Course code	Course name	L-T-P-Credits	Year of Introduction
AE405	ADVANCED CONTROL THEORY	3-0-0-3	2016

Prerequisite: AE301 Control system

Course objectives

- To study the basic theory required for solving complex control problems.
- To do analysis and modelling of systems and signals.

Syllabus

Concept of state space - Linear time varying system - Non-linear system - Describing function analysis -Lyapunov stability analysis – Controllability- Observability - Z- Transform - Discrete root locus.

Expected outcome

- At the end of the semester students will have comprehensive knowledge in advanced control theory.

Text Books/Reference books

1. C. D. Johnson, *Process Control Instrumentation Technology*, 7th ed., Prentice Hall of India, New Delhi, 2003
2. K.Ogata "*Discrete Time Control Systems*" , 1996, PHI.
3. K.Ogata "*Modern Control Engineering*" , 1996, PHI.
4. M. Gopal, "*Modern Control System Theory*",New Age International Publishers, 2nd edition,1996
5. Madangopal "*Digital control and state variables methods*" 1997, PHI.
6. R. C. Dorf and R. H. Bishop, *Modern Control Systems*, 8th ed., Pearson Education, Delhi, 2004

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Concept of state space-state space representation of system, solution of time invariant state equation- state transition matrix. Linear time varying system. Discrete system state space representation and solution.	6	15%
II	Non-linear system, types of non-linearity, singular point, non-linear system stability analysis- phase plane technique, construction of phase trajectories, isocline method.	6	15%
	FIRST INTERNAL EXAMINATION		
III	Describing function analysis : Basic concepts, derivation of describing functions for common non-linearities Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.	7	15%
IV	Lyapunov stability analysis- definition of stability, instability and asymptotic stability. Lyapunov stability theorems. Stability analysis of simple linear systems.	7	15%
	SECOND INTERNAL EXAMINATION		

V	MIMO systems-controllability- Observability- Effect of pole-zero cancellation, Practical examples-controllable and uncontrollable systems-observable and unobservable systems. Optimal control system-definition- design using state variable feedback and error squared performance indices.	8	20%
VI	Z- Transform and digital control system- Z-transfer function- block diagram- signal flow graph- discrete root locus.	8	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)