47. Course Specification of System Dynamics and Vibrations

I.Course Identification and General Information:						
.1	Course Title:	System Dynamics and Vibrations.				
.2	Course Code & Number:	MT308.				
.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:	Fourth Year- Second Semester.				
.5	Pre –Requisite (if any):	Mathematics (1), Engineering Workshop, Engineering Mechanics and Theory of Machines.				
.6	Co –Requisite (if any):	System Modeling and Identification.				
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 Naji Ismaeel.				
11.	Date of Approval:					

II.Course Description:

This course is an introduction to the dynamics and vibrations of lumped-parameter models of mechanical systems. Topics covered include kinematics, force-momentum formulation for systems of particles and rigid bodies in planar motion, work-energy concepts, virtual displacements and virtual work. Students will also become familiar with the following topics: Lagrange's equations for systems of particles and rigid bodies in planar motion, and linearization of equations of motion. After this course, students will be able to evaluate forced and free vibration of linear multi-degree of freedom models of mechanical systems and matrix eigenvalue problems.

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Characterize the basic concepts associated with harmonic response functions, vibration transmissibility, system resonance of one and two-	A1

	degree-of-freedom systems, coordinate coupling and principal coordinates.	
a2.	Identify the natural frequency, damped frequency, logarithmic decrement, and time constant of dynamic systems.	A4
b1.	Investigate the vibration caused by the unbalance in rotating shafts.	B3
b2.	Analyze the response equation of un-damped and viscously damped single-degree-of-freedom systems subjected to different types of harmonic force, including base excitation and rotating unbalance.	B5
c1.	Apply vibration nomographs and vibration criteria to determine the levels of vibration to be controlled or reduced.	C1
c2.	Solve a spring-mass-damper system for different types of free-vibration response depending on the amount of damping manually as well as in MatLab.	C.3
d1.	Co-operate with team work for enhancing skills through homework and team projects.	D1
d2.	Review professional quality design project report and oral presentation.	D2

(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. Characterize the basic concepts associated with harmonic functions, response vibration transmissibility, system resonance of one and two-degree-of-freedom systems, coordinate coupling and principal coordinates.	• Active Lectures. • Tutorials.	• Written Assessment.
a2. Identify the natural frequency, damped frequency, logarithmic decrement, and time constant of dynamic systems.	• Active Lectures. • Tutorials. • Hands on Laboratory Work.	• Practical Assessment. • Simulation.

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

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies

Investigate the vibration caused by the unbalance in rotating shafts. **b1.**	• Design Work and Project. • Case Studies.	• Practical Assessment. • Reports.
Analyze the response equation of damped and viscously un- single-degree-of- damped subjected freedom systems harmonic to different types of excitation force, including base and rotating unbalance. **b2.**	• Active Lectures. • The Use of Communication and Information Technology. • Case Studies.	• Practical Assessment. • 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
Apply vibration nomographs vibration criteria to and levels of determine the or vibration to be controlled reduced. **c1.**	• Hands-on Laboratory Work. • Design Work. • Group Learning.	• Practical Assessment. • Laboratory Reports.
Solve a spring-mass-damper for different system response of free-vibration types of depending on the amount damping manually as well as in MatLab. **c2.**	• The Use of Communication and Information Technology. • Independent Learning. • Problem-Based Learning. • Computer-Based Learning.	• Simulations such as • Computer Based Learning.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
Co-operate with team work for enhancing skills through homework and team projects. **d1.**	• Design Work and Projects. • Problem-Based Learning.	• Acquire Team Work Skills through Homework and Team Projects.
Review professional quality design project report and oral presentation. **d2.**	• Design Work and Projects.	• Generate Professional Quality Design Project

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

	• Group Learning.	Report and Oral Presentation.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Fundamentals of Vibration.	a1, a2 , d1	Basic concepts of vibrations, Classification of vibrations, Vibration analysis procedure, Spring elements, Mass elements, Damping elements.	1	2
2.	Harmonic Motion.	a1, a2, d1	Vectorial representation of harmonic motion, Complex-number representation of harmonic motion, Complex algebra, Operations on harmonic functions, Definitions and terminology.	1	2
3.	Harmonic Analysis.	a2, b2, c2, d1	Fourier series expansion, complex Fourier Series, frequency spectrum, Time- and frequency- domain representations, Examples using MATLAB.	1	2
4.	Free Vibration of Single-Degree-of-Freedom Systems.	a1, a2, b2, d1	Free vibration of an undamped translational systems, Equation of motion using Newton s second law of motion, Equation of motion using other methods, Equation of motion of a spring-mass System in vertical position, Solution, Harmonic motion.	1	2
5.	Free Vibration of Single-	a2, b1, b2, d1	Free vibration of an undamped	1	2

	Degree-of-Freedom Systems.		torsional systems, Response of first order systems and time constant, Rayleigh's energy method.		
6.	Free Vibration of Single-Degree-of-Freedom Systems.	a2, b1, b2, d1	Free vibration with viscous damping: Equation of motion, Logarithmic Decrement, Energy dissipated in viscous Damping, Torsional systems with viscous Damping.	1	2
7.	Harmonically Excited Vibration.	b1, b2, c2, d1	Equation of motion, Response of un-damped system under harmonic force.	1	2
8.	Mid Term Exam.	a1, a2, b1, b2, c1, c2.	The First 7 Chapters.	1	2
9.	Harmonically Excited Vibration.	b1, b2, c2, d1.	Response of damped system under harmonic force, Response of damped system under $F(t) = Fe^{i\omega t}$	1	2
10.	Harmonically Excited Vibration.	b1, d1	Response of a damped system under the harmonic motion of the base, Response of a damped system under rotating unbalance.	1	2
11.	Vibration Under General Forcing Conditions.	a2, b1, d1	Response under a general periodic force, First-order systems, Second order systems.	1	2
12.	Vibration Under General Forcing Conditions.	a2, b1, c2, d1	Response under a periodic force of irregular form, Response under a non-periodic force, Response to an impulse, Response to a general forcing condition, Response to Base excitation.	1	2
13.	Two-Degree-of-Freedom Systems.	b1, b2, c2, d1	Introduction, Equations of motion for forced vibration, Free vibration analysis of an un damped system.	1	2

14.	Two-Degree-of-Freedom Systems.	b1, c1, d1	Torsional system, Coordinate coupling and principal Coordinates, Forced-vibration analysis.	1	2
15.	Review.	a1, a2, b1, b2, c1, c2, d1, d2	All the Chapters.	1	2
16.	Final Exam.	a1, a2, b1, b2, 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.	Tutorial (1) for the following subtopics: Basic concepts of vibrations, Classification of vibrations, Vibration analysis procedure, Spring elements, Mass elements, Damping elements. Computer Lab& Experimental Lab.	1	**1 h** for Tutorial (1) **1 h** for Lab exercises and project design.	a1, a2 , d1
2.	Tutorial (2) for the following subtopics: Vectorial representation of harmonic motion, Complex-number representation of harmonic motion, Complex algebra, Operations on harmonic functions, Definitions and terminology. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (2) **1 h** for Lab exercises and project design.	a1, a2, d1
3.	Tutorial (3) for the following subtopics: Fourier series expansion, complex Fourier Series, frequency spectrum, Time- and frequency- domain representations, Examples using MATLAB. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (3) **1 h** for Lab exercises and project design.	a2, b2, c2, d1
4.	Tutorial (4) for the following subtopics: Free vibration of an un damped translational systems, Equation of motion using Newton's second law of	1	**1 h** for Tutorial (4) **1 h** for Lab exercises and project design.	a1, a2, b2, d1

	motion, Equation of motion using other methods, Equation of motion of a spring-mass System in vertical position, Solution, Harmonic motion. Computer Lab & Experimental Lab.			
5.	Tutorial (5) for the following subtopics: Free vibration of an un damped torsional systems, Response of first order systems and time constant, Rayleigh's energy method. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (5) **1 h** for Lab exercises and project design.	a2, b1, b2, d1, d2
6.	Tutorial (6) for the following subtopics: Free vibration with viscous damping: Equation of motion, Logarithmic Decrement, Energy dissipated in viscous Damping, Torsional systems with viscous Damping. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (6) **1 h** for Lab exercises and project design**.**	a2, b1, b2, d1
7.	Tutorial (7) for the following subtopics: Equation of motion, Response of un-damped system under harmonic force. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (7) **1 h** for Lab exercises and project design	b1, b2, c2, d1
8.	Tutorial (8) for the following subtopics: Response of damped system under harmonic force, Response of damped system under $F(t) = Fe^{i\omega t}$ Computer Lab& Experimental Lab.	1	**1 h** for Tutorial (8) **1 h** for Lab exercises and project design	b1, b2, c2, d1
9.	Tutorial (9) for the following subtopics: Response of a damped system under the harmonic motion of the base, Response of a damped system under rotating unbalance. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (9) **1 h** for Lab exercises and project design**.**	b1, d1
10.	Tutorial (10) for the following subtopics: Response under a general periodic force, First-order systems, Second order systems. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (10) **1 h** for Lab exercises and project design**.**	a2, b1, d1
11.	Tutorial (11) for the following subtopics:	1	**1 h** for Tutorial (11)	a2, b1, c2, d1

	Response under a periodic force of irregular form, Response under a non-periodic force, Response to an impulse, Response to a general forcing condition, Response to Base excitation. Computer Lab & Experimental Lab.		**1 h** for Lab exercises and project design.	
12.	Tutorial (12) for the following subtopics: Introduction, Equations of motion for forced vibration, Free vibration analysis of an un damped system. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (12) **1 h** for Lab exercises and project design**.**	b1, b2, c2, d1
13.	Tutorial (13) for the following subtopics: Torsional system, Coordinate coupling and principal Coordinates, Forced-vibration analysis. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (13) **1 h** for Lab exercises and project design**.**	b1, c1, d1
14.	Tutorial (14) for the following subtopics: Vibration monograph and vibration Criteria, Reduction of vibration at the source, Balancing of rotating machines. Computer Lab & Experimental Lab.	1	**1 h** for Tutorial (14) **1 h** for Lab exercises and project design**.**	b1, c1, d1
Number of Weeks /and Units Per Semester		**14**	**28**	

V.Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- Group Learning.
- Independent Learning and Work.
- Case Studies.
- The Use of Communication and Information Technology.
- Hands-on Laboratory Work.
- Design Work.

VI.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark

1.	Experimentally measure deferent parameters of Harmonic Motion.	a1, a2, b1, b2, c1, c2, d1, d2.	2nd	1
2.	Experimentally measure damping ratio in under-damped systems.	a1, a2, b1, b2, c1, c2, d1, d2.	3rd	1
3.	Problems, Intro to MATLAB.	a1, a2, b1, b2, c1, c2, d1, d2.	4th	1
4.	Damped Free Vibration – MATLAB.	a1, a2, b1, b2, c1, c2, d1, d2.	5th	1
5.	Frequency Response with MATLAB.	a1, a2, b1, b2, c1, c2, d1, d2.	6th	1
6.	MATLAB and Simulink Applications.	a1, a2, b1, b2, c1, c2, d1, d2.	8th	1
7.	Dynamic Vibration Absorbers/MATLAB Applications.	a1, a2, b1, b2, c1, c2, d1, d2.	9th	1
8.	MATLAB Applications for Multi-degree-of-freedom Systems.	a1, a2, b1, b2, c1, c2, d1, d2.	10th	1
9.	Simulink Applications for Multi-degree-of-freedom Systems.	a1, a2, b1, b2, c1, c2, d1, d2.	11th	2
Total			**9 Weeks**	**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.	Project report and Presentation (single/group) and Assignments.	15th	15	10%	a1, a2, b1, b2, c1, c2, d1, d2.
2.	Practical and Lab. Tests.	Weekly	7.5	5%	a1, a2, b1, b2, c1, c2
3.	Written Tests (1) and (2).	6th and 12 th	7.5	5%	a1, a2, b1, b2, c1, c2
4.	Mid-Term Exam.	8 th	15	10 %	a1, a2, b1, b2, c1, c2
5.	Final Exam (practical).	15th	15	10%	a1, a2, b1, b2, c1, c2.
6.	Final Exam (theoretical)	16th	90	60%	a1, a2, b1, b2, c1, c2
	Total		**150**	**100%**	

Head of the Department
Assoc. Prof. Dr. Abdul-Malik Momin

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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

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. S.S. Rao, (2011), Mechanical Vibrations, 5th Edition, Pearson-Prentice hall,
2. William J. Palm III, (2007), Mechanical Vibration, John Wiley & Sons, Inc.

	2- Essential References.
	1. William J. Bottega, (2014), Engineering Vibration, Second Edition, CRC Press. 2. W. T. Thomson, (1998), Theory of Vibration with Applications, Fourth Edition, Chapman & Hall, 3. L. Meirovitch, (2001), Fundamentals of Vibrations, McGraw Hill, 4. S. G. Kelly, (1996), Mechanical vibrations, McGraw Hill, Schaums Outlines, 5. J. Inman, (2000), Engineering Vibration, 2nd Edition, Prentice Hall.
	3- Electronic Materials and Web Sites *etc*.
	1. www.pearsonhighered.com/rao. 2. http://www.me.mtu.edu/courses/meem3700/index.htm. 3. www.howstuffworks.com.

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. Assoc. Prof. Dr. Riyadh Muharam.
	Deputy Rector for Academic Affairs Assoc. Prof. Dr. Ibrahim AlMutaa. Assoc. Prof. Dr. Ahmed Mujahed and Asst. Prof. Munasar Al-Subari.

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

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 students should respect the timing of attending the lectures. They should attend within 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.

Course Plan of System Dynamics and Vibrations

I.Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Asst. Prof. Dr. Abdulsalam Naji Ismaeel.	**Office Hours**					
Location& Telephone No.	-	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	-						

II. Course Identification and General Information:

1.	Course Title:	System Dynamics and Vibrations.				
2.	Course Number & Code:	MT308.				
3.	Credit hours:	C.H				TOTAL CR. HRS.
		Th.	Seminar	Pr	Tu.	
		2	-	2		3
4.	Study level/year at which this course is offered:	Fourth Year- Second Semester.				
5.	Pre –requisite (if any):	Mathematics (1), Engineering Workshop, Engineering Mechanics and Theory of Machines.				
6.	Co –requisite (if any):	System Modeling and Identification.				
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 Labs.				
11.	Location of teaching the course:	Mechatronics Engineering Department.				

III.Course Description:

This course is an introduction to the dynamics and vibrations of lumped-parameter models of mechanical systems. Topics covered include kinematics, force-momentum formulation for systems of particles and rigid bodies in planar motion, work-energy concepts, virtual displacements and virtual work. Students will also become familiar with the following topics: Lagrange's equations for systems of particles and rigid bodies in planar motion, and linearization of equations of motion. After this course, students will be able to evaluate free and forced vibration of linear multi-degree of freedom models of mechanical systems and matrix eigenvalue problems.

IV.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Characterize the basic concepts associated with harmonic response functions, vibration transmissibility, system resonance of one and two-degree-of-freedom systems, coordinate coupling and principal coordinates.	A1
a2.	Identify the natural frequency, damped frequency, logarithmic decrement, and time constant of dynamic systems.	A4
b1.	Investigate the vibration caused by the unbalance in rotating shafts.	B3
b2.	Analyze the response equation of un-damped and viscously damped single-degree-of-freedom systems subjected to different types of harmonic force, including base excitation and rotating unbalance.	B5
c1.	Apply vibration monographs and vibration criteria to determine the levels of vibration to be controlled or reduced.	C1
c2.	Solve a spring-mass-damper system for different types of free-vibration response depending on the amount of damping manually as well as in MatLab.	C.3
d1.	Co-operate with team work for enhancing skills through homework and team projects.	D1
d2.	Review professional quality design project report and oral presentation.	D2

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.	Fundamentals of Vibration.	Basic concepts of vibrations, Classification of vibrations, Vibration analysis procedure, Spring elements, Mass elements, Damping elements.	1	2
2.	Harmonic Motion.	Vectorial representation of harmonic motion, Complex-number representation of harmonic motion, Complex algebra, Operations on harmonic functions, Definitions and terminology.	2	2

3.	Harmonic Analysis.	Fourier series expansion, complex Fourier Series, frequency spectrum, Time- and frequency- domain representations, Examples using MATLAB.	3	2
4.	Free Vibration of Single-Degree-of-Freedom Systems.	Free vibration of an undamped translational systems, Equation of motion using Newton s second law of motion, Equation of motion using other methods, Equation of motion of a spring-mass System in vertical position, Solution, Harmonic motion.	4	2
5.	Free Vibration of Single-Degree-of-Freedom Systems.	Free vibration of an undamped torsional systems, Response of first order systems and time constant, Rayleigh's energy method.	5	2
6.	Free Vibration of Single-Degree-of-Freedom Systems.	Free vibration with viscous damping: Equation of motion, Logarithmic Decrement, Energy dissipated in viscous Damping, Torsional systems with viscous Damping.	6	2
7.	Harmonically Excited Vibration.	Equation of motion, Response of un-damped system under harmonic force.	7	2
8.	Mid -Term Exam.	The First 7 Chapters.	8	2
9.	Harmonically Excited Vibration.	Response of damped system under harmonic force, Response of damped system under $F(t) = Fe^{i\omega t}$	9	2
10.	Harmonically Excited Vibration.	Response of a damped system under the harmonic motion of the base, Response of a damped system under rotating unbalance.	10	2
11.	Vibration Under General Forcing Conditions.	Response under a general periodic force, First-order systems, Second order systems.	11	2
12.	Vibration Under General Forcing Conditions.	Response under a periodic force of irregular form, Response under a non-periodic force, Response to an impulse, Response to a general forcing condition, Response to Base excitation.	12	2

13.	Two-Degree-of-Freedom Systems.	Introduction, Equations of motion for forced vibration, Free vibration analysis of an un damped system.	13	2
14.	Two-Degree-of-Freedom Systems.	Torsional system, Coordinate coupling and principal Coordinates, Forced-vibration analysis.	14	2
15.	Review.	All the Chapters.	15	2
16.	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.	Tutorial (1) for the following subtopics: Basic concepts of vibrations, Classification of vibrations, Vibration analysis procedure, Spring elements, Mass elements, Damping elements. Computer Lab & Experimental Lab.	1	2	a1, a2 , d1
2.	Tutorial (2) for the following subtopics: Vectorial representation of harmonic motion, Complex-number representation of harmonic motion, Complex algebra, Operations on harmonic functions, Definitions and terminology. Computer Lab & Experimental Lab.	1	2	a1, a2, d1
3.	Tutorial (3) for the following subtopics: Fourier series expansion, complex Fourier Series, frequency spectrum, Time- and frequency- domain representations, Examples using MATLAB. Computer Lab & Experimental Lab.	1	2	a2, b2, c2, d1
4.	Tutorial (4) for the following subtopics: Free vibration of an un damped translational systems, Equation of motion using Newton s second law of motion, Equation of motion using other methods, Equation of motion of a spring-mass System in vertical position, Solution, Harmonic motion. Computer Lab & Experimental Lab.	1	2	a1, a2, b2, d1

5.	Tutorial (5) for the following subtopics: Free vibration of an un damped torsional systems, Response of first order systems and time constant, Rayleigh's energy method. Computer Lab & Experimental Lab.	1	2	a2, b1, b2, d1, d2
6.	Tutorial (6) for the following subtopics: Free vibration with viscous damping: Equation of motion, Logarithmic Decrement, Energy dissipated in viscous Damping, Torsional systems with viscous Damping. Computer Lab & Experimental Lab.	1	2	a2, b1, b2, d1
7.	Tutorial (7) for the following subtopics: Equation of motion, Response of un-damped system under harmonic force. Computer Lab & Experimental Lab.	1	2	b1, b2, c2, d1
8.	Tutorial (8) for the following subtopics: Response of damped system under harmonic force, Response of damped system under $F(t) = Fe^{i\omega t}$ Computer Lab & Experimental Lab.	1	2	b1, b2, c2, d1
9.	Tutorial (9) for the following subtopics: Response of a damped system under the harmonic motion of the base, Response of a damped system under rotating unbalance. Computer Lab & Experimental Lab.	1	2	b1, d1
10.	Tutorial (10) for the following subtopics: Response under a general periodic force, First-order systems, Second order systems. Computer Lab& Experimental Lab.	1	2	a2, b1, d1
11.	Tutorial (11) for the following subtopics: Response under a periodic force of irregular form, Response under a non-periodic force, Response to an impulse, Response to a general forcing condition, Response to Base excitation. Computer Lab& Experimental Lab.	1	2	a2, b1, c2, d1
12.	Tutorial (12) for the following subtopics: Introduction, Equations of motion for forced vibration, Free vibration analysis of an un damped system. Computer Lab& Experimental Lab.	1	2	b1, b2, c2, d1
13.	Tutorial (13) for the following subtopics:	1	2	b1, c1, d1

	Torsional system, Coordinate coupling and principal Coordinates, Forced-vibration analysis Computer Lab& Experimental Lab.			
14.	Tutorial (14) for the following subtopics: Vibration monograph and vibration Criteria, Reduction of vibration at the source, Balancing of rotating machines. Computer Lab& Experimental Lab.	1	2	b1, c1, d1
Number of Weeks /and Units Per Semester		**14**	**28**	

VI.Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- Group Learning.
- Independent Learning and Work.
- Case Studies.
- The Use of Communication and Information Technology.
- Hands-on Laboratory Work.
- Design Work.

VII.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Experimentally measure deferent parameters of Harmonic Motion.	a1, a2, b1, b2, c1, c2, d1, d2	2nd	1
2.	Experimentally measure damping ratio in under-damped systems.	a1, a2, b1, b2, c1, c2, d1, d2	3rd	1
3.	Problems, Intro to MATLAB,	a1, a2, b1, b2, c1, c2, d1, d2	4th	1
4.	Damped Free Vibration – MATLAB.	a1, a2, b1, b2, c1, c2, d1, d2	5th	1
5.	Frequency Response with MATLAB.	a1, a2, b1, b2, c1, c2, d1, d2	6th	1
6.	MATLAB and Simulink Applications.	a1, a2, b1, b2, c1, c2, d1, d2	8th	1
7.	Dynamic Vibration Absorbers/MATLAB Applications.	a1, a2, b1, b2, c1, c2, d1, d2	9th	1

8.	MATLAB Applications for Multi-degree-of-freedom Systems.	a1, a2, b1, b2, c1, c2, d1, d2	10th	1
9.	Simulink Applications for Multi-degree-of-freedom Systems.	a1, a2, b1, b2, c1, c2, d1, d2	11th	2
Total			**9 weeks**	**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.	Project report and Presentation (single/group) and Assignments.	15th	15	10%	a1, a2, b1, b2, c1, c2, d1, d2
2.	Practical and Lab. Tests.	Weekly	7.5	5%	a1, a2, b1, b2, c1, c2
3.	Written Tests (1) and (2).	6th and 12 th	7.5	5%	a1, a2, b1, b2, c1, c2
4.	Mid-Term Exam.	8 th	15	10 %	a1, a2, b1, b2, c1, c2
5.	Final Exam (practical).	15th	15	10%	a1, a2, b1, b2, c1, c2.
6.	Final Exam (theoretical)	16th	90	60%	a1, a2, b1, b2, c1, c2
	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. S.S. Rao, (2011), Mechanical Vibrations, 5th Edition, Pearson-Prentice hall,
2. William J. Palm III, (2007), Mechanical Vibration, John Wiley & Sons, Inc.

2- Essential References.

1. William J. Bottega, (2014), Engineering Vibration, Second Edition, CRC Press.
2. W. T. Thomson, (1998), Theory of Vibration with Applications, Fourth Edition, Chapman & Hall,
3. L. Meirovitch, (2001), Fundamentals of Vibrations, McGraw Hill,
4. S. G. Kelly, (1996), Mechanical vibrations, McGraw Hill, Schaums Outlines,
5. J. Inman, (2000), Engineering Vibration, 2 nd Edition, Prentice Hall,

3- Electronic Materials and Web Sites *etc*.

X.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 students should respect the timing of attending the lectures. They should attend within 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. www.pearsonhighered.com/rao. 2. http://www.me.mtu.edu/courses/meem3700/index.htm. 3. www.howstuffworks.com.

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