BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
HYDERABADCAMPUS
INSTRUCTION DIVISION
FIRST SEMESTER 2016-2017
Course Handout Part-II

Date: 01/08/2016

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. **: CE G551**
Course Title **: DYNAMICS OF STRUCTURES**
Instructor-in-charge **: Dr. Mohan S C**

❖ Scope and Objective of the Course:

Natural phenomena and man made events usually impose forces of time-dependent variability on various civil engineering structures and consideration of these are essential to design a structure resistant to these type of forces.Hence,this course is focused on analysis of structures, subjected to dynamic loads such as buildings, bridges, tanks, industrial structures, tall chimneys, highway infrastructure etc subjected to earthquake excitations.

At the end of the course, students will be able to understand and analyse the behaviour of structures under dynamic loading. They willbe able to design a structure which is resistant to dynamic loading such as seismic, wind, vehicle induced vibration etc. Hence, this course will be useful for students desirous of designing structures resistant to time dependent forces such as seismic, wind, vehicle induced vibrations etc.

❖ Text Book (TB):

1. Chopra, Anil K. “Dynamics of Structures: Theory and applications to earthquake engineering”, Pearson Edu., 4th edition, 2012.

❖ Reference Books (RB):

1. R.W. Clough and J. Penzien, “Dynamics of Structures”, Second edition, McGraw Hill International edition, 1993.
2. M. Mukhopadhyay, “Structural Dynamics: Vibrations & Systems” Ane’s Student Edition,2010.
3. Mario Paz, “Structural Dynamics - Theory and Computation”, Van Nostrand, 1985.
4. J.L.Humar, “Dynamics of Structures”, Prentice Hall India Ltd., 1990.
5. L. Meirovitch, “Elements of Vibration Analysis”, 2nd Ed., McGraw-Hill, 1986.
6. Daniel J. Inman, “Engineering Vibration”, Prentice Hall of India Ltd., 2001.
7. Singiresu S. Rao, “Mechanical Vibrations” Pearson Education.2010.
8. Roy R Craig,Jr., “Structural Dynamics”, John Wiley & sons, 1981.
9. J. M. Biggs, “Introduction to Structural Dynamics”, McGraw-Hill, 1964.
10. N.C. Nigam, “Introduction to Random Vibration”, MIT Cambridge, 1983.
11. L. Fryba, “Dynamics of Railway Bridges”, Thomas Telford, 1996.
12. E. Siniu and R.H. Scanlan, “Wind effects on structures: fundamentals and applications to design”, John wiley and sons, 1997.
13. P.Agarwal, and M. Shrikhande, “Earthquake resistant design of structures”, Prentice-Hall India.2006.
14. Patrick Paultre. “Dynamics of Structures” Wiley, Reprint 2013.

❖ **Course Plan**

Lec. No.	Learning Objective	Topics to be covered	Ref.	Teaching Mode
I.	**Introduction to Dynamics of Structures**			
1	Importance of the course	Introduction and Scope of dynamic analysis of structures;origins of vibration theory and experiment; review of earlier concepts: d'Alembert's principle, equations of motion.	TB	PPT/BB
2-3	Fundamentals of Dynamics of Structures	Elements of a structural system: springs, mass; Springs in parallel and series; methods to formulate equations of motion: Newton's equation of motion.	TB	PPT / BB
II.	**Single Degree of Freedom (S.D.O.F) System(Discrete Mass Systems)**			
4-5	Free vibration analysis	Formulation (equation of motion) and solution of undamped and damped free vibration analysis of S.D.O.F system.	TB	PPT / BB
6-8	Forced vibration analysis	Formulation (equation of motion) and solution of undamped and damped forced vibration analysis of S.D.O.F system.	TB	PPT / BB
9-11	General dynamic load analysis	Evaluation of Response for SDOF system for general dynamic loading like periodic, step, impulse etc.	TB	PPT / BB
III.	**Multi Degree of Freedom (M.D.O.F) Systems**			
12-15	Analysis of MDOF	Development of equation of motion and solution for Multi degree of freedom systems.(Free and Forced)	TB	PPT / BB
16-18	Modal analysis of MDOF systems	Evaluation of natural frequencies, modeshapes, orthogonality conditions and modal combination rules.	TB	PPT / BB
19-22	Dynamic Analysis under support excited vibration	Response history analysis under support excited vibration; Response spectram analysis, modal combination rules using absolute sum, SRSS and CQC method.		
23-26	Numerical evaluation for MDOF systems	Approximate methods for obtaining natural frequencies and mode shapes; Reyleigh-Ritz method; Time history analysis; Central Difference method; Newmark beta method; average and linear acceleration method.	TB	PPT / BB
IV.	**Free and Forced Vibration of Continuous Systems**			
27-28	Derivation of equation of motion	Equations of motion;undamped free vibration;forced response.	TB	PPT/BB
29-30	Application for continuous systems	Vibration of bars and beam, modal analysis; bars (axial vibrations), beams.	TB	PPT/BB
V.	**Modeling and Dynamic Analysis**			
31-35	Dynamic analysis using FEM	Modelling and Dynamic analysis of beam, frame, bridge, multi-story building, water tank, etc.	RB-2	PPT/ BB
36-37	Vibration isolation	Vibration absorber and tuned mass damper;		
VI.	**Random Vibration**			
38-40	Random vibration	Introduction of random vibration; stochastic processes; Stochastic response of SDOF systems;	RB-10	PPT/BB
VII.	**Frequency Domain Analysis of Structures**			
41-42	Frequency domain analysis	Response of Multi-degree systems in frequency domain.	Note/ RB-14	PPT/BB

❖ **Evaluation Scheme:**

EC No.	Evaluation Component	Duration	Weightage	Date, Time & Venue	Nature of Component
1.	Test I	60 Min	15%	8/9, 10.00--11 AM	CB
2.	Test II	60 Min	15%	25/10, 10.00--11 AM	CB
3.	Laboratory / Assignments		20%		OB
4.	Term Paper/ Projects		20%		OB
5.	Compre Exam.	180 Min	30%	08/12 FN	OB

❖ Chamber Consultation Hour: Will be announced in class

❖ **Notice**: Notices will be displayed on Department of Civil Engg. notice board only.

Instructor-in-Charge
CE G551