Important notes pertaining to ME354A

Title of the Course: (Vibration & Control) 3L-0T-1P-0A (10 Credits)
(Pre-requisite: ESO209)

Objective of the course: This course will introduce the students to the concepts of vibrations in single and multi-degree of freedom systems, approximate methods and classical control theory. The course will also include brief discussions on advanced topics in vibrations and control.

Course content: Introduction to modeling of dynamical systems. Single Degree of Freedom Systems – Free undamped vibration, Free damped vibration, Forced vibration, Transmissibility, Convolution method, Mechanisms of damping. Two Degree of Freedom System (undamped vibration only) – Free and forced vibrations, vibration absorber. Multi Degree of Freedom Systems (undamped and proportional damping) – Matrix methods, Modal analysis. Approximate Methods. Vibration of continuous systems (free vibration only).

Introduction to controls. Review of Laplace transforms. Block diagrams. Root locus method. Stability – Routh-Hurwith criterion, Nyquist plots. Bode plots. Controller performance and types. Steady state errors and constants. Feedback control systems – Derivative error compensation, Integral error compensation, Proportional error compensation. Modern control. Digital control.

Lecture-wise breakup:

Sl No	**Topic**	**Suggested number of lectures**
1	Introduction – modelling of dynamical systems	1
2	Vibrations of single degree of freedom systems – Free undamped, Free damped, Forced vibration, Transmissibility, Convolution method, Mechanisms of damping.	9
3	Two Degree of Freedom System (undamped vibration only) – Free and forced vibration, vibration absorber.	5
4	Multi Degree of Freedom Systems (undamped and proportional damping) – Matrix methods, Modal analysis.	4
5	Approximate methods – Rayleigh method.	2
6	Vibration of continuous systems (free vibration only).	2
7	Introduction to controls.	1
8	Review of Laplace transforms.	2
9	Block diagrams.	1
10	Root locus method.	2
11	Stability – Routh-Hurwith criterion, Nyquist plots.	3
12	Bode plots,	2
13	Controller performance and types.	1
14	Steady state errors and constants.	1
15	Types of feedback control systems – Derivative error compensation, Integral error compensation, Proportional error compensation.	2
16	Modern control.	1

17	Digital control.	1
Total number of lectures		**40**

Laboratory sessions:

Sessions	Name of Experiment
1	Study of Dynamic Vibration Absorber
2	Study of transmissibility in a single degree of freedom system.
3	Forced and free vibration study of a rigid beam-spring-damper system.
4	DC Motor Speed Control with Various Sensors
5A 5B	Measurement of Linear Displacement by Potentiometer Speed Torque Characteristics of DC Servomotor.
6	Study of characteristics of a PID Control using the control kit
Total number of laboratory sessions: 6	

Suggested text and reference materials:

1. Theory of Vibrations. W. T. Thomson, Prentice Hall.
2. Control Systems Engineering. N. S. Nise, John Wiley & Sons.
3. Vibration Problems in Engineering. W. Weaver, S. P. Timoshenko and D. H. Young, John Wiley & Sons.
4. Mechanical Vibration. J. P. Den Hartog, Dover Publications.
5. Feedback Control of Dynamic Systems. G. Franklin, J. D. Powell, and A. Emami-Naeini, Prentice Hall.
6. Modern Control Engineering. K. Ogata, Prentice Hall.

Grading Policy:

End-semester examination	40% (Appearing in end sem exam is compulsory)
Mid-semester examination	30%
Quizzes (best 4)	15%
Lab reports	05%
Lab quiz	10%

In case, it is not possible to take the lab quiz, lab reports will have a share of 15%.

Note:

1) There is no weightage associated with the assignments that will be given every week as well as for attendance in the class. However, those who do their assignments themselves and are regular to the class, should be easily able to score at least 60% marks. Keeping this in view, you are expected to get a minimum of 35% marks to secure a passing grade.
2) The lab report is supposed to have a detailed theory about the experiment being conducted, details of the experimental set-up, the results and their interpretation and most importantly the reason for deviation of the experiment from the theoretical result (if such a discrepancy exists). On top of this, the report should also highlight the contribution of each individual member.