Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2021-2022

Course Handout Part II

Date: 09-08-2021

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **DE G611**
Course Title : ***DYNAMICS & VIBRATIONS***
Instructor-in-Charge : Sabareesh G R
Instructor for lab : Hemanth Mithun Praveen

Description: Steady and transient Vibration of single and multi degree freedom systems. Systems with distributed mass and elasticity. Nonlinear and self-excited vibrations, structural damping, Random vibrations, vibration analysis, vibration control - reduction, isolation and vibration absorber

Scope and Objective of the Course:

The course covers advanced topics in dynamics and vibrations. The emphasis is on application to common engineering situations. The main aim of the course is to prepare students to tackle complex and frontier technological problems in dynamics and vibrations. Advanced topics like Non-linear system analysis are included in **Part A** (Vibrations). The analysis of increasingly complex system has been instrumental in the development of advanced concepts like Lagrange and variation calculus, which forms the core of **Part B** (dynamics).

Textbooks:

1. "Advanced dynamics for Engineering Application", EDD Notes by N N SHARMA
2. "Elements of Vibration analysis", Leonard Meirovitch, McGraw-Hill, Singapore, 1986.

Reference books

1. "Classical Dynamics",Donald T. Greenwood, Prentice Hall Inc. Englewood Cliffs, 1977
2. "Lagrangian and Hamiltonian mechanics" M.G. Calkin, World Scientific, Singapore, 1996
3. "The Theory of classical dynamics", J.B. Griffiths, Cambridge University Press, 1985.
4. "Vibration Theory and application", William T. Thomson, CBS Publications, 3rd Ed., 1988.
5. "Mechanical Vibrations - Theory and Application" Francis S. Tse, Ivan E. Morse and Rolland T.Hinkle, Allyn and Bacon Inc. London, 1983.

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Text Book
1-3	Introduction to the concept of Vibration-Steady	Review of Basics, Equivalent spring and mass elements	TB 2, RB 4
4-6	Single DOF Vibrations	Review of Single DOF free damped and undamped Vibrations & forced Vibrations	TB 2, RB 4

7-9	Higher DOF Vibrations	Two DOF, Modal vectors Eigenvalue Problems	TB 2, RB 4
10-12	Extension to Multi DOF Vibrations	Lumped Parameter models	TB 2, RB 4
13	Structural and Coulomb damping	Different types of damping and energy dissipated in damping	TB 2, RB 4
14-16	Vibration control - reduction, Vibration isolation, Vibration absorbers	Understanding vibration control, Methods for Isolation of Vibration, Methods for Absorbing vibration	TB 2, RB 4
17-21	Transient Vibrations	Impulse Excitation, Arbitrary Excitation, Laplace Transform formulation	TB 2, RB 4
22-25	Finite Element method Equation of motion using FEM	General Discussion, Stiffness and Flexibility coefficients	TB 2, RB 4
26-27	Continuous Systems	Vibrating String, Longitudinal vibration of rods, torsional vibration of rods	TB 2, RB 4
28-29	Introduction to Nonlinear systems and Self-excited vibrations	General consideration, Perturbation Technique	TB 2, RB 4
30-31	Random vibrations	Bending vibration of Bars Boundary conditions	TB 2, RB 4
32-35	Vibration Analysis	Machinery Vibration Analysis, Techniques and Methods	TB 2, RB 4
36-37	Review Newtonian Mechanics	Newton's law, Principle of virtual work, D Alembert's Principle Examples	TB 1 RB :1,2
38-41	Lagrange Mechanics Formulation and application of Lagrange Mechanics	Lagrange Mechanics Engineering Application	TB 1 RB : 1,2
42	Introduction to Hamiltonian Mechanics	Hamilton's equation, Langrage equation for impulsive forces	TB 1 RB : 1,2
43	Formulation of Hamiltonian Mechanics	Formulation for Hamiltonian Principle, Application of Hamilton's principle	TB 1 RB : 1,2

Evaluation Scheme:

Component	**Duration**	**Weightage**	**Date & Time**	**Nature of component**
Mid-Semester Test	90 min	25%		OB
Project		10%		OB
Term paper		10%		OB
Practical		20%		OB
Comprehensive Examination	120 mins	35%	23/12 FN	OB

Chamber Consultation Hour: To be announced in the class.
Notices: All the notices regarding the course will be displayed on the CMS.

Make-up Policy: Only for genuine cases with prior permission

Dynamics and Vibration Laboratory- List of Experiments

Lab No	Experiment/Simulation	Schedule	Mode
1	Introduction Lab	Week 1	
2	Study of response of critically damped system	Week 2	Matlab
3	Study of response of under damped system	Week 3	Matlab
4	Study of response of over damped system	Week 4	Matlab
5	Modal& Harmonic Analysis of I Section beam	Week 5	ANSYS
6	Modal & Harmonic Analysis of Pentagonal plate	Week 6	ANSYS
7	Modal & Harmonic Analysis of pressure vessel	Week 7	ANSYS
8	Study of Static and Dynamic Balancing	Week 8	Video Mode
9	Calculation of frequency of undamped free vibration of equivalent spring mass system	Week 9	Video Mode
10	Study the modes of vibration and measure the frequency using Whirling of Shaft Apparatus	Week 10	Video Mode
11	Study of fault diagnosis in gearbox of wind turbine	Week 11	Video Mode
12	Study of fault diagnosis in 4-cylinder SI engine	Week 12	Video Mode

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

INSTRUCTOR-IN-CHARGE