SAULT COLLEGE OF APPLIED ARTS A TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title:	MECHANICS OF MACHINES
Code No.:	MCH 204-3
Program:	MECHANICAL TECHNOLOGY
Semester:	
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MECHANICS OF MACHINES — MCH 204-3

Course Name — Course Number

PHILOSOPHY/GOALS:

METHOD OF ASSESSMENT (GRADING METHOD)

REFERENCE
TEXTBOOK(S):

Mechanics of Machinery - Ham, Crane & Rogers (McGraw-Hill)

MECHANICS OF MACHINES

MCH 204-3

TOPIC NO.	TOPIC INFORMATION
1	Mechanisms - definitions, fundamentals
2	Displacement Diagrams
3	Relative Velocities
4	Instant Centres
5	Velocity Polygon

MECHANICS OF MACHINES

MTY-3

Part #1 '•Mechanisms[1]'

General Objective:

To have a basic understanding of what the topics covered in Mechanics of Machines involve and a specific understanding of the definitions and concepts involved.

Specific Objectives;

1. To be able to define:
   i) Kinematics
   ii) Statics
   iii) Kinetics
   iv) Dynamics
2. To be able to state a definition of mechanics of machinery.
3. To be able to define: a) MACHINE, b) MECHANISM and state their main functions.
4. To be able to discuss what is involved in Kinematics of Machinery and Dynamics of Machinery*
5. To be able to define:
   i) PLANE MOTION
   ii) TRANSLATION
   iii) ROTATION
   iv) SPACE MOTION
   v) FREE MOTION
   vi) CONSTRAINED MOTION
6. To be able to state two types of space motion.
7. To be able to define:
   i) CYCLE
   ii) PERIOD
   iii) PHASE
8. To be able to give examples of the above definitions.

Part #1 Mechanisms - cont'd

9. To be able to define:
   i) CONTINUOUS MOTION
   ii) INTERMITTENT MOTION
   iii) RECIPROCATING MOTION
   and state examples of these motions.

10. To be able to define:
   i) PAIRING ELEMENTS
   ii) PAIRS
   iii) PARING

11. To be able to state the difference between "LOWER" and "HIGHER" pairs and give examples of each.

12. To be able to define "LINK" and label the various links on the skeleton outline of a reciprocating engine.

13. To be able to define:
   i) KINEMATIC CHAIN
   ii) LOCKED KINEMATIC CHAIN
   iii) CONSTRAINED KINEMATIC CHAIN
   iv) UNCONSTRAINED KINEMATIC CHAIN
   and draw sketches of examples of ii, iii, and iv.

14. To be able to state the difference in functions of a MACHINE MECHANISM and STRUCTURE.

*/15. To be able to represent a machine in its SKELETON OUTLINE form. The student should understand how the skeleton outline of a shaper mechanism in fig. l-4(b) was developed from fig. l-4(a).

16. The student will be able to state that the "size of pairing elements has no effect on relative motion of links connected by the pair", and be able to give or draw examples of this.

17. To be able to define INVERSION and give two examples of form, and two examples of inversion of function.

MECHANICS OF MACHINES

MTY 3

Fart #2 - "Displacement Diagrams[1]'

GENERAL OBJECTIVE:

To be able to plot the paths of motion of certain points on mechanisms and also to construct a diagram of the displacement of some point corresponding to the motion or displacement of some other point.

SPECIFIC OBJECTIVES:

1. To be able to draw the displacement diagram of the piston displacement vs. crank positions for a simple single cylinder reciprocating engine.
2. To be able to draw the displacement diagram of the piston displacement vs. crank positions for more complicated engines such as the ATKINSON engine.
3. To be able to define:
   a) LINEAR VELOCITY
   b) ANGULAR VELOCITY
   c) LINEAR ACCELERATION
   d) ANGULAR ACCELERATION
4. To be able to list the following formulas and solve for the required values:

   a) $V_P = rw$

   b) $A^c = r <_p$

   c) $A^n = rw^2_P$

MECHANICS OF MACHINES -.MTY-3

Part #3 "Method of Relative Velocities"

General Objective:

The student will be able to solve for the velocity of any point on a mechanism by the method of RELATIVE VELOCITIES.

Specific Objectives:

1. To be able to list the three results of study of kinematics and dynamics of machinery.
2. To be able to state two reasons for a velocity analysis.
3. To be able to state the definition of VECTOR and SCALAR quantities.
4. To be able to draw a vector indicating MAGNITUDE, DIRECTION and SENSE,
5. To be able to list three examples of: a) Vector quantities, b) Scalar quantities.
6. To be able to add and subtract vectors.
7. To be able to define:
   i) ABSOLUTE MOTION
   ii) RELATIVE MOTION
   iii) RELATIVE VELOCITY

Motion of a Point

8. To be able to state two methods of locating the position of a point.
9. To be able to define:
   i) DISPLACEMENT OF A POINT
   ii) SIMULTANEOUS DISPLACEMENT
10. To be able to define:
   i) Average velocity
   ii) Speed
   iii) instantaneous velocity
   iv) simultaneous velocity

MECHANICS OF MACHINES

MTY-3

Part #3 - Continued

To be able to define:

a) ANGULAR POSITION OF A LINE

b) ANGULAR DISPLACEMENT OF A LINE

c) ANGULAR VELOCITY

To be able to define:

a) Relative Displacement of two points

b) Relative Velocity, and

c) Relative angular velocity of two rigid bodies, and write the vector equations that apply to each case.

To have a basic understanding of the Method of Relative Velocities as applied to two points on the same rigid body.

To be able to state that the velocity of any point of a rigid body is given by the vector sum of the velocity of some other point and the velocity of the first point relative to the second.

To be able to state that the velocity of any point of a rigid body relative to any other point of the body is a vector quantity having a magnitude equal to the product of the angular velocity of the body and the distance between the points and a direction at right angles to the line connecting the points-

To be able to use the Method of Relative Velocities to find the velocity of two of the vertexes of a triangular shaped link, given the velocity and direction of the third point and the direction of the velocity of either of the other two points

To be able to list the following equations and use them in carrying out objective #16.

a) $V_B = V_A + V_{BA}$

b) $V_C = V_A + V_{CA}$

c) $V_C = V_B + V_{CB}$

MECHANICS OF MACHINES

MTY-3

Part #3 - Continued

To be able to use the Method of Relative Velocities to solve for the velocity of points on a simple mechanism, and to be able to draw the Vector diagram, and Velocity Polygon for this simple mechanism.

To be able to use the Method of Relative Velocities as applied to sliding members such as Cams and Gears.

To be able to use the Method of Relative Velocities as applied to more complex mechanisms such as a toggle press.

To be able to use the velocity image idea to solve for velocities of any point on the same link.

The student will be able to state the reason for the Velocity Analysis of a Crank Shaper, in regard to the velocity polygon for one position, analysis for all positions of the crank, the Velocity Space Diagram, the Velocity-time Diagram, and Inertia force of the Ram.

MECHANICS OF MACHINES - MTY-3

Part #4 "Method of Instantaneous Centers'[1]

General Objective:

The student will be able to solve for the velocity of any point on a mechanism by the method of Instantaneous Centers.

Specific Objectives:

1. To be able to state the concept of the method of. instantaneous centers, that any displacement of a body having plane motion may be considered as a pure rotation about some center.
2. To be able to discuss the development of the generalized formula V = Rw as applied to any two points of any rigid body in plane motion.
3. To be able to use the relationship that the instantaneous radii of any two points on any body are perpendicular to the direction of their respective velocities, and where these radii intersect is the instant center.
4. To be able to state that a link having motion of straight-line translation, has instantaneous radii for any two points that are parallel and intersect at infinity.
5. To be able to state the definition of the instantaneous center of any pair of links.
6. To be able to locate I.C.'s using the idea of the instantaneous radii of two points (which are perpendicular to the direction of their velocity) on the same link intersecting at the I.C.
7. To be able to state the difference between "TRANSFER POINTS'* and "CENTERS OF ROTATION".
8. To be able to state the "LAW OF THREE CENTERS".
9. To be able to locate all instantaneous centers by inspection and the law of three centers, and use the bookkeeping method to keep track of them.

10. To be able to use the method of instantaneous centers to find the velocity of any point on the mechanism, given the velocity of another point on the mechanism in the following cases:

i) FOUR LINK MECHANISMS •
ii) SLIDER CRANK MECHANISM
iii) CAMS AND GEARS
iv) COMPLEX MECHANISMS