30.Course Specification of Theory of Machines

I.Course Identification and General Information:

.1	Course Title:	Theory of Machines.				
.2	Course Code & Number:	MT203.				
.3	Credit hours:	C.H				TOTAL Cr. Hrs.
		Th.	Seminar	Pr.	Tu.	
		2	-	2	-	3
4.	Study level/ semester at which this course is offered:	Third Year-First Semester.				
5.	Pre –requisite (if any):	Engineering Mechanics (2).				
6.	Co –requisite (if any):	Computer Programming (2).				
7.	Program (s) in which the course is offered:	Mechatronics Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	Location of teaching the course:	Mechatronics Engineering Department.				
10.	Prepared By:	Asst. Prof. Dr. Abdul-Salam Al-Mekhlafy.				
11.	Date of Approval:					

II.Course Description:

Theory of Machines is that branch of Engineering-science, which deals with the study of relative motion between the various parts of a machine and forces which act on them. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine. Theory of Machines may be sub-divided into kinematics, kinetics, dynamics, and statics. Students will learn simple mechanisms, computer simulation of various machine mechanisms, velocity in mechanisms, acceleration in mechanisms, cams, static force analysis of mechanisms, dynamic force analysis of mechanisms, balancing of rotating masses.

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Define the fundamental concepts of mechanisms machines " chain", " links and joints.	A1
a2.	Depict kinematic and kinetic analysis, the " position, velocity, acceleration, and force analysis".	A2
a3.	Describe graphic and analytical methods of the mechanism parts motion.	A3
b1.	Categorize the motion of every part in the mechanism graphic or analytic.	B1
b2.	Compare the mechanism shape graphically related to the input link motion.	B2
b3.	Differentiate between the input motion and the output motion of the mechanism and how many drives need any mechanism.	B4
b4.	Analyze a mechanism for a specific application and decide how to improve the mechanism performance.	B6
c1.	Apply computer programs to determine the positions of every points in the mechanism links. And simulate the mechanism motion.	C1
c2.	Perform solid work or SAM61 software programs to simulate the mechanism motion.	C2
d1.	Co-operate in group projects.	D1
d2.	Evaluate technical reports for the group projects.	D6

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
Define the fundamental concepts of mechanisms machines " chain", " links and joints. **a1.**	• Active Lectures. • Tutorials.	• Written Assessment. • Quiz.
Depict kinematic and kinetic analysis, the " position, velocity, acceleration, and force analysis". **a2.**	• Lectures. • Demonstrations. • Modeling. • Tutorial.	• Develop Computer Program. • Simulation Program.
Describe graphic and analytical methods of the mechanism parts motion. **a3.**	• Lectures. • Demonstrations. • Modeling. • Tutorial.	• Develop Computer Program. • Simulation Program

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies

Categorize the motion of every part in the mechanism graphic or analytic. **b1.**	• Lectures. • Design Modeling. • Tutorial. • Case Study.	• Computer Program. • Computer Simulation.
Compare the mechanism shape graphically related to the input link motion. **b2.**	• Lectures. • Design Modeling. • Tutorial. • Case Study.	• Computer Program. • Computer Simulation.
Differentiate between the input motion and the output motion of the mechanism and how many drives need any mechanism. **b3.**	• Lectures.	• Written Assessment.
Analyze a mechanism for a specific application and decide how to improve the mechanism performance. **b4.**	• Lectures.	• Written Assessment.

© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
Apply computer programs to determine the positions of every points in the mechanism links. And simulate the mechanism motion. **c1.**	• Design Work.	• Practical Assessment. • Written Report.
Perform solid work or SAM61 software programs to simulate the mechanism motion. **c2-**	• Use Communication and Information Technology.	• Simulation Programing.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Co-operate in group projects.	Group Learning	Project Report.
d2. Evaluate technical reports for the group projects.	Active Lectures.	Presentation.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction to Mechanisms and Kinematics.	a1,b2.	• Types of Links and their joints. • Constrained Motions. • Mobility.	1	2
2.	Develop Computer Program and Simulation.	a1,a2,a3,b1,b 2,c1.	• Modeling: Sliding, • Rotation, • General motion	1	2
3.	Kinematic Analysis of Mechanisms.	a1,a2,a3,b1,b 2,b4,c1.	• Position analyses. • Velocity analysis • Acceleration analysis	3	6
4.	Cams.	a1,a2,a3,b1,b 2,b4,c2.	• Classification of Followers and cams. • Motion of the Follower • Construction of Cam Profiles	1	2
5.	Kinetic Analysis in Mechanisms.	a1,a2,a3,b1,b 4,c2.	• Static Force Analysis. • Dynamic Force Analysis	1	2
6.	Mid- Term Exam.	a1, a2, a3, b1, b2, b3, b4, c1, c2.	• The first 5 chapters.	1	2
7.	Gear Train: Kinematic Analysis.	a1,a2,a3,b1,b 2,b4, c2.	• Types of Gears • Types of Gear Train • Planetary gears • Torque and Power	2	4
8.	Friction.	a1,a2,c2.	• Types of friction • Friction angle • Friction Limit.	1	2
9.	Belts Drives	a1,a2,a3,b1,b 2,b4, c2.	• Types of Belts • Tight and slake tension. • Effect of centrifugal Force • Torque and Power	1	2
10.	Power Screw Mechanism.	a1,a2,a3,b1 ,c2.	• Types Screw • Screw Kinematics. • Screw force and Torque.	1	2

11.	Turning Moment Diagram, and Flywheel.	a1,a2,c2.	• Introduction. • Turning Moment Diagram • Determination of Maximum Fluctuation of Energy • Flywheel in Punching Press	1	2
12.	Revision.	a1, a2, a3, b1, b2, b3, b4, c1, c2.	• All the chapters.	1	2
13.	Final Exam.	a1, a2, a3, b1, b2, b3, b4, c1, c2.	• All the chapters.	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	Develop computer program., and determine the motion parameters (position, velocity, displacement and acceleration).	4	8	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
2.	Using software simulation and determine motion parameters.	3	6	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
3.	Force and torque in slide crank mechanism.	2	4	a1, a2, a3, b1, b2, b3, b4, c1, c2. d1, d2.
4.	Force and torque in cam mechanism.	2	4	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2
5.	Velocity reduction in gear train.	1	2	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
6.	Force and torque in gear mechanism.	1	2	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
7.	Friction coefficients.	1	2	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
Number of Weeks /and Units Per Semester		**14**	**28**	

V.Teaching strategies of the course:

Lectures.
Demonstrations.
Modeling.
Tutorial.
Design Work.
Use Communication and Information Technology.

VI.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Quiz and Home Work.	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.	2-14	10
Total				**10**

VII.Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Develop Computer Program using cc+ or MATLAB to simulate slid Crank Mechanism to determine the Path and the Position. use Software Program.	2,3,5,7,9,11,14	15	10%	a1,a2,a3,b1 ,b2,b3,b4,c1,c2, d1, d2.
2.	Quiz and Home work	2,3,5,7,9,11,14	15	10%	a1,a2,a3,b1 ,b2,b3,b4,c1,c2, d1, d2.
3.	Mid- Term.	8	15	10%	a1,a2,a3,b1 ,b2,b3,b4,c1,c2.
4	Practical Project and Report.	13	15	10%	d1,d2.
5.	Final Exam.		90	60 %	a1,a2,a3,b1 ,b2,b3,b4,c1,c2.
TOTAL			**150**	**100**	

VIII.Learning Resources:

- Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).

Head of the Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
Assoc. Prof. Dr. Abdul-Malik Momin	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad	Prof. Dr. Al-Qassim Mohammed Abbas

	IX.Course Policies:
.1	**Class Attendance:** The students should have more than 75 % of attendance according to rules and regulations of the Faculty.
.2	**Tardy:** the lectures. They should attend within The students should respect the timing of attending 10 minutes from starting of the lecture.
.3	**Exam Attendance/Punctuality:** The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
.4	**Assignments & Projects:** The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time.
.5	**Cheating**: If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquiries.
6.	**Plagiarism**: The student will be terminated from the Faculty, if one student attends the exam on another behalf according to the policy, rules and regulations of the university.
7.	**Other Policies:** • All the teaching materials should be kept out the examination hall. • The mobile phone is not allowed. • There should be a respect between the student and his teacher
	1- Required Textbook(s) (maximum two).
	Khurmi Gupta, 2006, Theory of Machines, Eurasia Publishing House Pvt. Ltd. 1- Uicker, John, Pennock, Gordon, and Shigley, Joseph, 2010, Theory of Machines and 2- Mechanisms, 4th ed., Oxford University Press, New York.
	2- Essential References.
	David H. Myszka, 2012, Machines and Mechanisms: Applied Kinematic Analysis - 4th ed. -1 Prentice Hall, One Lake Street,Upper Saddle River,New Jersey. Norton, Robert, 2008, Design of Machinery, 4th ed., McGraw-Hill Book Company, New York.-2
	3- Electronic Materials and Web Sites *etc*.
	1- sam61 **2-** solid work **3-** www.howstuffworks.com **4-** http://www.purdue.edu/discoverypark/PLM/SME/Tutorial_6_Crank_Slider.zip **5-** http://www.purdue.edu/discoverypark/PLM/SME/Cams_Design.bin

Head of the Department Assoc. Prof. Dr. Abdul-Malik Momin	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	Dean of the Faculty Prof. Dr. Mohammed AL-Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad	Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas

Reviewed By	Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat. President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi. Head of Mechatronics Engineering Department: Assoc. Prof. Dr. Abdul-Malik Momin.
	Deputy Rector for Academic Affairs Assoc. Prof. Dr. Ibrahim AlMutaa. Assoc. Prof. Dr. Ahmed Mujahed and Asst. Prof. Dr. Munaser Alsubari.

Head of the Department Assoc. Prof. Dr. Abdul-Malik Momin	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	Dean of the Faculty Prof. Dr. Mohammed AL-Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad	Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas

Course Plan of Theory of Machines

I.Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Asst. Prof. Dr.Abdulslam Mekhlafy.	**Office Hours**					
Location& Telephone No.		**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	Abdulsalam2@gmail.com.						

II.Course Identification and General Information:						
1.	Course Title:	Theory of Machines.				
2.	Course Number & Code:	MT203.				
3.	Credit hours:	**C.H**				**Total**
		Th.	**Seminar**	**Pr.**	**Tu.**	
		2	-	2	-	3
4.	Study level/year at which this course is offered:	Third Year- First Semester.				
5.	Pre –requisite (if any):	Engineering Mechanics (2).				
6.	Co –requisite (if any):	Computer Programming (2).				
7.	Program (s) in which the course is offered	Mechatronics Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	System of Study:	Semesters.				
10.	Mode of delivery:	Lectures and Lab. Work.				
11.	Location of teaching the course:	Mechatronics Engineering Department.				

Head of the Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
Assoc. Prof. Dr. Abdul-Malik Momin	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad	Prof. Dr. Al-Qassim Mohammed Abbas

III.Course Description:

Theory of Machines is that branch of Engineering-science, which deals with the study of relative motion between the various parts of a machine and forces which act on them. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine. Theory of Machines may be sub-divided into kinematics, kinetics, dynamics, and statics. Students will learn simple mechanisms, computer simulation of various machine mechanisms, velocity in mechanisms, acceleration in mechanisms, cams, static force analysis of mechanisms, dynamic force analysis of mechanisms, balancing of rotating masses.

IV.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Define the fundamental concepts of mechanisms machines " chain", " links and joints.	A1
a2.	Depict kinematic and kinetic analysis, the " position, velocity, acceleration, and force analysis".	A2
a3.	Describe graphic and analytical methods of the mechanism parts motion.	A3
b1.	Categorize the motion of every part in the mechanism graphic or analytic.	B1
b2.	Compare the mechanism shape graphically related to the input link motion.	B2
b3.	Differentiate between the input motion and the output motion of the mechanism and how many drives need any mechanism.	B4
b4.	Analyze a mechanism for a specific application and decide how to improve the mechanism performance.	B6
c1.	Apply computer programs to determine the positions of every points in the mechanism links. And simulate the mechanism motion.	C1
c2.	Perform solid work or SAM61 software programs to simulate the mechanism motion.	C2
d1.	Co-operate in group projects.	D1
d.2	Evaluate technical reports for the group projects.	D6

V.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction to Mechanisms and kinematics.	• Types of Links and their joints. • Constrained Motions.	1	2

		• Mobility.		
2.	Develop Computer Program and Simulation.	• Modeling: Sliding, • Rotation, • General motion	2	2
3.	Kinematic Analysis of Mechanisms.	• Position analyses. • Velocity analysis • Acceleration analysis	3,4,5	6
4.	Cams.	• Classification of Followers and cams. • Motion of the Follower • Construction of Cam Profiles	6	2
5.	Kinetic Analysis in Mechanisms.	• Static Force Analysis. • Dynamic Force Analysis	7	2
6.	Mid- Term.	• The First 5 Chapters.	8	2
7.	Gear Train: Kinematic Analysis.	• Types of Gears • Types of Gear Train • Planetary gears • Torque and Power	9,10	4
8.	Friction.	• Types of friction • Friction angle • Friction Limit.	11	2
9.	Belts Drives	• Types of Belts • Tight and slake tension. • Effect of centrifugal Force • Torque and Power	12	2
10.	Power Screw Mechanism.	• Types Screw • Screw Kinematics. • Screw force and Torque.	13	2
11.	Turning Moment Diagram, and Flywheel.	• Introduction. • Turning Moment Diagram • Determination of Maximum Fluctuation of Energy • Flywheel in Punching Press	14	2
12.	Revision.	• All the Chapters.	15	2
13.	Final Exam.	• All the Chapters.	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B - Practical Aspect:				
Order	**Tasks/ Experiments**	**Number of Weeks**	**Contact Hours**	**Learning Outcomes**
1.	Develop computer program., and determine the motion parameters (position, velocity, displacement and acceleration).	4	8	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
2.	Using software simulation and determine motion parameters.	3	6	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
3.	Force and torque in slide crank mechanism.	2	4	a1, a2, a3, b1, b2, b3, b4, c1, c2. d1, d2.
4.	Force and torque in cam mechanism.	2	4	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2
5.	Velocity reduction in gear train.	1	2	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
6.	Force and torque in gear mechanism.	1	2	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
7.	Friction coefficients.	1	2	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.
Number of Weeks /and Units Per Semester		**14**	**28**	

VI.Teaching strategies of the course:

Lectures.
Demonstrations.
Modeling.
Tutorial.
Design Work.
Use of Communication and Information Technology.

VII.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Quiz and Home Work.	a1, a2, a3, b1, b2, b3, b4, c1, c2, d1, d2.	2-14	10
Total				**10**

VIII.Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Develop Computer Program using cc+ or MATLAB to simulate slid Crank Mechanism to determine the Path and the Position. use Software Program.	2,3,5,7,9,11,14	15	10%	a1,a2,a3,b1 ,b2,b3,b4,c1,c2, d1, d2.
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3.	Mid- Term Exam.	8	15	10%	a1,a2,a3,b1 ,b2,b3,b4,c1,c2.
4	Practical Project and Report.	13	15	10%	d1,d2.
5.	Final Exam.	16	90	60 %	a1,a2,a3,b1 ,b2,b3,b4,c1,c2.
TOTAL			**150**	**100**	

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