

Faculty of Engineering

End Semester Examination May 2025

ME3CO47 Kinematics of Machines

Programme	:	B.Tech.	Branch/Specialisation	:	ME
Duration	:	3 hours	Maximum Marks	:	60

Note: All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Section 1 (Answer all question(s))

Marks CO BL
1 1 1

Q1. Which of the following mechanism is used to enlarge or reduce the size of a drawing?

Rubric	Marks
Pantograph	1

- Grasshopper mechanism
- Pantograph
- Watt mechanism
- Peaucellier's mechanism

Q2. Which of the following statement is not true?

1 1 1

Rubric	Marks
A structure transforms the available energy into some useful work	1

- Parts of a machine move relative to one another
- Members of a structure transmit forces only
- Members of a structure do not move relative to one another
- A structure transforms the available energy into some useful work

Q3. The total number of instantaneous centers for a mechanism consisting of n links are

1 1 1

Rubric	Marks
$n(n-1)/2$	1

- n
- $(n-1)/2$
- $n/2$
- $n(n - 1)/2$

Q4. Coriolis component of acceleration exists in which of the following mechanisms?

1 1 1

Rubric	Marks
Whitworth quick return motion mechanism	1

- Beam engine
- Elliptical trammels
- Watt's indicator mechanism
- Quick return mechanism

Q5. Which motion of follower is best for high speed cams?

1 1 1

Rubric	Marks
Cycloidal motion follower	1

- SHM follower motion Uniform acceleration and retardation of follower motion
 Cycloidal motion follower All of the above

Q6. Which of the following statements is false for SHM follower motion?

1 1 1

Rubric	Marks
The acceleration is zero at the beginning and the end of each stroke	1

- SHM can be used only for moderate speed purpose
 The jerk is maximum at the mid of each stroke The acceleration is zero at the beginning and the end of each stroke
 Velocity of follower is maximum at the mid of each stroke

Q7. The Primary function of Gear is to-

1 1 1

Rubric	Marks
Transmit power	1

- Transmit power maintaining constant velocity ratio
 Generate heat Store energy
 None of the above

Q8. What is Gear Ratio of a gear train having 20 Tooth gear driving a 40 tooth gear?

1 1 2

Rubric	Marks
2	1

- 1 2
 0.5 4

Q9. Gyroscopic effect is not observed in which of the following actions performed by the ships?

1 1 1

Rubric	Marks
Rolling	1

- Rolling Pitching
 Steering All of the above

Q10. What is the effect of reactive gyroscopic couple when aeroplane takes right turn and propeller rotates in clockwise direction when observed from rear end?

1 2 2

Rubric	Marks
The tail of the aeroplane is raised and nose is dipped	1

- The tail of the aeroplane is dipped and nose is raised
 Reactive gyroscopic couple has no effect when propeller rotates in clockwise direction The tail of the aeroplane is raised and nose is dipped
 None of the above

Section 2 (Answer all question(s))

Marks CO BL

Q11. State and write any four inversions of Four Bar Mechanism.

2 1 1

Rubric	Marks
State and write any four inversions of Four Bar Mechanism. 0.5 marks for each inversion.	2

Q12. Explain the difference between higher pairs and lower pairs.

3 1 1

Rubric	Marks
award one number for each difference between higher pairs and lower pairs	3

Q13.(a) What is inversion? Explain with help of suitable sketches the inversion of slider crank chain mechanism.

5 3 3

Rubric	Marks
What is inversion	2
Explain with help of suitable sketches the inversion of slider crank chain mechanism	3

(OR)

(b) What is quick return mechanisms? Discuss Whitworth's quick return mechanism in detail.

Marks CO BL

2 2 2

Q14. How graphical method is applied for velocity analysis of planer mechanisms?

Rubric	Marks
Explanation of Graphical Method is applied for Velocity Analysis of Planer Mechanisms	2

Q15. Explain Aronhold-Kennedy three centres in line theorem.

3 1 2

Rubric	Marks
Explanation of Aronhold-Kennedy Three Centres in Line Theorem.	3

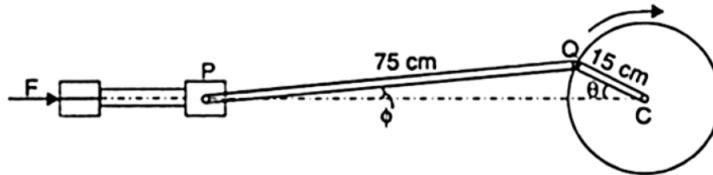
Q16. (a) Draw and explain Klien's construction for slider crank mechanism.

5 3 3

Rubric	Marks
Draw Klien's construction	2
explanation of Klien's construction for slider crank mechanism.	3

(OR)

- (b)** A steam engine has a crank radius of length 15 cm and connecting rod of length 75 cm as shown in figure. The Crank CQ rotates in a clockwise direction with a constant speed of 300 rpm. Calculate velocity of piston P at the instant when the angle theta = 30 degree.



Rubric	Marks
Graphical Diagram	3
Correct Explanation	2

Section 4 (Answer all question(s))

Marks CO BL
2 2 2

Q17. Give a brief classification of cams.

Rubric	Marks
Give a brief Classification of Cams.	2

Q18. Give a brief classification of followers.

Rubric	Marks
classification of Followers	2

Q19. (a) Deduce an expression of displacement, velocity and acceleration when a knife edge follower moves with uniform velocity over cam. Assume suitable data.

6 2 2

Rubric	Marks
Plotting the graph	3
Derrivation of displacement , velocity and acceleration	3

(OR)

- (b)** Design a cam for operating the exhaust valve of an oil engine. It is required to give uniform acceleration and retardation during opening and closing of valve each of which corresponds to 60 degree of cam rotation . the valve must remain in fully open position for 20 degree of cam rotation. The lift of valve is 37.5 mm and the least radius of 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.

Rubric	Marks
Graphical Diagram	3
CAM	Profile 3

Section 5 (Answer all question(s))

Marks CO BL

- Q20.** Classify gears on the basis of shafts' layout. What are the different materials used for gears? Write two advantages of using gears for power transmission.

4 2 2

Rubric	Marks
Classification and Material of Gears (1 Mark each)	2
Different materials	1
two advantages of using gears for power transmission.	1

Q21. (a) What is law of gearing? Deduce the condition for constant velocity ratio of toothed wheels.

6 3 1

Rubric	Marks
What is Law of Gearing	1
Deduce the condition for constant velocity ratio of toothed wheels.	3
Sketch of the two meshing bodies	2

(OR)

- (b)** Deduce the formula for minimum number of teeth on the pinion to avoid interference between gear train.

Rubric	Marks
Description of Minimum number of teeth to avoid interference between Gear Train	2
Deduce the formula for Minimum number of teeth	4

Section 6 (Answer all question(s))

Q22. What is gyroscope? Differentiate between spinning and precessional motion in gyroscope.

Marks CO BL

2 3 2

Rubric	Marks
Define Gyroscope	1
Differentiate between spinning and Precessional motion in Gyroscope.	1

Q23. Discuss effect of gyroscopic couple on an aeroplane.

2 2 2

Rubric	Marks
Discuss effect of gyroscopic couple on an aeroplane	2

Q24. (a) Discuss the stability of two wheeler while taking a turn left or right . Deduc an expression of gyroscopic couple generated.

6 2 2

Rubric	Marks
Discuss the stability of two wheeler while taking a turn left or right	3
Deduce an expression of gyroscopic couple generated.	3

(OR)

- (b)** The mass of the motor cycle along with the rider is 180 kg. The height of the center of gravity of total mass is 60 cm above the ground when it moves straight. Each wheel has diameter equal to 70 cm and polar mass moment of inertia of each wheel is 2 kgm^2 . The engine rotates at a speed 5 times the road wheel and engine rotating parts have polar mass moment of inertia equal to 0.2 kgm^2 . Determine the angle of heel required if motor cycle negotiates a curve of radius 100 m at a speed of 108 km/hr.

Rubric	Marks
<p>Solution</p> <p>Solution. Let angle of heel be θ. It is the angle of inclination of the plane of motor cycle with vertical plane.</p> <p>Speed of motor cycle = 108 km/hr</p> <p>\therefore The velocity 'V' = $\frac{108 \times 1000}{60 \times 60} = 30 \text{ m/s}$</p> <p>The radius of wheel 'r' = 0.7 m.</p> <p>Radius of curve, $R = 100 \text{ m}$.</p> <p>The height of C.G. of total mass, 'h' = 0.6 m.</p> <p>The mass moment of inertia of each wheel, 'I_w' = 2 kg m^2</p> <p>The mass moment of inertia of engine rotating parts, 'I_E' = 0.2 kg m^2</p> <p>The total mass of motor cycle along with rider 'M' = 180 kg</p> <p>Therefore, weight $W = M \times g = 180 \text{ g Newton}$</p> <p>Engine rotates at a speed 5 times the road wheel</p> <p>$\therefore G=5$</p> <p>The angle of heel is given by equation (21.6) as</p> $\tan \theta = \frac{\frac{V^2}{R} \left[\frac{(2I_w + GI_E)}{r} + M \right]}{Wh}$ $= \frac{30^2}{100} \left[\frac{(2 \times 2 + 5 \times 0.2)}{0.7} + 180 \times 0.6 \right] = \frac{9}{180 \times 9.81} \left\{ \frac{5}{0.7} + 180 \times 0.6 \right\}$ <p>or $\tan \theta = 0.978$</p> <p>or $\theta = 44.36^\circ$. Ans.</p>	6
