure damping ratio?  | CO5 [K <sub>2</sub> ] |

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

11. a) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. Determine: 1. Linear velocity and acceleration of the midpoint of the connecting rod, and 2. angular velocity and angular acceleration of the connecting rod, at a crank angle of  $45^\circ$  from inner dead centre position. CO1 [K<sub>3</sub>]

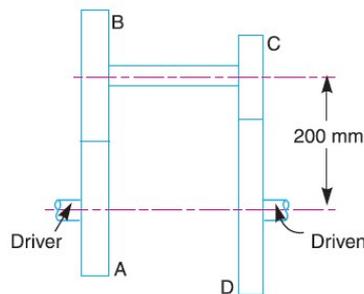
12. a) A cam is to be designed for a knife edge follower with the following data : CO2 [K<sub>3</sub>]
1. Cam lift = 40 mm during  $90^\circ$  of cam rotation with simple harmonic motion.
  2. Dwell for the next  $30^\circ$ .
  3. During the next  $60^\circ$  of cam rotation, the follower returns to its original position with simple harmonic motion.
  4. Dwell during the remaining  $180^\circ$ .

Draw the profile of the cam when

- (a) the line of stroke of the follower passes through the axis of the cam shaft, and
- (b) the line of stroke is offset 20 mm from the axis of the cam shaft.

The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.

13. a) The speed ratio of the reverted gear train, as shown in Figure below, is to be 12. The module pitch of gears A and B is 3.125 mm and of gears C and D is 2.5 mm. Calculate the suitable numbers of teeth for the gears. No gear is to have less than 24 teeth. CO3 [K<sub>3</sub>]



- b) Two shafts A and B are co-axial. A gear C (50 teeth) is rigidly mounted on shaft A. A compound gear D-E gears with C and an internal gear G. D has 20 teeth and gears with C and E has 35 teeth and gears with an internal gear G. The gear G is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft B. Sketch the arrangement and find the number of teeth on internal gear G assuming that all gears have the same module. If the shaft A rotates at 110 r.p.m., find the speed of shaft B. 10 CO3 [K<sub>3</sub>]
14. a) A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. CO4 [K<sub>3</sub>]
15. a) A shaft 50 mm diameter and 3 metres long is simply supported at the ends and carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. The Young's modulus for shaft material is 200 GN/m<sup>2</sup>. Find the frequency of transverse vibration. 8 CO5 [K<sub>3</sub>]
- b) An instrument vibrates with a frequency of 1 Hz when there is no damping. When the damping is provided, the frequency of damped vibrations was observed to be 0.9 Hz. Find 1. the damping factor, and 2. logarithmic decrement. 8 CO5 [K<sub>3</sub>]
16. a) Sketch and explain the inversion of a four-bar mechanism, all the four pairs are turning pairs. CO6 [K<sub>2</sub>]

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