2023
TP-153

Course Specification
(Bachelor)

Course Title:	Mechanical Vibration
Course Code:	351-MEC-3
Program:	Bachelor of Science in Engineering
Department:	Mechanical Engineering
College:	College of Engineering
Institution:	Najran University
Version:	1.0
Last Revision Date:	27 February 2024

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Fourth Year \ Level 8)					
4. Course general Description:					
This course is an introduction to mechanical vibrations of lumped-parameter models of mechanical systems. Topics covered include Introduction to vibrations, basic concepts, equivalent systems, Fourier analysis. Free damped and undamped vibrations of single degree of freedom systems. Forced vibrations of single degree of freedom systems, transmissibility. Vibration measuring instruments. Whirling of shafts. Free and forced vibrations of two-degree-of-freedom systems, Semi-definite systems, close and far coupled systems. Introduction to matrix method, vibration absorbers. Introduction to multi-degree of freedom systems. Determination of fundamental frequency by Rayleigh's methods.					
5. Pre-requirements for this course (if any)**:**					
312-MEC-3 (MECHANICS OF MACHINES)					
6. Co-requisites for this course (if any)**:**					
NIL					
7. Course Main Objective(s):					
1.Draw a free-body and kinetic diagram for dynamic configurations. 2.Formulate the dynamic equations of motion of problems in vibrations using Newton's second law, Lagrange's equations and any influence coefficients. 3.Design of vibration isolators and to select the appropriate parameters for the vibration absorbers. 4.Demonstrate a basic understanding of the vibration measuring techniques, as well as different instrumentations for measuring and recording vibration signals. 5.Investigate the whirling problem of a rotating flexible shaft when designing a simple rotor-shaft system.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	15
3.	**Field**	
4.	**Tutorial**	15
5.	**Others (specify)**	
Total		60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Introduce the basic concepts and train the students to analyze vibration problems in mechanical engineering and analyzing free and force (harmonic) vibration for single and multi-degree of freedom systems	1	TS:1-Interactive lectures using PowerPoint slides TS:2- Engaging the students in problem-based learning through tutorials TS: 3 – Associating the topics in each chapter with the CLO.	-Test performance evaluation -Evaluation of participation in discussion and group assignments -Written Assessment.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			TS:4 – Conducting quizzes for each chapter TS:5 – Giving more example programs in the lecture TS: 6 – Discussion with the students in the class hours	
1.2	Analyzing vibration response of a single degree of freedom system under general forcing condition and Derive equations of motions for a free and force damped and undamped vibration systems using either Newton's 2nd law.	1	TS:1-Interactive lectures using PowerPoint slides TS:2- Engaging the students in problem-based learning through tutorials TS: 3 – Associating the topics in each chapter with the CLO. TS:4 – Giving more assignment by for each chapter TS:5 – Giving more example programs in the lecture TS: 6 – Discussion with the students in the class hours	-Test performance evaluation -Evaluation of participation in discussion and group assignments -Practical Assessment
2.0	**Skills**			
2.1	Interpret of Mechanical Vibration is an essential part of a comprehensive foundation in the engineering sciences.	6	TS:1-Interactive lectures using PowerPoint slides TS:2- Engaging the students in problem-based learning through tutorials TS: 3 – Associating the topics in each chapter with the CLO.	•Locally Developed Exams such as Quiz, Mid & Final Exams with scoring rubrics •Assignments involving critical and logical thinking questions

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			TS:4 – Conducting quizzes for each chapter TS: 5 – Discussion with the students in the class hours	•Quizzes
2.2	Mechanical Vibration requires the application of calculus, vector algebra, and other elements of mathematical reasoning and at the heart of Mechanical Vibration is precisely the ability to identify, formulate, and solve engineering problems.	2	TS:1-Interactive lectures using PowerPoint slides TS:2- Engaging the students in problem-based learning through tutorials TS: 3 – Associating the topics in each chapter with the CLO. TS:4 – Conducting quizzes for each chapter TS: 5 – Discussion with the students in the class hours	•Locally Developed Exams such as Quiz, Mid & Final Exams with scoring rubrics •Assignments involving critical and logical thinking questions •Quizzes
3.0	**Values, autonomy, and responsibility**			
3.1	The study of Mechanical Vibration is an essential part of a comprehensive foundation in the engineering sciences.	5	TS:1-Interactive lectures using PowerPoint slides TS:2- Engaging the students in problem-based learning through tutorials TS: 3 – Associating the topics in each chapter with the CLO. TS:4 – Conducting midterm and Final Exam for each chapter TS:5 – Giving more example programs in the lecture	Locally Developed Exams such as Quiz, Mid & Final Exams with scoring rubrics •Assignments involving critical and logical thinking questions •Quizzes

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			TS: 6 – Discussion with the students in the class hours	
3.2	Training in Mechanical Vibration, particularly in developing sound problem-solving methodology, will prepare students for graduate school, to conduct research, and otherwise to discover knowledge throughout life.	5	TS:1-Interactive lectures using PowerPoint slides TS:2- Engaging the students in problem-based learning through tutorials TS: 3 – Associating the topics in each chapter with the CLO. TS:4 – Conducting midterm and Final Exam for each chapter TS:5 – Giving more example programs in the lecture TS: 6 – Discussion with the students in the class hours	Locally Developed Exams such as Quiz, Mid & Final Exams with scoring rubrics •Assignments involving critical and logical thinking questions •Quizzes

C. Course Content

No	List of Topics	Contact Hours
1.	Basic concepts of vibrations, Classification of vibrations, Vibration analysis procedure, Spring elements, Mass elements, Damping elements.	8
2.	Vectorial representation of harmonic motion, Fourier series expansion, complex Fourier Series, frequency spectrum, Time and frequency- domain representations, Examples using MATLAB.	8
3.	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.	8
4.	Free vibration with viscous damping: Equation of motion, Logarithmic Decrement, Energy dissipated in viscous Damping, Torsional systems with viscous Damping.	8
5.	Equation of motion, Response of un-damped system under harmonic force	8

6.	Response of a damped system under the harmonic motion of the base, Response of a damped system under rotating unbalance.	8
7.	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.	6
8.	Introduction, Equations of motion for forced vibration, Free vibration analysis of an undamped system.	6
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignments	1-12	10%
2.	Quizzes	1-12	10%
3.	Mid-terms	6 & 12	20%
4.	labs	2-8	10%
5.	Final exam	15	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Mechanical Vibrations, 5th Edition, S.S. Rao, (2011), Pearson-Prentice hall,
Supportive References	1. William J. Palm III, (2007), Mechanical Vibration, John Wiley & Sons, Inc. 2. William J. Bottega, (2014), Engineering Vibration, Second Edition, CRC Press. 3. W. T. Thomson, (1998), Theory of Vibration with Applications, Fourth Edition, Chapman & Hall,
Electronic Materials	1.www.pearsonhighered.com/rao. 2.http://www.me.mtu.edu/courses/meem3700/index.htm. 3.www.howstuffworks.com.
Other Learning Materials	NA

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms and laboratories
Technology equipment (projector, smart board, software)	--
Other equipment (depending on the nature of the specialty)	--

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Program Leaders and Peer Reviewer	Direct, Indirect
Effectiveness of Students assessment	Students & Faculty	Direct and Indirect
Quality of learning resources	Students & Faculty	Direct and Indirect
The extent to which CLOs have been achieved	Students & Faculty	Direct and Indirect
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	DEPARTMENT OF MECHANICAL ENGINEERING
REFERENCE NO.	
DATE	27/02/2023