BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
SECOND SEMESTER 2015-2016
Course Handout (Part II)

Date: 13/01/2016

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

Course No. : **EEE/INSTR F242**
Course Title : **Control Systems**
Instructor-in-charge : **HARI OM BANSAL**
Instructors : **Hari Om Bansal, Pawan K Ajmera, Pradyumn Chaturvedi, Mahesh Angira, Ashish Patel**

1. Scope & Objective of the Course:

Feedback automatic control systems are an essential feature of numerous industrial processes, scientific instruments and even commercial, social and management situations. A thorough understanding of the elementary principles of this all embracing technology is of great relevance for all engineers and scientists. This course tries to bring out the basic principles of Feedback Control Systems.

2. Text Book: Nagrath I. J. and M. Gopal, Control Systems Engineering, New Age International (P) Ltd, 5th ed, 2007.

3. Reference Books:

(i) Kuo, B. C., and Golnaraghi, F., Automatic Control Systems, John Wiley & Sons, 8th ed, 2003.
(ii) Drof, R. C., and Bishop, R. H., Modern Control Systems, Addison Wesley, 7th ed, 1995.

4. Course Plan:

Lect. No.	Topic	Learning object(s)	Ref. to Text Book/ Class Notes
1.	Introduction Concept of Measurement, feedback and automatic control Example from various fields	General understanding of the concept of control. Identification of various examples encountered in life from engineering and non-engineering fields as well	1.1, 1.2
2.	History of Contr Classification of Systems; Linear/non-linear ; analog/digital time invariant/ time varying lumped/distributed parameters	-do-	1.3, 1.4
3-4.	Mathematical Modelling. Integro-differential equations for electrical, mechanical and electromechanical systems Transfer functions	Understanding examples from various fields and making block diagram model of the same. Working out transfer function by various methods	2.1, 2.2, 2.4
5.	Example of Control with armature Controlled dc motor as drive. Block diagram development, closed loop transfer function	- do -	2.4
6-7.	Example of Control with field controlled dc motor, gear reduction, disturbance input Block diagram reduction examples.	- do -	2.4,2.5
8-9.	Signal flow graph: Mason's gain formula, Various Examples	- do -	2.6,
10.	Liquid Level Control Example, MIMO systems	- do -	Class Notes, 2.2
11.	Open loop and closed loop example, Effect on gain, dynamic response, disturbance input,	Learning about more examples of open loop and closed loop control systems and their comparison	3.1
12.	Sensitivity to parameter variations. Concept of frequency content in signals,	- do -	3.2, 3.6, 3.7

	regenerative feedback, further examples		
13.	Carrier control system, Linearisation of non-linear relationship of ac servomotor, ac tacho generator	Learning about control components and their use in various examples; making block diagram and deriving transfer function	4.1, 4,2, 4.3
14.	Synchro pairs, Stepper motors	- do -	4.3,4.4
15.	Hydraulic and Pneumatic control components	- do -	4.5, 4.6
16.	Various Test signals in time domain, Response of zeroth and first order systems Second order systems	Transient response analysis of dynamic systems to different excitations - do -	5.1, 5.2, 5.3 5.4
17-19.	Time response specifications of second order systems, error constants, effect of adding pole(s)/zero(s)	- do -	5.4, 5,5, 5.6
20.	Compensation Techniques Higher order systems	To design control system for given time domain specifications.	5.7, 5.8, 5.10
21-22.	Stability; Routh Test	To apply Routh Test to closed loop system stability study	6.1 to 6.6
23-24.	Root Locus: Introduction, Magnitude and Angle criterion	To draw root locus for various systems and therefrom infer information on time response and stability	7.1, 7.2
25.	Root Locus for second order systems without zero and with zeros	- do -	7.2
26.	Other rules of root locus Higher order examples	- do -	7.3 7.5
27.	Higher order examples (contd.) Root contours	- do -	7.4
28.	Frequency Response; Introduction, Polar plot	To plot frequency response of systems and use for analysis by frequency domain approach	8.1, 8.2, 8.3
29.	Bode plot	- do -	8.4
30-31.	Identification of Transfer function from Bode plot, Gain margin and phase margin	- do -	8.5 & 8.6, 9.4
32.	Nyquist criterion; Introduction Nyquist contour	Investigation of closed loop system stability using their open loop transfer function frequency plot	9.1, 9.2, 9.3
33.	Nyquist stability criterion. Various Examples	- do -	9.3
34-37.	Introduction to Design	To design lag, lead compensators, Tuning of PID controllers	10.1-10.7
38-40.	State variable analysis and design	Analysis and design of a system using state variable approach	12.1 to 12..9

5. Evaluation Scheme:

Component	Duration	Weightage	Date & Time	Remarks
Midsem Test	90 Min	90 (30%)	18/3 2:00 -3:30 PM	OB
Tutorials	15Min	80 (26.67%)	To be announced	CB
Comprehensive Exam.	3 hours	130 (43.33%)	13/5 FN	CB

6. Chamber Consultation Hours: to be announced in the class.

7. Notices: All notices will be displayed on NALANDA/EEE Notice Board only.

8. Makeup Policy: Makeup will be granted to extremely genuine cases only.

(Instructor-In-Charge, EEE/INSTR F242)