Sana'a University
Faculty of Engineering
Mechanical Engineering Department
Mechanical Engineering Program

27. Course Specification of Mechanics of Machines

I. Course Identification and General Information:						
1.	Course Title:	Mechanics of Machines.				
2.	Course Code & Number:	ME121.				
3.	Credit hours:	C.H				TOTAL CR. HRS.
		Th.	Seminar/Tu	Pr	Tr.	
		2	2	-	-	3
4.	Study level/ semester at which this course is offered:	Second Year – Second Semester.				
5.	Pre –requisite (if any):	Kinematics and Dynamics of Machines (ME120).				
6.	Co –requisite (if any):	None				
7.	Program (s) in which the course is offered:	Mechanical Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	Location of teaching the course:	Mechanical Engineering Department.				
10.	Prepared By:	Asst. Prof. Dr. Abdulsalam Almakhlafy				
11.	Date of Approval:					

II. Course Description:

This is the second course concerning the relative motion between connected parts in the machines. Mechanical parts can be connected together in order to transmit power through the friction between them as in the clutches and belts with pulleys. In this course the students will learn the efficiency of the mechanical system in transmit the power. The knowledge of this subject is very essential for an engineer in designing and selecting the various parts of a machine.

III. Alignment course intended learning outcomes (CILOs) of the course		Referenced PILOs
a1	Explain the friction definition and the mathematical relationship between the friction parameters.	A1
a2	Identify the fundamental concepts of friction clutches, belts, gears, screw power, and governor mechanism.	A2
b1	Analyze the kinematic and the kinetics parameters in every part in the mechanism.	B1

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b2	Determine the dynamic (position, velocity, acceleration, torque and power transmitted) characteristics for all the mechanisms components.	B2
c1	Use computer software to demonstrate the motion of the mechanism.	C1
d1	Carry out group manufacturing projects to Demonstrate the mechanisms motion.	D1

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

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1- Explain the friction definition and the mathematical relationship between the friction parameters.	Lectures, Tutorials Laboratory, Seminars	Examinations, Laboratory Reports, Homework Presentations
a2- Identify the fundamental concepts of: friction clutches, belts, gears, screw power, and governor mechanism.	Lectures, Tutorials Laboratory, Seminars, Projects	Examinations, Laboratory Reports, Homework Presentations, Individual and Group Project Reports.

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

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1- Analyze the kinematic and the kinetics parameters in every part in the mechanism.	Lectures, Tutorials Seminars, Projects	Examinations, Homework Presentations, Individual and Group Project Reports.
b2- Determine the dynamic (position, velocity, acceleration, torque and power transmitted) characteristics for all the mechanisms components.	Lectures, Tutorials, Seminars, Projects	Examinations, Homework Presentations, Individual and Group Project Reports.

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© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1- Use computer software to demonstrate the motion of the mechanism.	Lectures, Tutorials Seminars, Projects	Examinations, Presentations, Individual and Group Project Reports.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1- Carry out group manufacturing projects to Demonstrate the mechanisms motion.	Seminars, Projects, Small Group	Presentations, Reports

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours
1	Friction	a1,a2	• Types of Friction. • Friction Limiting. • Coefficient of Friction. • Torque Required to Lift the Load by a Screw Jack. • Efficiency of a Screw Jack. • Maximum Efficiency of a Screw Jack. Screws. • Friction of a V-thread.	2	4
2	Friction Clutches.	a1,a2	• Friction Clutches. • Single Disc or Plate Clutch. • Multiple Disc Clutch.	1	2

			• Cone Clutch. • Centrifugal Clutches.		
3	Belt and Rope	a1,a2	• Types of Belt Drives. • Velocity Ratio of Belt Drive. • Power Transmitted by a Belt. • Ratio of Driving Tensions for Flat Belt Drive. • Centrifugal Tension. Maximum Tension in the Belt. • Initial Tension in the Belt. V-belt Drive. • Ratio of Driving Tensions for V-belt.	1	2
	Brakes and Dynamometers	a2,b1,b2	• Braking of a Vehicle. • Dynamometer. Types of Dynamometers. • Classification of Transmission Dynamometers. • Epicyclic-train Dynamometers. • Belt Transmission Dynamometer-Froude or Throneycraft Transmission Dynamometer. • Torsion Dynamometer.	2	4
4	Gear Trains	a2,b1,b2	• Introduction. • Types of Gear Trains. • Simple Gear Train. • Compound Gear Train. • Epicyclic Gear Train. • Velocity Ratio of Epicyclic Gear Train. Compound Epicyclic Gear	1	2

			• Train (Sun and Planet Wheel). Epicyclic Gear Train with Bevel Gears. • Torques in Epicyclic Gear Trains.		
5	Mid-Term Exam	a1,a2,b1,b2	• All Previous Topics	1	2
6	Gear Trains	a2,b1,b2	• Introduction. • Types of Gear Trains. • Simple Gear Train. • Compound Gear Train. • Epicyclic Gear Train. • Velocity Ratio of Epicyclic Gear Train. Compound Epicyclic Gear • Train (Sun and Planet Wheel). Epicyclic Gear Train with Bevel Gears. • Torques in Epicyclic Gear Trains.	1	2
7	Governors	a2,b1,c1	• Types of Governors. • Centrifugal Governors. • Terms Used in Governors. Effort and Power of a Governor. • Controlling Force Diagram for a Porter Governor. • Controlling Force Diagram for a Spring-controlled Governor. Coefficient of Insensitiveness	2	4
8	Inertia Forces in Reciprocating Parts	b1,b2,c1	• Velocity and Acceleration of the Reciprocating Parts in Engines.	2	4

			• Forces on the Reciprocating Parts of an Engine Neglecting Weight of the Connecting Rod. • Equivalent Dynamical System. Dynamically Equivalent. • Inertia Forces in a Reciprocating Engine Considering the Weight of Connecting Rod.		
9	Turning Moment Diagrams and Flywheel	b1,b2,c1	• Turning Moment Diagram • for a Single Cylinder Double Acting Steam Engine. • Determination of Maximum Fluctuation of Energy. • Coefficient of Fluctuation of Energy. Flywheel. • Coefficient of Fluctuation of Speed. Energy Stored in a Flywheel. Dimensions of the Flywheel Rim. Flywheel in Punching Press	1	2
10	Review	a1,a2,b1,b2,c1	• All Topics	1	2
11	Final Exam	a1,a2,b1,b2,c1,d1	• All Topics	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

C – Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes
1	Determine Velocity, Torque Power for Screws.	3	6	a1,a2,b1,b2,c1,d1

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2	Disc Clutches, Cone Clutches and Centrifugal Clutches: - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	1	2	a1,a2,b1,b2,c1,d1
3	Open and Close Belt Drive; - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	1	2	a1,a2,b1,b2,c1,d1
4	Brakes and Dynamometers. - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	1	2	a1,a2,b1,b2,c1,d1
5	Gear Trains: - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	2	4	a1,a2,b1,b2,c1,d1
6	Governors - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	1	2	a1,a2,b1,b2,c1,d1
7	Inertia Forces in Reciprocating Parts: - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	2	4	a1,a2,b1,b2,c1,d1
8	Turning Moment Diagrams and Flywheel: - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	3	6	a1,a2,b1,b2,c1,d1
Number of Weeks /and Units Per Semester		**14**	**28**	

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V. Teaching strategies of the course:

- Lectures,
- Tutorials
- Laboratory,
- Seminars, and
- Projects

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Homework (Three Problems each Chapter)	a1,a2,b1,b2,c1,d1	Weekly	10
2	Carryout Fabrication Mechanism Projects in Groups	a1,a2,b1,b2,c1,d1	13th week	20
Total				**30**

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	Assignments	Weekly	30	20%	a1,a2,b1,b2,c1,d1
2	Quizzes (3)	4th , 10th and 13th weeks	10	6.7%	a1, a2, b1, b2, c1, d1
4	Mid-Term Exam	8th week	20	13.3%	a1,a2,b1,b2,c1,d1
5	Final Exam.	16th week	90	60%	a1,a2,b1,b2,c1,d1
Total			**150**	**100%**	

VIII. Learning Resources:

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

1- Required Textbook(s) (maximum two).

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	1. Khurmi Gupta, 2006, Theory of Machines, Eurasia Publishing House Pvt. Ltd. 2. J. J. Uicker Jr, GR Pennock, J. E. Shigley. 2003, "Theory of Machines and Mechanisms", University Press, Inc., New York.
2- Essential References.	
	1. Myszka, David H., (2012, Machines and Mechanisms, 4 th Ed., Publishing as Prentice Hall, One Lake Street,Upper Saddle River,New Jersey. 2. S.S.Rattan "Theory of Machine", McGraw Hill companies, 2 nd Edition. 3. P.L.Ballaney Theory of Machines Khanna Publication.
3- Electronic Materials and Web Sites *etc*.	
	1. solid work 2. www.howstuffworks.com 3. http://www.purdue.edu/discoverypark/PLM/SME/Tutorial_6_Crank_Slider.zip 4. http://www.purdue.edu/discoverypark/PLM/SME/Cams_Design.bin

I. Course Policies:

1	**Class Attendance:** - The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and be considerd as an exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic.
2	**Tardy:** - For lateness in attending the class, the student will be initially notified. If he repeates late in attending class he will be considered absent.
3	**Exam Attendance/Punctuality:** - The student should attend the exam on time. He is permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in the exam.
4	**Assignments & Projects:** - In general one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment
5	**Cheating**: - For cheating in exam, the student is considered as failure. In case the cheating is repeated three times during study the student will be disengaged from the Faculty
6	**Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved a plagiarism of a student, he will be disengaged from

	the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Affair Council of the university.
7	**Other policies:** - The mobile phone is not allowable to be used during class lecture. It must be switched off, otherwise the student will be ordered to leave the lecture room. - The mobile phone is not allowed to be taken during the examination time. - Lecture notes and assignments may be given directly to students using soft or hard copy.

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 Name of Reviewer from the Department: Assoc.Prof. Dr. Khalil Al-Hatab
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa Assoc. Prof. Dr. Ahmed Mujahed Asst. Prof. Dr. Munasar Alsubri

27. Course Plan of Mechanics of Machines

I. Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Asst. Prof. Dr.Abdulsalam Almakhlafy	**Office Hours**					
Location& Telephone No.		**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	drabdulsalam2@gmail.com						

II. Course Identification and General Information:

1.	Course Title:	Mechanics of Machines.				
2.	Course Number & Code:	ME121.				
3.	Credit hours:	C.H				TOTAL CR. HRS.
		Th.	Seminar/Tu	Pr	Tr.	
		2	2	-	-	3

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4.	Study level/year at which this course is offered:	Second Year – Second Semester
5.	Pre –requisite (if any):	Kinematics and Dynamics of Machines (ME120).
6.	Co –requisite (if any):	None.
7.	Program (s) in which the course is offered	Mechanical Engineering Program.
8.	Language of teaching the course:	English Language.
9.	System of Study:	Semesters.
10.	Mode of delivery:	Lectures and Tutorials.
11.	Location of teaching the course:	Mechanical Engineering Department.

III. Course Description:

This is the second course concerning the relative motion between connected parts in the machines. Mechanical parts can be connected together in order to transmit power through the friction between them as in the clutches and belts with pulleys. In this course the students will learn the efficiency of the mechanical system in transmit the power. The knowledge of this subject is very essential for an engineer in designing and selecting the various parts of a machine.

IV. Intended learning outcomes (ILOs) of the course:

Brief summary of the knowledge or skill the course is intended to develop**:**

1. Explain the friction definition and the mathematical relationship between the friction parameters .
2. Identify the fundamental concepts of: friction clutches, belts, gears, screw power, and governor mechanism .
3. Analyze the kinematic and the kinetics parameters in every part in the mechanism.
4. Determine the dynamic (position, velocity, acceleration, torque and power transmitted) characteristics for all the mechanisms components.
5. Apply computer software to demonstrate the motion of the mechanism.
6. Carry out group manufacturing projects to Demonstrate the mechanisms motion.

V. Course Content:

- Distribution of Semester Weekly Plan of Course Topics/Items and Activities.

A – Theoretical Aspect:

Order	Topics List	Sub Topics List	Week Due	Contact Hours
1.	Friction.	• Types of Friction. • Friction Limiting. • Coefficient of Friction. • Torque Required to Lift the Load by a Screw Jack. • Efficiency of a Screw Jack. • Maximum Efficiency of a Screw Jack. Screws. • Friction of a V-thread.	1st and 2nd weeks	4
2.	Friction Clutches.	• Friction Clutches. • Single Disc or Plate Clutch. • Multiple Disc Clutch. • Cone Clutch. • Centrifugal Clutches.	3rd week	2
3.	Belt and Rope	• Types of Belt Drives. • Velocity Ratio of Belt Drive. • Power Transmitted by a Belt. • Ratio of Driving Tensions for Flat Belt Drive. • Centrifugal Tension. Maximum Tension in the Belt. • Initial Tension in the Belt. V-belt Drive. • Ratio of Driving Tensions for V-belt.	4th week	2
4.	Brakes and Dynamometers	• Braking of a Vehicle. • Dynamometer. Types of Dynamometers. • Classification of Transmission Dynamometers. • Epicyclic-train Dynamometers.	5th and 6th weeks	4

		• Belt Transmission Dynamometer-Froude or Throneycraft Transmission Dynamometer. • Torsion Dynamometer.		
5.	Gear Trains	• Introduction. • Types of Gear Trains. • Simple Gear Train. • Compound Gear Train. • Epicyclic Gear Train. • Velocity Ratio of Epicyclic Gear Train. Compound Epicyclic Gear • Train (Sun and Planet Wheel). Epicyclic Gear Train with Bevel Gears. • Torques in Epicyclic Gear Trains.	7th week	2
6.	Mid-Term Exam	• All Previous Topics	8th week	2
7.	Gear Trains	• Introduction. • Types of Gear Trains. • Simple Gear Train. • Compound Gear Train. • Epicyclic Gear Train. • Velocity Ratio of Epicyclic Gear Train. Compound Epicyclic Gear • Train (Sun and Planet Wheel). Epicyclic Gear Train with Bevel Gears. • Torques in Epicyclic Gear Trains.	9th week	2
8.	Governors	• Types of Governors. • Centrifugal Governors. • Terms Used in Governors. Effort and Power of a Governor. • Controlling Force Diagram for a Porter Governor.	10th and 11th weeks	4

		• Controlling Force Diagram for a Spring-controlled Governor. Coefficient of Insensitiveness		
9.	Inertia Forces in Reciprocating Parts	• Velocity and Acceleration of the Reciprocating Parts in Engines. • Forces on the Reciprocating Parts of an Engine Neglecting Weight of the Connecting Rod. • Equivalent Dynamical System. Dynamically Equivalent. • Inertia Forces in a Reciprocating Engine Considering the Weight of Connecting Rod.	12th and 13th weeks	4
10.	Turning Moment Diagrams and Flywheel	• Turning Moment Diagram • for a Single Cylinder Double Acting Steam Engine. • Determination of Maximum Fluctuation of Energy. • Coefficient of Fluctuation of Energy. Flywheel. • Coefficient of Fluctuation of Speed. Energy Stored in a Flywheel. Dimensions of the Flywheel Rim. Flywheel in Punching Press	14th week	2
11.	Review	• All Topics	15th week	2
12.	Final Exam	• All Topics	16th week	2
Number of Weeks /and Units Per Semester			**16**	**32**

C – Tutorial Aspect:

Order	Topics List	Week Due	Contact Hours
1.	Determine Velocity, Torque Power for Screws.	1st ,2nd and 3rd weeks	4

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2.	Disc Clutches, Cone Clutches and Centrifugal Clutches: - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	4th week	2
3.	Open and Close Belt Drive; - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	5th week	2
4.	Brakes and Dynamometers. - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	6th weeks	2
5.	Gear Trains: - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	7th , 8th	4
6.	Governors - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	9th week	2
7.	Inertia Forces in Reciprocating Parts: - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	10th and 11th weeks	4
8.	Turning Moment Diagrams and Flywheel: - Determine Velocity, Acceleration, Force, Torque, Power and Energy Loses.	12th ,13th and 14th weeks	4
Number of Weeks /and Units Per Semester		**14**	**28**

VI. Teaching strategies of the course:

- Lectures,
- Tutorials
- Laboratory,
- Seminars, and
- Projects

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VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Homework (Three Problems each Chapter)	a1,a2,b1,b2,c1,d1	Weekly	10
2	Carryout Fabrication Mechanism Projects in Groups	a1,a2,b1,b2,c1,d1	13th week	20
	Total			**30**

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

Assessment	Type of Assessment Tasks	Week Due	Mark	Proportion of Final Assessment
1	Assignments	Weekly	30	20%
3	Quizzes (3)	4th, 10th and 13th weeks	10	6.7%
4	Mid-Term Exam	8th week	20	13.3%
5	Final Exam.	16th week	90	60%
Total			**150**	**100%**

IX. Learning Resources:

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

1- Required Textbook(s) (maximum two).

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2. J. J. Uicker Jr, GR Pennock, J. E. Shigley. 2003, "Theory of Machines and Mechanisms", University Press, Inc., New York

2- Essential References.

1. Myszka, David H. (2012, Machines and Mechanisms, 4 th Ed., Publishing as Prentice Hall, One Lake Street,Upper Saddle River,New Jersey.
2. S.S.Rattan "Theory of Machine", McGraw Hill Companies, 2nd Edition
3. P.L.Ballaney Theory of Machines Khanna Publication

3- Electronic Materials and Web Sites *etc*.

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1. solid work
2. www.howstuffworks.com
3. http://www.purdue.edu/discoverypark/PLM/SME/Tutorial_6_Crank_Slider.zip
4. http://www.purdue.edu/discoverypark/PLM/SME/Cams_Design.bin

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