

Faculty of Engineering

End Semester Examination May 2025

RA3CO52 Kinematics & Dynamics of Machines

Programme	:	B.Tech.	Branch/Specialisation	:	RA
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
Q1. According to Grashof's criterion, for a four-bar linkage to have continuous relative motion, the sum of the shortest and longest link should be-				1 1 1
<input type="radio"/> Equal to the sum of the remaining two links			<input type="radio"/> Greater than the sum of the remaining two links	
<input checked="" type="radio"/> Less than or equal to the sum of the remaining two links			<input type="radio"/> Independent of the remaining links	
Q2. Which of the following is an inversion of a four-bar mechanism?				1 1 1
<input type="radio"/> Elliptical trammel			<input type="radio"/> Whitworth quick return mechanism	
<input type="radio"/> Beam engine mechanism			<input checked="" type="radio"/> Double crank mechanism	
Q3. In a cam-follower system, which type of motion produces the least acceleration at the beginning and end of the stroke?				1 1 1
<input type="radio"/> Uniform motion			<input type="radio"/> Parabolic motion	
<input type="radio"/> Simple Harmonic Motion (SHM)			<input checked="" type="radio"/> Cycloidal motion	
Q4. Pitch point on a cam profile is the point where-				1 1 1
<input type="radio"/> Pressure angle is zero			<input checked="" type="radio"/> Pressure angle has maximum value	
<input type="radio"/> Pressure angle has minimum value but not zero.			<input type="radio"/> None of these	
Q5. Interference in involute gears can be avoided by-				1 1 1
<input checked="" type="radio"/> Increasing the number of teeth			<input type="radio"/> Using cycloidal gears	
<input type="radio"/> Decreasing the pressure angle			<input type="radio"/> Increasing the addendum	
Q6. Which type of gear train is used when high-speed reduction in a compact space is required?				1 3 2
<input type="radio"/> Simple gear train			<input type="radio"/> Compound gear train	
<input type="radio"/> Reverted gear train			<input checked="" type="radio"/> Epicyclic gear train	
Q7. The displacement of a piston in an internal combustion engine is given by which analytical expression?				1 1 1
<input checked="" type="radio"/> $S = r(1 - \cos \theta)$			<input type="radio"/> $S = r\theta$	
<input type="radio"/> $S = r \cos \theta$			<input type="radio"/> $S = r(1 - \sin \theta)$	
Q8. The turning moment diagram of a single-cylinder engine is characterized by-				1 1 1
<input type="radio"/> A uniform torque curve			<input checked="" type="radio"/> A fluctuating torque curve with peaks and valleys	
<input type="radio"/> A straight-line curve			<input type="radio"/> Constant energy throughout the cycle	
Q9. A governor is said to be isochronous when-				1 1 1
<input type="radio"/> It has a range of speed variation			<input checked="" type="radio"/> It maintains constant speed at all loads	
<input type="radio"/> It allows large speed fluctuations			<input type="radio"/> It operates only at high speeds	

Q10. Hunting in a governor refers to-

1 1 1

- Quick adjustment of speed
- Continuous fluctuation of Sleeve of governor about mean position
- Sudden stoppage of the engine
- Excessive friction in the governor mechanism

Section 2 (Answer all question(s))

Marks CO BL

Q11. Define link, mechanism, machine and inversion with sketch.

4 1 1

Rubric	Marks
Each of the term with 1 Mark	4

Q12. (a) Describe with neat sketch the crank and slotted lever mechanism, an inversion of a slider crank mechanism. 6 1 3

Rubric	Marks
Sketch	3
Description and Working	3

(OR)

(b) Classify Kinematic pairs with neat sketches.

Rubric	Marks
Two Marks (One mark for Name and One Mark for Sketch) for each of the three classification	6

Section 3 (Answer all question(s))

Marks CO BL

Q13. How are the cams classified? Describe in detail.

4 2 2

Rubric	Marks
Three Classification with neat sketches (3+1)	4

Q14. (a) A cam is to be designed for knife edge with the following data:

6 2 2

- Cam lift is 40 mm, during 90° of cam rotation with simple harmonic motion.
- Dwell for the next 30°
- During the next 60° of cam rotation the follower returns to its original position with simple harmonic motion
- Dwell during the remaining 180°

Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft.

Rubric	Marks
Displacement Diagram (3 Marks) + Cam Profile (3 Marks)	6

(OR)

(b) Draw the displacement, velocity and acceleration diagrams for a follower when it moves with simple harmonic motion. Derive the expression for velocity and acceleration during outstroke and return stroke of the follower.

Rubric	Marks
Draw the displacement, velocity and acceleration diagrams for a follower when it moves with simple harmonic motion.	3
Derive the expression for velocity and acceleration during outstroke and return stroke of the follower.	3

Section 4 (Answer all question(s))**Marks CO BL****Q15.** Define the terms pitch circle, tooth thickness, circular pitch and pressure angle for spur gear.

4 1 1

Rubric	Marks
1 mark for each of the term	4

Q16. (a) Two gears wheels mesh externally and rate to give a velocity ratio of 3to1. The teeth are of involute from module=6mm, addendum=1module, pressure angle = 20^0 the pinion rotates at 90rpm. Determine minimum no. of teeth on each wheel to avoid interference and the number of pair of teeth in contact.

6 3 3

Rubric	Marks
Minimum no. of Teeth	3
Path of Contact -1 Mark ; Arc of Contact -1 Mark and Contact ratio- 1 Mark	3

(OR)

- (b)** Sketch and explain simple gear train, compound gear train and epicyclic gear train with neat sketches.

Section 5 (Answer all question(s))**Marks CO BL****Q17.** What is a turning moment diagram? How does it differ for single-cylinder and multi-cylinder internal combustion engines?

4 2 2

Rubric	Marks
TM Diagram for Single Cylinder Engine	2
TM Diagram for Multi-Cylinder Engine	2

Q18. (a) Derive an expression for the energy stored in a flywheel and explain its role in regulating speed fluctuations in an engine.

6 3 2

Rubric	Marks
Derivation of Energy expression	4
Role of Flywheel in regulating speed fluctuations in an engine	2

(OR)

- (b)** A reciprocating engine has a crank of radius 100 mm and a connecting rod of length 500 mm. The crank rotates at 600 RPM in the clockwise direction. Determine the velocity of the piston and the acceleration of the piston when the crank makes an angle of 45^0 with the inner dead center (IDC).

Rubric	Marks
Velocity of Piston	3
Acceleration of Piston	3

Section 6 (Answer all question(s))**Marks CO BL****Q19.** Differentiate between centrifugal governors and inertia governors. Provide examples of each type.

4 2 2

Q20. (a) Discuss in detail the effect of varying the controlling force in a governor. How does it influence the engine's operation?

6 5 5

Rubric	Marks
Controlling Force Diagram (2 Marks) + Discussion on the variation of the controlling force with radius of rotation (4 Marks)	6

(OR)

- (b)** A Proell governor has four arms of length 250 mm, each carrying a ball of mass 5 kg. The upper arms are pivoted at a distance of 30 mm from the axis of rotation. The lower arms are connected to the sleeve, which has a mass of 20 kg. The governor rotates at a steady speed of 150 RPM when the radius of rotation of the balls is 200 mm.

Determine the following:

- The height of the governor at the given speed
- The controlling force at this speed
- The governor effort when the speed increases by 5%
- The power of the governor

Rubric	Marks
The height of the governor at the given speed (1.5 marks)	6
The controlling force at this speed (1.5 marks)	
The governor effort when the speed increases by 5% (1.5 marks)	
The power of the governor (1.5 marks)	
