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

40. Course Specification of Machine Design - I

I. Course Identification and General Information:						
1.	Course Title:	Machine Design - I				
2.	Course Code & Number:	ME235				
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:	Third year - Second Semester				
5.	Pre –requisite (if any):	Materials Science and Engineering (ME111), Machine Drawing (ME131) & Mechanics of Materials - II (ME234)				
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:	Associate Prof. Dr. Khalil Al-Hatab				
11.	Date of Approval:					

II. Course Description:

This course emphasizes the application of theoretical and engineering background taught in other courses, but also relies heavily on empirical approaches and simplifications of theory. Core material includes static and fatigue failure theories, design of shafts, design of permanent joints; riveted joints, welded joints, bolted joints, power screws, keys, splines, pins, rings and design of springs. The course is centered on a major design project, which is undertaken in groups.

III. Alignments of the Course Intended learning outcomes (CILOs)		Referenced PILOs
a1	Understand the fundamental scientific principles of mechanical design (stress, strain, material properties, and complex statics and fatigue loadings) and their importance and use in design analysis.	A1.

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

a2	Gain fundamental ideas and principles toward the selection of engineering materials and design of basic machine elements (shafts, bolted and welded joints and springs) based on the mechanical strength.	A2.
a3	Relate analytical skills, modern engineering tools and systematic approaches to mechanical design analysis procedures, employing a practice-oriented design workflow, computer-aided design and developing engineering judgment through this practice.	A4.
b1	Explore a range of key machine component categories following fundamental engineering analysis that includes evaluation of component function, complex statics and fatigue loadings, failure mode and criteria and life.	B1.
b2	Design machine elements by applying stress analysis and fatigue theories and appropriate criteria of failure.	
b3	Examine the design standards in assessment and specification of machine components, appreciating the role and context of standards in design, and being exposed to examples that highlight how and why standards are formulated in engineering practice.	B2.
c1	Employ the practical experience of available computer aided design software (ANSYS, SOLIDWORKS & ABAQUS) within the engineering design workflow and apply this to a range of design analysis problems.	C1.
c2	Perform technical reports that includes analysis briefs, graphically express basic machine elements, describe the context and significance of the design, and stress analysis of machine components and the procedures / methods used to solve them and apply the results for the services.	C2.
c3	Implement of safety and reliability concepts in the design of machine elements.	C3.
d1	Cooperate effectively as a part of a team.	D1.
d2	Review the literature for a real-world problem, select the project idea, use databases and analytical and computing skills tools as well as, evaluate information and evidence from various sources.	D4.
d3	Effectively Communicate, discuss results and defend his ideas.	D5.

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

(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- Understand the fundamental scientific principles of mechanical design (stress, strain, material properties, and complex statics and fatigue loadings) and their importance and use in design analysis.	Lectures, Tutorials, Software Packages, Projects	Examinations, Homework Presentations
a2- Gain fundamental ideas and principles toward the selection of engineering materials and design of basic machine elements (shafts, bolted and welded joints and springs) based on the mechanical strength.	Lectures, Tutorials, Software Packages, Projects	Examinations, Homework Presentations, Individual and Group Project Reports.
a3- Relate analytical skills, modern engineering tools and systematic approaches to mechanical design analysis procedures, employing a practice-oriented design workflow, computer- aided design and developing engineering judgment through this practice.	Lectures, Tutorials, Software Packages (ANSYS, SOLIDWORKS & ABAQUS), Projects.	Examinations, 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- Explore a range of key machine component categories following fundamental engineering analysis that includes evaluation of component function, complex statics and fatigue loadings, failure mode and criteria and life.	Lectures, Tutorials, Lectures, Real-World Problem, Projects	Examinations, Homework, Presentations, Individual and Group Project Reports

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

b2- Design machine elements by applying stress analysis and fatigue theories and appropriate criteria of failure.	Lectures, Tutorials, Lectures, Real-World Problem, Projects	Examinations, Homework, Presentations, Individual and Group Project Reports
b3- Examine the design standards in assessment and specification of machine components, appreciating the role and context of standards in design, and being exposed to examples that highlight how and why standards are formulated in engineering practice.	Lectures, Tutorials, Lectures, Real-World Problem, Projects	Examinations, Homework, Presentations, Individual and Group Project Reports

© **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- Employ the practical experience of available computer aided design software (ANSYS, SOLIDWORKS & ABAQUS) within the engineering design workflow and apply this to a range of design analysis problems.	Real-World Problem, Software Packages (ANSYS, SOLIDWORKS & ABAQUS), Projects	Examinations, Presentations, Individual and Group Project Reports.
c2- Perform technical reports that includes analysis briefs, graphically express basic machine elements, describe the context and significance of the design, and stress analysis of machine components and the procedures / methods used to solve them and apply the results for the services.	Real-World Problem, Projects	Examinations, Presentations, Individual and Group Project Reports.
c3- Implement safety and reliability concepts in the design of machine elements.	Lectures, Real-World Problem, Projects	Examinations, Presentations, Individual and Group Project Reports.

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

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1- Cooperate effectively as a part of a team.	Real-World Problem, Projects	Presentations, Reports
d2- Review the literature for a real-world problem, select the project idea, use databases and analytical and computing skills as well as, evaluate information and tools as evidence from various sources.	Real-World Problem, Projects	Presentations, Reports
d3- Communicate effectively, discuss results and defend his ideas.	Real-World Problem, Projects.	Presentations, Reports

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction to Mechanical Engineering Design	a1, b1, b2, b3 c1, c3	– Course Overview and Introduction – Mechanical Engineering Design – Design Phases & Considerations – Design Tools and Resources – Responsibilities & Product Liability – Standards and Codes – Design Factor, Factor of Safety & Reliability	2	4

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

			– Dimensions and Tolerances		
2	Review of Stress Analysis	a1, b1, b2, b3 c3	– 2D & 3D Stress – Combined Loading – Engineering Materials – Generalized Hooke's Law – Static Loading Failure Criteria – Deflection and Stiffness of Beas	1	2
3	Variable Loading & Fatigue Failure Criteria	a1, b1, b2, b3 c3	– Introduction to Fatigue – Approaches to Fatigue Failure – Endurance Limit & Fatigue Strength – Endurance Limit Modifying Factors – Stress Concentration & Notch Sensitivity – Characterizing Fluctuating Stresses – Fatigue Failure Criteria for Fluctuating Stress – Torsional Fatigue Strength – Combinations of Loading Modes – Cumulative Fatigue Damage	2	4
4	Shafts and Shaft Components	a1, a2, a3, b1, b2, b3, c3	– Introduction – Shaft Materials – Shaft Layout – Shaft Design for Stress – Deflection Considerations	2	4

			– Critical Speeds for Shafts – Miscellaneous Shaft Components – Limits and Fits		
5	Mid-Term Exam	a1, a2, a3, b1, b2, b3, c1, c2, c3	The First Four Chapters	1	2
6	Power Screws	a1, a2, a3, b1, b2, b3, c3	– Thread Standards & Definitions – The Mechanics of Power Screws	1	2
7	Fasteners and the Design of Nonpermanent Joints	a1, a2, a3, b1, b2, b3, c3	– Threaded Fasteners – Fastener & Member Stiffness – Bolt Strength – The External Load – Bolt Torque – Static & Fatigue Loadings Joint – Gasketed Joints – Bolted & Riveted Joints Loaded in Shear	2	4
8	Welding and the Design of Permanent Joints	a1, a2, a3, b1, b2, b3, c3	– Welding Symbols – Butt and Fillet Welds – Stresses in Welded Joints – The Strength of Welded Joints – Static & Fatigue Loadings	2	4
9	Mechanical Springs	a1, a2, a3, b1, b2, b3, c3	– Stresses In Helical Springs – The Curvature Effect – Deflection of Helical Springs – Compression Springs – Stability & Spring Materials	2	4

			– Critical Frequency of Helical Springs – Static & Fatigue Loadings of Helical Compression Springs – Extension Springs – Helical Coil Torsion Springs – Leaf Springs		
10	Final Exam	a1,a2,a3,b1,b2, b3,c1,c2,c3	All the Chapters	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

Head of Department Asst. Prof. Dr. Adel Ahmed Al-Shakiri	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

B: Tutorial Aspects

Order	Units/Topics List	Number of Weeks	Contact hours	Learning Outcomes
1	Introduction to Mechanical Engineering Design	2	4	a1, b1, b2, b3 c1, c3
2	Review of Stress Analysis	1	2	a1, b1, b2, b3 c3
3	Variable Loading & Fatigue Failure Criteria	2	4	a1, b1, b2, b3 c3
4	Shafts and Shaft Components	2	4	a1, a2, a3, b1, b2, b3, c3
5	Power Screws	1	2	a1, a2, a3, b1, b2, b3, c3
6	Fasteners and the Design of Nonpermanent Joints	2	4	a1, a2, a3, b1, b2, b3, c3
7	Welding and the Design of Permanent Joints	2	4	a1, a2, a3, b1, b2, b3, c3
8	Mechanical Springs	2	4	a1, a2, a3, b1, b2, b3, c3
Total number of weeks and hours		**14**	**28**	

V. Teaching Strategies of The Course:

- Active Lectures,
- Project
- Tutorials
- Software Packages (ANSYS, SOLIDWORKS & ABAQUS)
- Projects.
- Interactive Class Discussions
- Exercises and Home Works
- Problem Based Learning
- Real-World Problem

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Homework 1	a1, b1, b2, b3,c1,c3	2nd	1.25

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

2	Homework 2	a1, b1, b2, b3, c3	3rd	1.25
3	Homework 3	a1, b1, b2, b3, c3	4th	1.25
4	Homework 4	a1, a2, a3, b1, b2, b3, c3	5th	1.25
5	Homework 5	a1, a2, a3, b1, b2, b3, c3	6th	1.25
6	Homework 6	a1, a2, a3, b1, b2, b3, c3	7th	1.25
7	Homework 7	a1, a2, a3, b1, b2, b3, c3	9th	1.25
8	Homework 8	a1, a2, a3, b1, b2, b3, c3	10th	1.25
9	Homework 9	a1, a2, a3, b1, b2, b3, c3	11th	1.25
10	Homework 10	a1, a2, a3, b1, b2, b3, c3	12th	1.25
11	Homework 11	a1, a2, a3, b1, b2, b3, c3	13th	1.25
12	Homework 12	a1, a2, a3, b1, b2, b3, c3	14th	1.25
Total				**15**

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	Homework	2nd to 14th	15	10%	a1, a2, a3, b1, b2, b3, c3
2	Real problem Presentation	5th to 11th	10	6.67.%	a1, a2, a3, b1, b2, b3, c1, c2, c3, d1, d2,d3
3	Project report and presentation	4th , 5th , 6th ,11th , 14th	15	10%	a1, a2, a3, b1, b2, b3, c1, c2, c3, d1, d2,d3
4	Quiz 1- Quiz 3	4th ,7th,11th	15	6.67%	a1,a2,a3,b1,b2, b3,c1,c2,c3
5	Mid-Term Exam	8th	20	13.33%	a1,a2,a3,b1,b2, b3,c1,c2,c3
6	Final exam	15th	75	50%	a1,a2,a3,b1,b2, b3,c1,c2,c3
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).

1. Budynas, RG & Nisbett, JK, 2015, Shigley's Mechanical Engineering Design (SI units), 10th ed, McGraw Hill, New York.
2. Course Notes and Power Point Presentations

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

2- Essential References.	
	1. Juvinall, RC & Marshek, KM 2017, Fundamentals of machine component design, 6th ed., John Wiley & Sons, Hoboken, NJ. 2. Hamrock, B.J., Schmid, S.R., Jacobson, B., 2014, Fundamentals of Machine Elements (SI units), 3rd ed., CRC Press (Taylor & Francis Group, LLC). 3. Norton, R. L., 2012, Machine Design: An Integrated Approach, 3rd ed., Pearson Education. 4. Shahin Nudehi, John Steffen, 2017, Analysis of Machine Elements Using SOLIDWORKS Simulation 2017, SDC Publications. 5. Ansel C. Ugural, 2015, Mechanical Design of Machine Components, 2nd ed., CRC Press (Taylor & Francis Group, LLC).
3- Electronic Materials and Web Sites *etc*.	
	1- Software packages: ANSIS & SOLIDWORKS

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.Riyad Muharam**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

Head of Department Asst. Prof. Dr. Adel Ahmed Al-Shakiri	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

40. Course Plan of Machine Design - I

I. Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Assoc. Prof. Dr. Khalil Al-Hatab	Office Hours					
Location& Telephone No.		SAT	SUN	MON	TUE	WED	THU
E-mail							

II. Course Identification and General Information:

1.	Course Title:	Machine Design – I.				
2.	Course Number & Code:	ME235.				
3.	Credit Hours:	C.H				TOTAL CR. HRS
		Th.	Seminar/Tu.	Pr.	Tr.	
		2	2	-	-	3
4.	Study level/year at which this course is offered:	Third Year - Second Semester.				
5.	Pre –requisite (if any):	Materials Science and Engineering (ME111), Machine Drawing (ME131) & Mechanics of Materials - II (ME234).				
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 course emphasizes the application of theoretical and engineering background taught in other courses, but also relies heavily on empirical approaches and simplifications of theory. Core material includes static and fatigue failure theories, design of shafts, design of permanent joints; riveted joints, welded joints, bolted joints, power screws, keys, splines, pins, rings and

design of springs. The course is centered on a major design project, which is undertaken in groups.

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

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

1. Identify appropriate analytical models to describe and predict the behaviour of standard machine components;
2. Apply stress analysis theory, fatigue theory and appropriate criteria of failure to the design of simple machine elements;
3. Select appropriate mechanical components from manufacturers' catalogues;
4. Apply codes and standards to machine component design;
5. Understand safety and reliability concepts in the design of machine elements.
6. Communicate the results of a design assignment by means of drawings and a design report
7. Make appropriate use of available computer aided design software.

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	Introduction to Mechanical Engineering Design	– Course Overview and Introduction – Mechanical Engineering Design – Design Phases & Considerations – Design Tools and Resources – Responsibilities & Product Liability – Standards and Codes – Design Factor, Factor Of Safety & Reliability Dimensions and Tolerances	1st -2nd	4

2	Review of Stress Analysis	– 2D & 3D Stress – Combined Loading – Engineering Materials – Generalized Hooke's Law – Static Loading Failure Criteria Deflection and Stiffness of Beas	3rd	2
3	Variable Loading & Fatigue Failure Criteria	– Introduction to Fatigue – Approaches to Fatigue Failure – Endurance Limit & Fatigue Strength – Endurance Limit Modifying Factors – Stress Concentration & Notch Sensitivity – Characterizing Fluctuating Stresses – Fatigue Failure Criteria for Fluctuating Stress – Torsional Fatigue Strength – Combinations of Loading Modes Cumulative Fatigue Damage	4th -5th	4
4	Shafts and Shaft Components	– Introduction – Shaft Materials – Shaft Layout – Shaft Design for Stress – Deflection Considerations – Critical Speeds for Shafts – Miscellaneous Shaft Components Limits and Fits	6th -7th	4
5	Mid-Term Exam	The First Four Chapters	8th	2
6	Power Screws	– Thread Standards & Definitions The Mechanics of Power Screws	9th	2
7	Fasteners and the Design of Nonpermanent Joints	– Threaded Fasteners – Fastener & Member Stiffness – Bolt Strength – The External Load – Bolt Torque	10th - 11th	4

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

		– Static & Fatigue Loadings Joint – Gasketed Joints Bolted & Riveted Joints Loaded in Shear		
8	Welding and the Design of Permanent Joints	– Welding Symbols – Butt and Fillet Welds – Stresses in Welded Joints – The Strength of Welded Joints Static & Fatigue Loadings	12th-13th	4
9	Mechanical Springs	– Stresses In Helical Springs – The Curvature Effect – Deflection of Helical Springs – Compression Springs – Stability & Spring Materials – Critical Frequency of Helical Springs – Static & Fatigue Loadings of Helical Compression Springs – Extension Springs – Helical Coil Torsion Springs Leaf Springs	14th - 15th	4
10	Final Exam	All the Chapters	16th	2
Number of Weeks /and Units Per Semester			**16**	**32**

B: Tutorial Aspects

Order	Units/Topics List	Sub -Topics List	Week Due	Contact Hours
1	Introduction to Mechanical Engineering Design	– Course Overview and Introduction – Mechanical Engineering Design – Design Phases & Considerations – Design Tools and Resources – Responsibilities & Product Liability – Standards and Codes	1st, 2nd	4

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

		– Design Factor, Factor Of Safety & Reliability – Dimensions and Tolerances		
2	Review of Stress Analysis	– 2D & 3D Stress – Combined Loading – Engineering Materials – Generalized Hooke's Law – Static Loading Failure Criteria – Deflection and Stiffness of Beas	3rd	2
3	Variable Loading & Fatigue Failure Criteria	– Introduction to Fatigue – Approaches to Fatigue Failure – Endurance Limit & Fatigue Strength – Endurance Limit Modifying Factors – Stress Concentration & Notch Sensitivity – Characterizing Fluctuating Stresses – Fatigue Failure Criteria for Fluctuating Stress – Torsional Fatigue Strength – Combinations of Loading Modes – Cumulative Fatigue Damage	4th, 5 th	4
4	Shafts and Shaft Components	– Introduction – Shaft Materials – Shaft Layout – Shaft Design for Stress – Deflection Considerations – Critical Speeds for Shafts – Miscellaneous Shaft Components – Limits and Fits	6 th, 7 th	4
5	Power Screws	– Thread Standards & Definitions – The Mechanics of Power Screws	8 th	2

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

6	Fasteners and the Design of Nonpermanent Joints	– Threaded Fasteners – Fastener & Member Stiffness – Bolt Strength – The External Load – Bolt Torque – Static & Fatigue Loadings Joint – Gasketed Joints – Bolted & Riveted Joints Loaded In Shear	9 th, 10 th	4
7	Welding and the Design of Permanent Joints	– Welding Symbols – Butt and Fillet Welds – Stresses in Welded Joints – The Strength of Welded Joints – Static & Fatigue Loadings	11 th, 12 th	4
8	Mechanical Springs	– Stresses In Helical Springs – The Curvature Effect – Deflection of Helical Springs – Compression Springs – Stability & Spring Materials – Critical Frequency of Helical Springs – Static & Fatigue Loadings of Helical Compression Springs – Extension Springs – Helical Coil Torsion Springs – Leaf Springs	13 th, 14 th	4
Total number of weeks and hours			**14**	**28**

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

VI. Teaching strategies of the course:

- Active Lectures,
- Project
- Tutorials
- Software Packages (ANSYS, SOLIDWORKS & ABAQUS)
- Projects.
- Interactive Class Discussions
- Exercises and Homework
- Problem Based Learning
- Real-World Problem

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Homework 1	a1, b1, b2, b3,c1,c3	2nd	1.25
2	Homework 2	a1, b1, b2, b3, c3	3rd	1.25
3	Homework 3	a1, b1, b2, b3, c3	4th	1.25
4	Homework 4	a1, a2, a3, b1, b2, b3, c3	5th	1.25
5	Homework 5	a1, a2, a3, b1, b2, b3, c3	6th	1.25
6	Homework 6	a1, a2, a3, b1, b2, b3, c3	7th	1.25
7	Homework 7	a1, a2, a3, b1, b2, b3, c3	9th	1.25
8	Homework 8	a1, a2, a3, b1, b2, b3, c3	10th	1.25
9	Homework 9	a1, a2, a3, b1, b2, b3, c3	11th	1.25
10	Homework 10	a1, a2, a3, b1, b2, b3, c3	12th	1.25
11	Homework 11	a1, a2, a3, b1, b2, b3, c3	13th	1.25
12	Homework 12	a1, a2, a3, b1, b2, b3, c3	14th	1.25
Total				**15**

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

Assessment	Type of Assessment Tasks	Week Due	Mark	Proportion of Final Assessment

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

1	Homework 1 to Homework 12	2nd to 14th	15	10%
2	Real Problem Presentation	5th to 11th	10	6.67.%
3	Project Report and Presentation	4th , 5th , 6th ,11th , 14th	15	10%
4	Quiz 1 - Quiz 3	4th ,7th,11th	15	10%
5	Mid-Term Exam	8th	20	13.33%
6	Final Exam	15th	75	50%
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).

1. Budynas, RG & Nisbett, JK, 2015, Shigley's Mechanical Engineering Design (SI units), 10th ed, McGraw Hill, New York.
2. Course Notes And Power Point Presentations

2- Essential References.

1. Juvinall, RC & Marshek, KM 2017, Fundamentals of machine component design, 6th ed., John Wiley & Sons, Hoboken, NJ.
2. Hamrock, B.J., Schmid, S.R., Jacobson, B., 2014, Fundamentals of Machine Elements (SI units), 3rd ed., CRC Press (Taylor & Francis Group, LLC).
3. Norton, R. L., 2012, Machine Design: An Integrated Approach, 3rd ed., Pearson Education.
4. Shahin Nudehi, John Steffen, 2017, Analysis of Machine Elements Using SOLIDWORKS Simulation 2017, SDC Publications.
5. Ansel C. Ugural, 2015, Mechanical Design of Machine Components, 2nd ed., CRC Press (Taylor & Francis Group, LLC)

3- Electronic Materials and Web Sites *etc*.

Software packages: ANSIS & SolidWorks

II. 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.

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

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