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Course code	Course name	L-T-P-Credits	Year of Introduction
AE301	CONTROL SYSTEM	3-1-0-4	2016

PREREQUISITE : Nil

Course objectives

- To familiarize the modelling of linear time invariant systems and their responses in time and frequency domain.
- To learn state space techniques

Syllabus

Mathematical model of systems – transfer function – block diagram -System analysis-time domain analysis- stability of linear systems -frequency domain analysis- state variable analysis –state diagram.

Expected outcome

At the end of the semester students will be able to understand and analyse the different behaviour of system performances.

Text Books

1. I J Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers, New Delhi,1997
2. M. Gopal, Digital Control and State Variable Methods, 2 nd ed., Tata McGraw Hill, New Delhi, 2003

Reference Books

1. G. J. Thaler, Automatic Control Systems, Jaico Publishing House, Mumbai, 2005
2. K. Ogata, Modern Control Engineering, 4th ed., Pearson Education, Delhi, 2002
3. B. C. Kuo, Automatic Control Systems, 7th ed., Prentice Hall of India, New Delhi, 1995
4. R. C. Dorf and R. H. Bishop, Modern Control Systems, 10th ed., Pearson Education, Delhi, 2004

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	System Analysis: Systems, subsystems, and stochastic and deterministic systems - Principles of automatic control -Open loop and closed loop systems -Principles of superposition and homogeneity-Transfer Function Approach: Mathematical models of physical systems and transfer function approach - Impulse response and transfer function -Determination of transfer functions for simple electrical, mechanical, electromechanical, hydraulic and pneumatic systems - Analogous systems -Multiple-input multiple-output systems: Block diagram algebra - block diagram reduction -Signal flow graphs -Mason's gain formula.	8	15%
II	Time Domain Analysis: Standard test signals -Response of systems to standard test signals –Step response of second order systems -Time domain specifications (of second order system) -Steady state response -Steady state error -Static and dynamic error coefficients -Zero input and zero state response	8	15%
	FIRST INTERNAL EXAMINATION		
III	Stability of linear systems -absolute stability -relative stability	8	15%

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	-Hurwitz and Routh stability criterion -Root locus method - construction of root locus -root contours -root sensitivity to gain k -effect of poles and zeros and their locations on the root locus.		
IV	Frequency Domain Analysis: Frequency response representation -Frequency domain specifications -Correlation between time and frequency response -Polar plots - Logarithmic plots -Bode plots – All pass, minimum-phase and non-minimum-phase systems -Transportation lag - Stability in frequency domain -Nyquist stability criterion - Stability from polar and bode plot -Gain margin and phase margin -relative stability -M-N circles -Nichols chart.	9	15%
SECOND INTERNAL EXAMINATION			
V	State Variable Analysis: Concepts of state, state variables, state vector and state space -State model of continuous time systems Transformation of state variable -Derivation of transfer function from state model -invariance property	9	20%
VI	State diagram -State variable from transfer function -bush or companion form -controllable canonical form - observable canonical form -Jordan canonical form -Diagonalization-State transition matrix -computation of state transition matrix by Laplace transform, Cayley-Hamilton theorem -Controllability and observability of a system. (proof not required)	10	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)