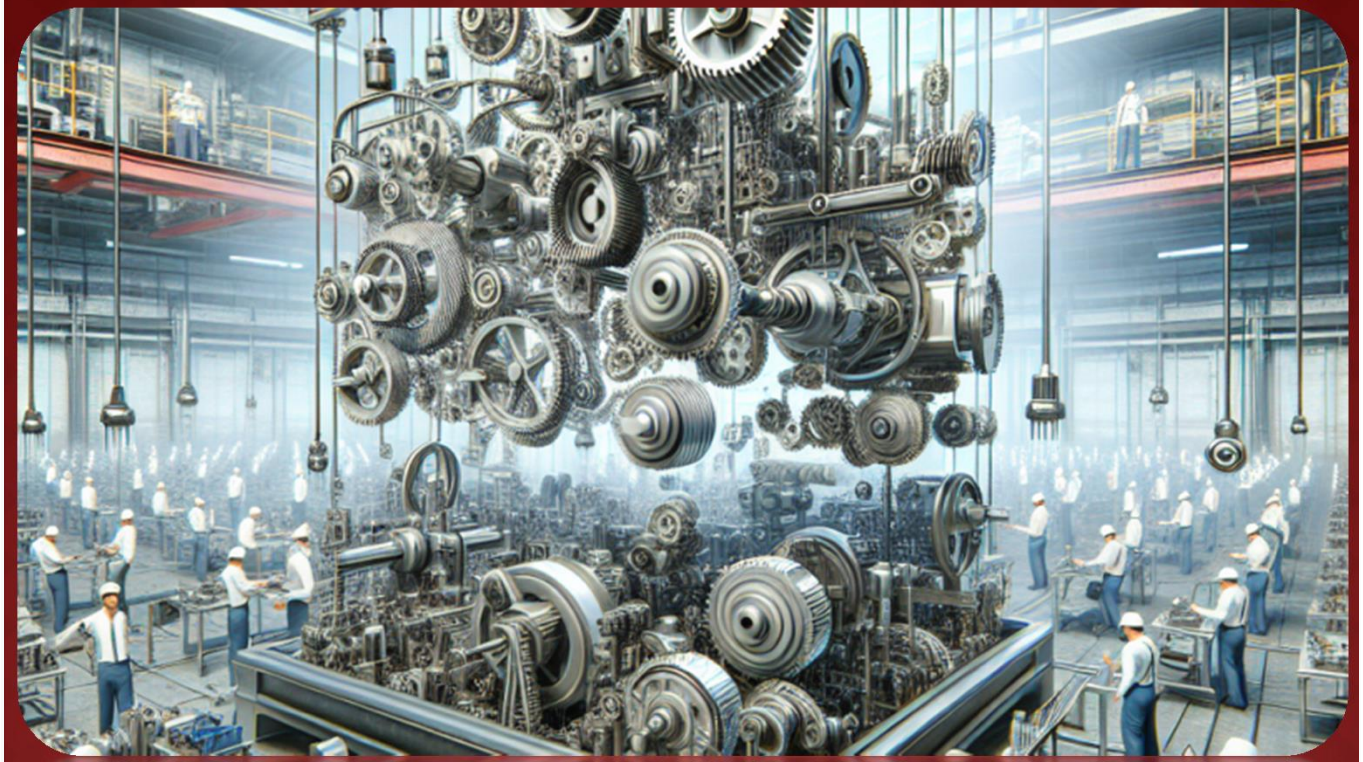
23MET204

MECHANICS OF MACHINES



MECHANICS OF MACHINES - AN OVERVIEW

Presented by

B.Balamurali
AP/MECH

SYLLABUS

- Unit 1 - Mechanisms and Kinematics
- Unit 2 - CAM Design
- Unit 3 - Gear, Gear Trains and Gyroscopes
- Unit 4 - Dynamic Force Analysis
- Unit 5 - Balancing and Vibration

MARK DISTRIBUTION

Description	Internal Assessment 1 (90 mins)	Internal Assessment 2 (90 mins)	Internal Assessment 3 (90 mins)	Group A Assignment	Group B Assignment	Semester Exam (180mins)	Total (100)
Marks	50	50	50	10	10	100	100
Final Marks	10	10	10	10	10	50	100

Internal Assessment	**Semester Exam**	**Group A**	**Group B**
Part A (2 Marks)	Part A (2 Marks)	Role Play	Recap
2X5=10 Marks	2X10=20 Marks	Debate	Summary
Part B (13 Marks)	Part B (13 Marks)	Demo Model	Activity
2X13=26 Marks	5X13=65 Marks	Group Discussion	Class Notes
Part C (14 Marks)	Part C (15 Marks)	Mini Project	
1X14=14 Marks	1X15=15 Marks	Seminar	

Branches of mechanics that deal with the motion of objects

KINEMATICS

- **Definition**: Studies motion without considering the forces or causes behind it.
- **Focus**: Describes how objects move (position, velocity, and acceleration) in space and time.
- **Key Parameters**: Displacement, velocity, acceleration, time.

DYNAMICS

- **Definition**: Studies motion considering the forces and causes behind it.
- **Focus**: Explains why objects move, linking forces and motion.
- **Key Parameters**: Forces (e.g., gravity, friction), mass, torque, energy, momentum.

MECHANISMS AND MACHINES

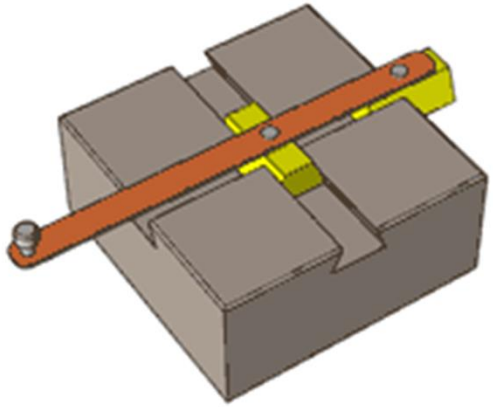
Aspect	Mechanism	Machine
Purpose	Transmit/transform motion	Perform useful work
Energy	Does not focus on energy conversion	Converts energy to perform tasks
Complexity	Simpler system	More complex system
Examples	Gears, cams, linkages	Engines, pumps, cranes
Output	A mechanism is a component of a system focused on motion and force transmission.	A machine uses one or more mechanisms to perform work, often involving energy conversion.

TERMINOLOGY

- **Kinetics -** A branch of physics that deals with the relation of force and changes of motion.
- **Kinematics -** A branch of dynamics dealing with motion in time and space but disregarding mass and forces.
- **Dynamics -** A branch of mechanics that deals with matter (mass) in motion and the forces that produce or change such motion. Mechanics deals with force and energy in their relation to the material bodies.
- **Mechanism -** A combination of rigid bodies (links) connected by kinematic pairs.
- **Machine -** A collection of mechanisms which transmit force from the source of power to the resistance to be overcome.

TERMINOLOGY

- **Kinematic Link -** A component forming a part of a chain; generally rigid with provision at each end for connection to two other links.
- **Kinematic Pair -** A joint which is formed by the contact between two bodies and allows relative motion between them.
- **Kinematic Chain -** A kinematic chain is an assemblage of links by pairs. When one link of a kinematic chain is held fixed, the chain is said to form a mechanism. The fixed link is called the ground link or frame.



DEGREES OF FREEDOM

The degrees of freedom of a mechanical system refer to the number of independent parameters or variables required to completely specify the position and orientation of the system in space.

Formula for Planar Mechanisms:

Gruebler's equation:

$$DOF=3(n-1)-2j-h$$

Where:

n: Number of links (including the fixed link).

j: Number of lower pairs (e.g., revolute or prismatic joints).

h: Number of higher pairs (e.g., cams or gear contacts).

Formula for Spatial Mechanisms:

$$DOF=6(n-1)-5j1-4j2-3j3-2j4-j5$$

Where:

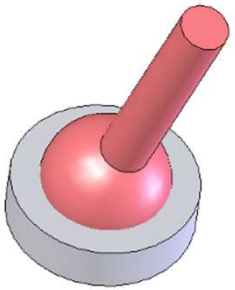
jx represents joints with x constraints.

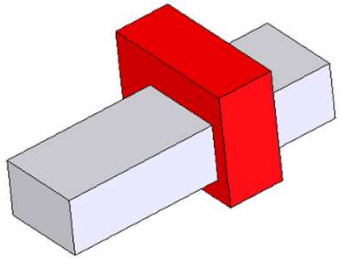
KINEMATIC PAIRS

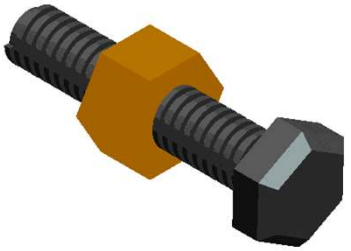
LOWER KINEMATIC PAIRS - Surface contact pairs are lower pairs.

The commonly used lower pairs include

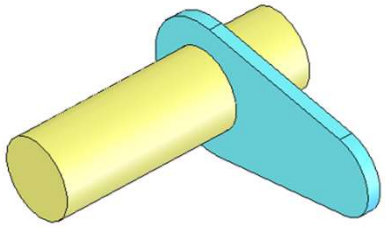
- Revolute Pair
- Prismatic Pair
- Screw Pair
- Cylindrical Pair
- Spherical Pair
- Planar Pair

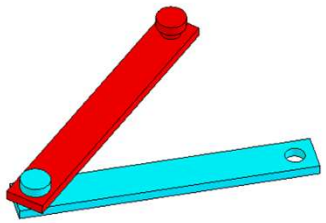


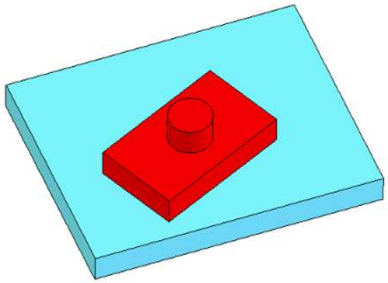




HIGHER KINEMATIC PAIRS – Have either a line contact or a point contact.







ASSESSMENT !!!