SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ON

COURSE OUTLINE

COURSE TITLE; MECHANICS OF MACHINES

CODE NO,; MCH204 **SEMESTER;** THREE

PROGRAM; MECHANICAL ENGINEERING TECHNOLOGY

AUTHOR; B. PROUT

DATE; AUG. 1994 **PREVIOUS OUTLINE DATED;** SEPT. 1992

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DATE

COURSE NAME | COURSE NO.
MECHANICS OF MACHINES | **MCH204**

TOTAL CREDITS: THREE

PREREQUISITE(S): DRF101, MCH111

I. PHILOSOPHY/GOALS:

In Mechanics of Machines, the engineering student learns how mechanical principles are applied in various linkages and machines. This study helps to bridge the gap between theory and practical application, specifically relating to mechanical devices.

A fundamental concern for the design of machinery is the motion characteristics of the individual parts that make up the machine. As such, a "Machines" curriculum normally begins with a through study of Kinematics.

In this course, the student will become familiar with the vocabulary of machines and mechanisms, study the properties of motion, and will learn graphical techniques to: a) represent machines and mechanisms in simplified form b) solve for displacement, velocity and acceleration of points or parts of a given mechanism.

II. STPDENT PERFORMANCE OBJECTIVES (OUTCOMES)t

Upon successful completion of this course, the student will be able to:

1.0 Clearly define the fundamental concepts listed below (and applicable components): kinematics, dynamics, machine, mechanism, kinematic diagrams, relative, absolute, link, inversion, link paring, plane motion, translation, rotation, helical motion, spherical motion, continuous motion, intermittent motion, reciprocating motion, cycle, period, phase, dead point, displacement, velocity, acceleration.

1.1 Interpret Kinematic Diagrams for typical mechanisms such as: slider/crank, four-bar, drag link, quick return, toggle, straight line, complex.

II. PERFORMANCE OBJECTIVES (OUTCOMES>. con't:

1.2 Produce in standard convention, neatly drawn, accurately scaled, Kinematic Diagrams for typical mechanisms described above.

1.3 Complete problems involving vectors, including composition and resolution, both graphically and algebraically.

2.0 Solve for motion characteristics of a point in a given body or mechanism.

2.1 Recall formulae and complete calculations involving linear displacement, velocity, and acceleration.

2.2 Recall formulae and complete calculations involving angular displacement, velocity, normal acceleration and tangential acceleration.

2.3 Convert between linear and angular measure.

2.4 Explain the following concepts: simple harmonic motion, absolute motion, relative motion, transmission of motion, line of transmission, angular velocity ratio, sliding contact, rolling contact, positive drive.

2.5 Express algebraically and vectorially the motion of a body using absolute and relative terms.

2.6 Solve angular-velocity ratios between driver and driven links in four-bar mechanisms.

3.0 Produce accurately scaled and neatly drawn displacement diagrams and displacement drawings for points in various mechanisms.

3.1 Define and identify the following terms: displacement diagram, displacement drawing, dead point, home position.

3.2 Analyze displacement drawings to locate positions of peak velocity and peak acceleration.

4.0 Describe unique characteristics and applications of mechanisms such as: four bar, crank-rocker, drag link, slider-crank, scotch-yoke, quick return, straight line, parallel, toggle, oldham coupling, universal joint, constant velocity joint, geneva wheel, ratchet, overrunning clutch.

II. PERFORMANCE OBJECTIVES (OUTCOMES), con't:

5.0 Complete an accurately scaled, graphically based, instantaneous velocity analysis for common mechanisms such as: slider crank, four-bar, direct contact, rolling contact, sliding contact, complex.

5.1 Compile an absolute/relative velocity equation points on any body in motion.

5.2 Solve for and scale the terms of the velocity equation, producing a velocity polygon.

5.3 Analyze a velocity polygon to determine linear velocities of various points in a mechanism.

5.4 Analyze a velocity polygon to solve for angular velocities of the various links in a mechanism.

6.0 Complete an accurately scaled, graphically based, instantaneous acceleration analysis for common mechanisms such as: slider crank, four bar, direct contact, rolling contact, sliding contact, complex.

6*1 Apply the theory of instantaneous centers to determine the direction of normal and tangential acceleration of a point.

6.2 Compile an absolute/relative acceleration equation for points on any body in motion.

6.3 Solve for and scale the vector terms of the acceleration equation, producing a velocity polygon.

6.4 Resolve any acceleration vector into normal and tangential components.

6.5 Analyze an acceleration polygon to determine linear acceleration of the various points in a mechanism.

6.6 Analyze an acceleration polygon to solve for the angular acceleration of the various links in a mechanism.

6.7 Use the concept of proportionality to construct acceleration polygons by image, and to complete a trial solution where there are too many unknowns for a standard solution.

III. TOPICS TO BE COVERED:	**APPROXIMATE HOURS**
1.0 Fundamental concepts	
Terms and definitions	4
Kinematic Diagrams	6
2.0 Properties of Motion	10
3.0 Displacement Diagrams	4
4.0 Linkages	8
5.0 Velocity Analysis	12
6.0 Acceleration Analysis	16

IV. LEARNING ACTIVITIES/REQUIRED RESOURCES:

1,0 STUDENT ACTIVITIES

i) Participate in classroom lectures of principles and demonstrations of procedures.

ii) Review, study, and summarize textbook information and hand out material.

ii) Complete assigned problems as in class and take home exercises.

iv) Research, document and present findings for research assignment. This exercise is intended to be completed as group work, using working models of various mechanisms.

v) Produce solutions for displacement, velocity and acceleration characteristics of various mechanisms. This work involves a combination of algebraic and graphical procedures, and requires accuracy, neatly completed and organized in a standard form. This work will be assigned as in class and take home exercises.

vi) Attempting quizzes and tests as administered throughout the term.

IV. LEARNING ACTIVITIES/REQUIRED RESOURCES, con't:

2.0 RESOURCES REQUIRED

i) Textbook: Kinematics and Dynamics of Machines.
2nd Edition, McGraw Hill, MARTIN

ii) Drafting room, drafting tables and regular classroom facilities.

iii) Printed resource material including reference texts and periodicals, available in college library.

iv) Department owned Mechanism models-

v) Supplementary hand out material by instructor.

V, EVALUATION METHODS; (INCLUDES ASSIGNMENTS, ATTENDANCE REQUIREMENTS, ETC.)

1.0 GRADING SYSTEM

There will be three major tests throughout the term. A minimum of one week notice will be provided for each test. Tests will be content organized in the following manner:

Test #1 « Units #1, #2, #3

Test #2 ~ Units #4, #5

Test #3 — Units (#5), #6

In addition to the major tests there will be a several problems/exercises that will be assigned and marked. These assignments will take place throughout the term.

There will also be one research project assigned for Unit #4. This exercise will be organized as a small team effort and will involve an oral presentation to the class.

Scheduled or unscheduled mini-tests MAY be held throughout the term. These exercises will be referred to as quizzes.

Final grades will be calculated in the following manner:

Test	75%
Assignments/Project/Quizzes	25%

Numerical marks will relate to grads according to the schedule below:

A+	90-100%
A	80-89%
B	70-79%
C	55-69%
R	less than 55%

2.0 ATTENDANCE

The policies regarding attendance are the responsibility of the individual professor, and will be issued as supplementary documentation.

V. EVALUATION METHODS, con't:

3,0 REWRITES

The policies regarding rewrites are the responsibility of the individual professor, and will be issued as supplementary documentation.

4.0 LATE ASSIGNMENTS AND MISSED TESTS

The policies regarding late assignments and missed tests are the responsibility of the individual professor, and will be issued as supplementary documentation.

VI, REQUIRED STUDENT RESOURCES:

i) Textbook: Kinematics and Dynamics of Machines. MARTIN, 2nd Edition, McGraw Hill

ii) Note taking supplies: 3-ring binder, paper etc.

iii) Drafting supplies: Quad ruled paper, blank paper, T-square, set squares, divider, compass, engineering scales (Imperial and SI), architects scale, protractor, pencils, etc.

iv) "Scientific" calculator.

VII. ADDITIONAL RESOURCE MATERIALS;

The following texts are used as reference and sources of supplementary information:

i) Basic Graphical Kinematics. KEPLER, 2nd Edition, Glenco

ii) Mechanics of Machinery. HAM, CRANE and ROGERS, 4th Edition, McGraw Hill

In addition there are several of texts and periodicals related to this study, available in the college library.

In the event that hand out materials are supplied by the instructor, students are responsible for the content knowledge.

VIII, SPECIAL NOTES:

1/ Your instructor reserves the right to modify the course and course outline as deemed necessary to meets the needs of the students, or in the case of special circumstance.

2/ Students with special needs are encouraged to discuss their required accommodations in confidence with the instructor.

3/ Disruptive conduct of any kind is not acceptable, and will not be tolerated in lecture or lab periods.

4/ General College policies, including those described in the "Students Rights and Responsibilities" document will be upheld.