

CARLETON UNIVERSITY
Department of Mechanical and Aerospace Engineering
MAAE 3004: Dynamics of Machinery

Course Outline, Fall 2010

MAAE 3004 [0.5 credit]

Dynamics of Machinery

Kinematic and dynamic analysis of mechanisms and machines. Mechanism force analysis. Static and dynamic balancing. Kinematic and dynamic analysis of cams. Free and forced vibration of single-degree-of-freedom systems. Introduction to multibody dynamics.

Instructors

MAAE 3004A: Prof. R.Langlois, Rm. 6214C-VS; Tel. ext. 5714; rlangloi@mae.carleton.ca
MAAE 3004B: Prof. F. Afagh, Rm. 2194-ME; Tel. ext. 5705; fafagh@mae.carleton.ca

Schedule:

<u>Lectures:</u>		<u>Rooms</u>
MAAE 3004A:	Tu,Th 14:35-15:55	TB 340
MAAE 3004B:	We,Fr 13:05-14:25	UC 182

<u>Problem Analysis Sessions:</u>		<u>Rooms</u>
A1:	Mo. 8:35-10:25	SA 501
A2:	Mo. 11:35-13:25	ME 4332
B1:	Mo. 11:35-13:25	ME 3165
B2:	Fr. 8:35-10.25	ME 3165

Lecture Outline

Week		Topic
1	Introduction:	<i>Definitions; geometrical categorization of mechanisms; mobility; kinematic inversion; Grashof's law.</i>
2	Displacement Analysis:	<i>Introduction; graphical solution of vector equations.</i>
3	Velocity Analysis:	<i>Definitions; velocity polygons; apparent linear velocity of a point; apparent angular velocity; instant centres of velocity.</i>
4, 5	Acceleration Analysis:	<i>Linear acceleration; angular acceleration; acceleration difference vector; acceleration polygons; apparent acceleration; instant centres.</i>
6	Force Analysis of Mechanisms:	<i>Preliminaries; forces acting on links; graphical analysis and superposition; analytical force balance and matrix solution.</i>
7	Force Balancing:	<i>Introduction; balancing of machinery; balancing of rotating shafts; analysis of rotor balancing.</i>

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8, 9	Free Vibration of SDOF Systems: <i>Basic concepts; undamped translational system; Rayleigh's energy method; free vibration with viscous damping.</i>
9,10	Harmonically Excited Vibration: <i>Equation of motion; undamped response; magnification factor; damped response; energy dissipation.</i>
11	Cams: <i>Kinematics of cams: definition and classification; displacement diagrams; cam profile design. Dynamics of cams: rigid cam systems.</i>
12	Multibody Dynamics: <i>Definitions; system description; kinematics and dynamics; software.</i>

Textbook:

J.J. Uicker, Jr., G.R. Pennock, and J.E. Shigley. Theory of Machines and Mechanisms, 4th edition, Oxford University Press, 2011.

Suggested Supplemental References (on reserve at McOdrum Library):

F.P. Beer, E.R. Johnston Jr., and W.E. Clausen. Vector Mechanics for Engineers - Dynamics, 7th edition, McGraw-Hill Inc.

H.H. Mabie and C.F. Reinholtz. Mechanisms and Dynamics of Machinery, 4th edition, Wiley.

G.H. Martin. Kinematics and Dynamics of Machines, 2nd edition, McGraw-Hill.

W.T. Thomson and M. D. Dahleh. Theory of Vibration with Application, 5th edition, Prentice-Hall.

Course Notes and Assignments: Posted on WebCT

Drawing Instruments: Students will require the elements of a geometry set to perform graphical kinematic analysis. This includes: ruler, protractor, compass, 45-45-90 degree triangle, 30-60-90 degree triangle.

Course Evaluation:

Midterm Examination:-----30%
Closed book
Friday Oct. 29, 2010
7:00 - 8:30 pm
Rooms will be announced in class

Final Examination:-----70%
(formula sheets will be provided)
As scheduled by Examinations Scheduling Office

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Notes:

- To pass this course students must pass the final examination.
- The final examination is for evaluation purposes only and will not be returned to students.
- Assignment problems will be posted on the web but they will not be marked. Students are expected to fully participate in the Problem Analysis (PA) sessions where the assignment problems will be reviewed and questions answered.
- During each problem analysis session, one practice test problem will be given to help prepare for mid-term and final examinations. These mock tests will be evaluated by the students themselves, but they will not count toward the final grade in the course.

Academic Accommodation

You may need special arrangements to meet your academic obligations during the term because of disability, pregnancy, or religious obligations. Please review the course outline promptly and write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.

Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities (PMC) for a formal evaluation of disability-related needs. Documented disabilities could include but are not limited to mobility/physical impairments, specific Learning Disabilities (LD), psychiatric/psychological disabilities, sensory disabilities, Attention Deficit Hyperactivity Disorder (ADHD), and chronic medical conditions. Registered PMC students are required to contact the PMC, 613-520-6608, every term to ensure that your Instructor receives your Letter of Accommodation, no later than two weeks before the first assignment is due or the first in-class test/midterm requiring accommodations. If you only require accommodations for your formally scheduled exam(s) in this course, please submit your request for accommodations to PMC by November 12, 2010.