COURSE OUTLINE: MCH601 - ADV. DYNAMICS MACH

Prepared: Kevin Sloss
Approved: Corey Meunier, Chair, Technology and Skilled Trades

Course Code: Title	MCH601: ADVANCED DYNAMICS OF MACHINES
Program Number: Name	4043: MECH ENG. TECHNOLOGY
Department:	MECHANICAL TECHNIQUES PS
Academic Year:	2022-2023
Course Description:	In this course students learn Kinetics of particles, work of a force, kinetic energy, principle of work and energy, power and efficiency, potential energy, conservative forces and conservation of energy, principle of impulse and momentum, impulsive motion, impact, System of particles, Effective forces, liner and angular momentum, motion of mass centre, angular momentum about its mass centre, conservation of momentum, work-energy principle and conservation of energy, principle of impulse and momentum, Plane dynamics of rigid bodies, work-energy principle, momentum principles for a system of particles, work and kinetics energy, conservation of energy, principle of impulse and momentum, conservation of angular motion, impulsive motion and eccentric impact, Three-dimensional kinematics of rigid bodies, motion about a fixed point and general motion, velocities and accelerations. Students also learn mechanism displacement diagrams of machine members and machine dynamics.
Total Credits:	3
Hours/Week:	3
Total Hours:	42
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
Vocational Learning Outcomes (VLO's) addressed in this course: **Please refer to program web page for a complete listing of program outcomes where applicable.**	**4043 - MECH ENG. TECHNOLOGY** VLO 5 Use current and emerging technologies to implement mechanical engineering projects. VLO 6 Analyze and solve complex mechanical problems by applying mathematics and fundamentals of mechanical engineering. VLO 8 Design and analyze mechanical components, processes and systems by applying fundamentals of mechanical engineering. VLO 9 Design, manufacture and maintain mechanical components according to required specifications.
Essential Employability Skills (EES) addressed in this course:	EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience. EES 3 Execute mathematical operations accurately. EES 4 Apply a systematic approach to solve problems. EES 5 Use a variety of thinking skills to anticipate and solve problems. EES 11 Take responsibility for ones own actions, decisions, and consequences.

Course Evaluation:

Passing Grade: 50%,

A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.

Books and Required Resources:

Vector Mechanics for Engineers by F.P. Beer, E.R. Johnston, Jr., D.F. Mazurek, P.J. Cornwell
Publisher: McGraw Hill Edition: 12th
ISBN: 978-1-260-09274-5

Course Outcomes and Learning Objectives:

Course Outcome 1	Learning Objectives for Course Outcome 1
1. Apply impulse and momentum principles to solve problems involving linear, angular and planar motion of machine components.	1.1 Use the impulse momentum method to solve problems with linear, angular and plane motions 1.2 Apply the conservation of momentum method to solve for various velocities for both linear and angular motion
Course Outcome 2	**Learning Objectives for Course Outcome 2**
2. Solve problems involving static and inertial forces in machines.	2.1 Identify and explain the transmission forces in a machine 2.2 Compare and explain static force analysis and dynamic force analysis 2.3 Effectively draw free body diagrams of each link of a machine to arrive at the force analysis 2.4 Define a two-force member 2.5 Demonstrate the ability to isolate each link of a free body diagram in order to solve systems that have more than 3 unknowns 2.6 Interpret and calculate the force analysis on a slider crank mechanism, a four-bar linkage and a shaper mechanism 2.7 Define inertia forces 2.8 Explain why it is important to consider inertia forces in a machine and site examples of when inertia force are required for design an when they can be neglected 2.9 Identify and utilize the equations of motion 2.10 Define inertia torque 2.11 Solve for inertia forces on a four-bar linkage 2.12 Interpret and solve for inertia forces for a slider crank, shaper and cam mechanisms, planetary gear systems 2.13 Determine the centre of mass and moments of inertia of a system 2.14 Identify the acceleration of a body due to external forces 2.15 Solve for dynamic systems
Course Outcome 3	**Learning Objectives for Course Outcome 3**
3. Analyze problems involving the effects of rotating and reciprocating machine components.	3.1 Explain what a flywheel is, what it is used for and two types of machines for which a flywheel is beneficial 3.2 Define the coefficient of fluctuation and determine the mass of a flywheel for a given system 3.3 Explain why balancing of rotating masses is required 3.4 Explain dynamic balancing in the same transverse plane and masses in several transverse planes

		3.5 Explain how unbalanced machines at high speed are at greater risk than low speed machines 3.6 Understand how to balance machines utilizing different methods 3.7 Demonstrate the ability to reduce or eliminate shaking forces for a four-bar linkage, and slider crank mechanism 3.8 Explain primary and secondary inertia force 3.9 Define the gyroscopic effect 3.10 Understand and utilize the right-hand rule 3.11 Explain the axis of precession, the angle of precession, the angular velocity of precession and gyroscopic torque 3.12 Define and explain critical whirling speed 3.13 Demonstrate the ability to determine the critical speed for a shaft with one disk, multiple disks, no disks, shaft of various diameters 3.14 Explain torsional vibrations, torsional spring constant for a stepped shaft 3.15 Determine the torsional vibration for a shaft with single and multiple disks 3.16 Determine the natural frequency of torsional vibration for a geared system

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Assignments	40%
Final Exam	30%
Midterm Test	30%

Date: August 15, 2022

Addendum: Please refer to the course outline addendum on the Learning Management System for further information.