INTERNATIONAL UNIVERSITY LIAISON INDONESIA

IULI

SYLLABUS

Date/ Revision 22 June 2016

Faculty Engineering

Approval

SUBJECT : KINEMATICS AND DYNAMICS

1. Identification of Subject:

Name of Subject	:Kinematics and Dynamics
Code of Subject	:KINE-2100
SKS / ECTS	:3/
Semester	:4
Study Program	:B-AVE
Lecturer	:Neno Ruseno, S.T., M.Sc.

2. Competency

After having the course, students are expected to:

a) Recognize examples of mechanical systems in which the application of the principles discussed in this course is necessary to complete their design
b) Select or design a mechanism for a specific purpose
c) Analyze the position, velocity and acceleration of a linkage using graphical, analytical and computer-based methods
d) Design and analyze cams and gear trains
e) Analyze shaking forces and moments of a machine
f) Balance a rotating machine to eliminate shaking forces and moments
g) Compare and contrast the use of hand calculations, computer simulation, and experiments in designing and analyzing machines

3. Description of Subject:

Displacement, velocity and acceleration analysis of linkage mechanisms; inertia force analysis of mechanisms; balancing of reciprocating and rotating masses; free and harmonic vibrations of single degree of freedom systems.

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4. Learning Approach

Approach : Combination of Expository - inquiry and colaborative
Method : Discussion, question answer, sample problem, group work
Student Task : Home work, group report, group presentation
Media : LCD projector, slide.

5. Evaluation

a) Absence maximum : 25%
b) Participation in discussion : 5 points
c) Homework, Classwork : 5 points
d) Presentation, Simulation : 10 points
e) Daily Quiz : 20 points
f) Final Examination : 60 pointa

Total : 100 points

6. Contents/ Topics of Lecturing:

Week	Content/ Topics of Lecturing	Text Book Chapter	Remark
1	**Introduction:** • Historical Perspective • Kinematics • Design Analysis and Synthesis • Mechanisms • Planar Linkages • Visualization • Constraint Analysis • Idle Degree of Freedom • Over-constrained Linkages • Uses of the Mobility Criterion • Inversion • Reference Frames • Motion Limits • Continuously Rotatable Joints • Coupler-Driven Linkages • Motion Limits for Slider-Crank Mechanisms • Interferences	Ch1[1]	
2	**Technique in Geometric Constraint Programming; Planar Linkage Design:** • Geometric Constraint Programming (GCP) • Constraints and Program Structure • Initial Setup for a GCP Session	Ch2,3[1]	

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	• Drawing a Basic Linkage Using GCP • Troubleshooting Graphical Programs Developed Using GCP • Two-Position Double-Rocker Design • Synthetic of Crank-Rocker Linkages for Specified Rocker Amplitude • Motion Generation • Path Synthesis		
3	**Graphical Position, Velocity, and Acceleration Analysis for Mechanisms with Revolute Joints or Fixed Slides:** • Graphical Position Analysis • Planar Velocity Polygons • Graphical Acceleration Analysis • Graphical Analysis of a Four-Bar Mechanism • Graphical Analysis of a Slider-Crank Mechanism • Velocity Image Theorem • Acceleration Image Theorem • Solution by Geometric Constraint Programming	Ch4[1]	
4	**Linkages with Rolling and Sliding Contacts and Joints on Moving Sliders:** • Reference Frames • General Velocity and Acceleration Equations • Special Cases for the Velocity and Acceleration Equations • Linkages with Rotating Sliding Joints • Rolling Contact • Cam Contact • General Coincident Points • Solution by Geometric Constraint Programming	Ch5[1]	
5	**Instant Centers of Velocity:** • Definition • Existence Proof • Location of an Instant Center from the Directions of Two Velocities • Instant Center at a Revolute Joint • Instant Center of a Curved Slider • Instant Center of a Prismatic Joint • Instant Center of a Rolling Contact Pair • Instant Center of a General Cam-Pair Contact • Centrodes • The Kennedy-Aronhold Theorem • Circle Diagram as a Strategy for Finding Instant Centers • Using Instant Centers to Find Velocities • Finding Instant Center Using Geometric Constraint Programming	Ch6[1]	

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6	**Computational Analysis of Linkages:** • Position, Velocity and Acceleration Representations • Analytical Closure Equations for Four-Bar Linkages • Analytical Equations for a Rigid Body After the Kinematic Properties of Two Points are Known • Analytical Equations for Slider-Crank Mechanisms • Other Four-Bar Mechanism with Revolute and Prismatic Joints • Closure or Loop Equation Approach for Compound Mechanism • Closure Equation for Mechanism with Higher Pairs • Notational Differences	Ch7[1]	
7	**Special Mechanisms:** • Special Planar Mechanisms • Spherical Mechanisms • Constant-Velocity Couplings • Automotive Steering and Suspension Mechanisms • Indexing Mechanisms	Ch8[1]	
8	**Computational Analysis of Spatial Linkages:** • Spatial Mechanisms • Robotic Mechanisms • Direct Position Kinematics of Serial Chains • Inverse Position Kinematics • Rate Kinematics • Closed-Loop Linkages • Lower-Pair Joints • Motion Platforms	Ch9[1]	
9	**Profile Cam Design:** • Cam-Follower Systems • Synthesis of Motion Programs • Analysis of Different Types of Follower-Displacement Functions • Determining the Cam Profile	Ch10[1]	
10	**Spur Gears:** • Spur Gears • Condition for Constant-Velocity Ratio • Involutes • Gear Terminology and Standards • Contact Ratio • Involutometry • Internal Gears • Gear Manufacturing • Interference and Undercutting	Ch11[1]	

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	• Nonstandard Gearing • Cartesian Coordinates of an Involute Tooth Generated with a Rack		
11	**Helical, Bevel, and Worm Gears; Gear Trains** • Helical Gears • Worm Gears • Involute Bevel Gears • General Gear Trains • Direction of Rotation • Simple Gear Trains • Compound Gear Trains • Planetary Gera Trains • Harmonic Drive Speed Reducers	Ch12,13[1]	
12	**Static and Dynamic Force Analysis of Mechanisms:** • Forces, Moments, and Couples • Static Equilibrium • Free-Body Diagrams • Solution of Static Equilibrium Problem • Transmission Angle in a Four-Bar Linkage • Friction Considerations • In-Plane and Out-of-Plane Forces Systems • Conservation of Energy and Power • Virtual Work • Gear Loads • Problem Solvable Using Particle Kinetics • Dynamic Equilibrium of Systems of Rigid Bodies • Flywheels	Ch14,15[1]	
13	**Static and Dynamic Balancing; Integration of Computer Controlled Actuators:** • Single-Plane (Static) Balancing • Multi-Plane (Dynamic) Balancing • Balancing Reciprocating Masses • Expression for Inertial Forces • Balancing Multi-Cylinder Machines • Static Balancing of Mechanisms • Reactionless Mechanisms • Computer Control of the Linkage Motion • The Basics of Feedback Control • Actuator Selection and Types • Hands-On Machine-Design Laboratory	Ch16,17[1]	
14	**Rehearsal and Tutorial:** Rehearsal of all subject and students can ask for more detail.		

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15	**Final Examination**		

7. Book Reference:

a) Main Text Book: [1] "Kinematics, Dynamics and Design of Machinery, 3rd Edition, 2016", Authors: Kenneth J. Waldron, Gary L. Kinzel, Sunil K. Agrawal, Publisher: Willey.

b) Supplement Textbooks:

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