

BMEE314E	Mechanical Vibrations and Acoustics	L	T	P	C
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Pre-requisite	BMEE207L, BMEE207P	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To enable students to understand the fundamental concepts of mechanical vibrations and acoustics. 2. To impart knowledge on the concept of vibration for single, two and multi degree of freedom systems. 3. To formulate mathematical models and complete solution of mechanical vibration and acoustic problems. 4. Obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF). 					
Course Outcomes					
At the end of the course, the student will be able to					
<ol style="list-style-type: none"> 1. Formulate the equations of motion for the given vibratory systems. 2. Examine the free and forced vibration response of a single degree of freedom system under damped or un-damped condition. 3. Investigate dynamic characteristics of two degree of freedom systems. 4. Investigate the vibration response of multi-degree of freedom systems by performing modal analysis. 5. Examine the vibration response for continuous systems. 6. Demonstrate the fundamentals concepts of acoustics and its control methods. 					
Module:1	Fundamentals of Vibration	6 hours			
Introduction, Degree-of-freedom, Classification of vibration, Vibration terminology, Harmonic Motion, Periodic Motion, Modelling of vibratory system, Equations of motion, Force and moment balance, energy methods.					
Module:2	Single degree of freedom System	6 hours			
Free vibration of undamped and damped SDOF systems, Harmonically excited vibration response of undamped and damped SDOF systems, Transmissibility, Estimation of damping, Logarithmic decrement, Quality factor, Introduction to Transient vibration.					
Module:3	Two Degree of Freedom System	6 hours			
Introduction to two degrees of freedom system, Equation of motion, Coordinate coupling and principal coordinates, Normal mode analysis, Properties of mode shapes, Forced vibration, Vibration absorber, Vibration isolation.					
Module:4	Multi Degree of Freedom System	7 hours			
Derivation of equation of motion, Free and forced vibration systems, Eigen value and Eigen vector, Orthogonal properties, Modal matrix, Modal analysis, Influence Coefficients, Approximate Numerical Methods.					
Module:5	Vibration of Continuous Systems	6 hours			
Systems governed by wave equations, Transverse Vibration of strings, Longitudinal Vibration of bars, Torsional Vibration of Shafts, Lateral Vibration of beams.					
Module:6	Fundamental of Acoustics	6 hours			
Introduction to acoustics, loudness, decibel scale, adding decibels, weighting sound levels, octave, music scales, sound pressure and power levels, sound fields – near, far and free and reverberant, inverse square law, wave number, Equation of state, continuity, Euler's					

equation. Linear wave equation and its solution.			
Module:7	Acoustics Concepts	6 hours	
Acoustic intensity, specific acoustic impedance, plane waves, spherical waves, cylindrical waves, reflection and transmission, radiation, absorption and attenuation, noise control methods, vibration and acoustic measurements.			
Module:8	Contemporary issues:	2 hours	
Total Lecture hours:		45 hours	
Text Books			
1.	Rao S.S, Mechanical Vibrations, 2016, 6 th Edition, Pearson Education.		
2.	Lawrence E. Kinsler, Austin R. Frey, Alan B, 2000, Coppers and James V. Sanders, Fundamentals of Acoustics, 4th Edition, John Wiley & Sons Inc, Delhi.		
Reference Books			
1.	Dukkipati RV, Advanced Mechanical Vibrations, 2012, Narosa Publications.		
2.	Kelly SG, Mechanical Vibrations, 2013, Mcgraw Hill (India) Ltd.,		
3.	W.T. Thomson, Theory of Vibration with Applications, 2013, 5 th Edition, Prentice – Hall.		
4.	L. Meirovitch, Elements of Vibration Analysis, 2001, Tata McGraw-Hill: New Delhi.		
5.	Munjal M. L., Noise and Vibration Control, , 2013, World Scientific Publishers in Collaboration with IISc Press, Singapore.		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT			
Indicative Experiments			
1.	To determine the radius of gyration 'k' of Simple and Compound Pendulum.		
2.	To verify the Dunkerley's rule.		
3.	Determination of Natural Frequency in Longitudinal Vibrating System.		
4.	To study the forced vibration of the beam with different boundary conditions.		
6.	To study the forced damped vibration of spring mass system.		
7.	To determine the radius of gyration of using bi filar system.		
8.	To determine the radius of gyration using tri-filar system.		
9.	To determine the natural frequency of undamped torsional vibration of a single and two rotor shaft system.		
10.	To study the damped torsional vibration of single rotor system and to determine the damping coefficient.		
11.	Determination of natural frequency and damping of beam using accelerometer and impact hammer.		
12.	Measurement of Noise.		
Total Laboratory Hours			30 hours
Text Book			
Lab manual prepared by the faculty member.			
Mode of assessment: Continuous assessment, FAT, Oral examination			
Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022