Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIFTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), DECEMBER 2023
MECHANICAL ENGINEERING
(2020 SCHEME)

Course Code : **20MET301**

Course Name: **Mechanics of Machinery**

Max. Marks : **100** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

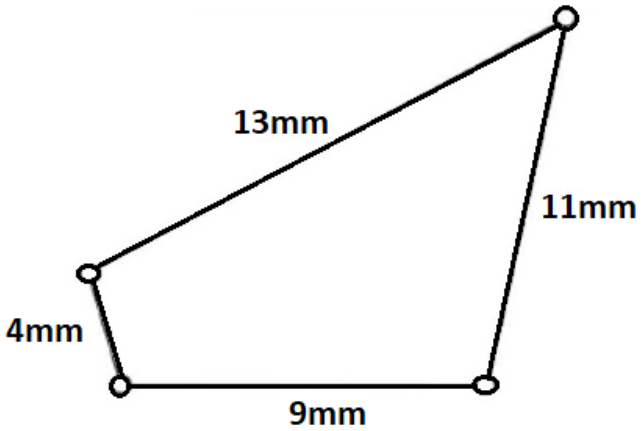
1. Define Degrees of Freedom. What is its significance?
2. What is instantaneous center?
3. Explain Coriolis component of acceleration.
4. Define the following terms as applied to a cam with simple sketches
   (i) Pitch circle and (ii) Pressure angle
5. List the fundamental condition that must be satisfied while designing the profiles for the teeth of gear wheels.
6. With examples, explain number synthesis.
7. What are the conditions for static equilibrium of a body?
8. Discuss the effect of the gyroscopic couple on a two wheeled vehicle when taking a turn
9. "Two masses in different planes are necessary to rectify dynamic unbalance" Give proper comments for the aforesaid statement.
10. What is primary and secondary unbalance in reciprocating engines?

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Find the inversions of the chain given in figure below



(12)

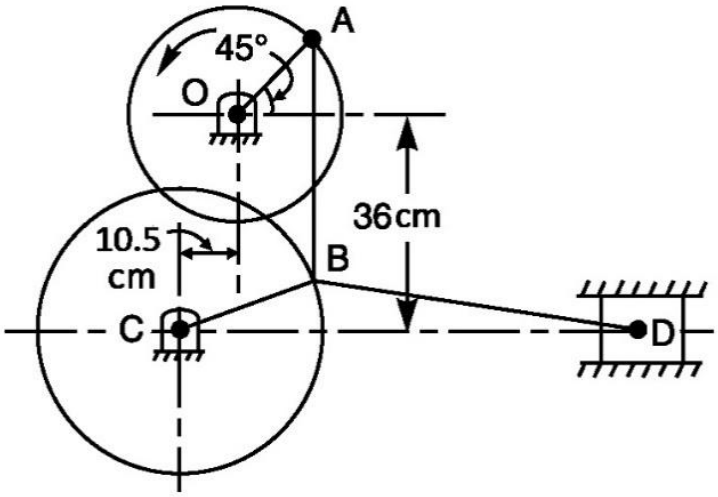
b) State Kennedy's theorem. (2)

OR

12. In the toggle mechanism, as shown in figure below, the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter-clockwise direction at a speed of 180 rpm. The dimensions of various links are as follows: (14)
OA = 18 cm; CB = 24 cm; AB = 36 cm; BD = 54 cm.

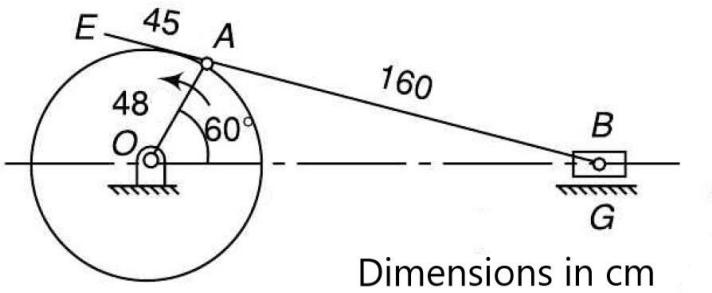
For the given configuration, find:

i. Velocity of slider D,
ii. Angular velocity of links AB, CB and BD;
iii. Velocities of rubbing on the pins of diameter 3 cm at A and D



MODULE II

13. For the configuration of a slider mechanism in the figure shown below. Calculate:
(i) The acceleration of the slider at B
(ii) The acceleration of point E
(iii) The angular acceleration of link AB. OA rotates at 20 rad/s counter-clockwise. (14)



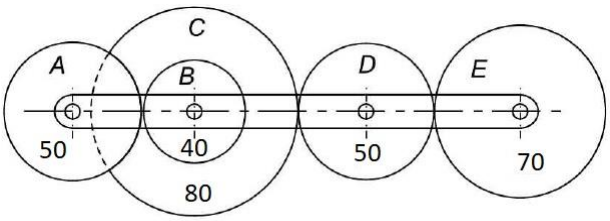
OR

14. Draw the profile of a cam operating a roller reciprocating follower and with the following data.
Maximum radius of cam = 25mm
Lift = 30mm
Roller diameter = 15mm
The cam lifts the follower for 120° with SHM followed by a dwell period of 30°. Then the follower lowers down during 150° of cam rotation with uniform acceleration and deceleration followed by a dwell period. If the cam rotates at a uniform speed of 150rpm, calculate the maximum velocity and acceleration of the follower during the decent period. (14)

MODULE III

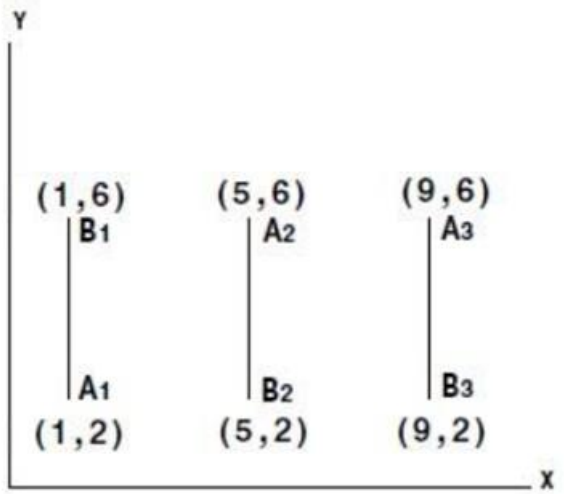
15. a) What do you mean by interference? What are its effects? (4)

b) Figure shows a gear train in which gears B and C constitute a compound gear. The number of teeth are shown along with each wheel in figure. Determine the speed and the direction of rotation of wheels A and E if the arm revolves at 200 rpm clockwise and gear D is fixed. (10)



OR

16. Synthesize a four-bar mechanism to guide a rod AB through three consecutive positions A_1B_1, A_2B_2 and A_3B_3 as shown in figure (14)



MODULE IV

17. Determine the torque required to be applied at the crankshaft of a slider crank mechanism to bring it in equilibrium. The slider is subjected to a horizontal force of 500N and a force of magnitude 1000N applied on the connecting rod at point C acting at an angle of 60°. The dimensions of various linkages are OA=250mm, AB=750mm, AC=250mm and ∠BOA =40° (14)

OR

18. The rotor of the turbine of a ship has a mass of 3000 kg and rotates at a speed of 3500 rpm counter clockwise when viewed from stern. The rotor has a radius of gyration of 0.4m.
Determine the gyroscopic couple and its effects when
    (i) The ship steers to the left in a curve of 100m radius at a speed of 20 knots (1 knot = 1860 m/hr) (14)
    (ii) The ship pitches 6° above and 6° below the normal position and the bow is descending with its maximum velocity – the pitching motion is simple harmonic with a periodic time of 40seconds.

MODULE V

19. A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine: (14)
    (i) The magnitude of the masses at A and D
    (ii) The distance between planes A and D and
    (iii) The angular position of the mass at D.

OR

20. Explain the balancing of the following engines (Neat diagrams are mandatory) (14)
    (i) Twin cylinder V-engine
    (ii) Four cylinder in-line engine.

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