Course code	Course Name	L-T-P-Credits	Year of Introduction
ME362	Control System Engineering	3-0-0-3	2016

Course Objectives: :

1. To introduce the concepts of controls and modelling of physical systems.
2. To give idea on system response analysis and stability of systems.
3. To use different methods to analyse stability of control systems

Syllabus:

Control systems and components, Mathematical models, Block diagrams, Signal Flow graphs, Transient and Steady state response analysis, Stability , Routh's stability criterion, Root locus method. Frequency response analysis using polar plots ,Bode plots, Nyquist stability criterion

Expected Outcomes: At the end of the course students will be able

1. To model and analyse physical systems.
2. To analyse the stability of feedback control systems

Text books:

1. Kuo, B. C., Automatic Control Systems, Prentice Hall,2012
2. Thaler and Brown, Analysis and Design of Feedback Control Systems, McGraw Hill, 1960.
3. Nagrath I J and Gopal M, Control Systems Engineering, New Age India Pvt Limited, 2009

References:

1. Ogata, K., Modern Control Engineering, Pearson Education, 2004
2. NPTEL courses, http//nptel.iitm.ac.in/courses.php, web and video courses on Control Engineering

COURSE PLAN

Module	Contents	Hours	End Sem. Exam. Marks
I	Introduction to control systems. Elementary ideas on types of control systems- Open loop and closed loop systems, Servo systems, Automatic regulating systems, Process control systems, Adaptive control systems, Learning control systems, Discrete control systems, Multivariable control systems, Linear and Non-linear systems. Elementary ideas on types of controls- proportional, integral, proportional integral, proportional integral derivative controls. Direct and indirect controls. Mathematical models of physical systems – typical examples of mechanical, thermal, electrical, hydraulic and pneumatic systems.	7	15%
II	Block diagram, transfer function, reduction of block diagrams, signal flow graphs :Manson's gain formula. Control system components – servomotors, stepper motor, synchros, hydraulic pumps and motors, hydraulic valves, pneumatic bellows, pneumatic valve, pneumatic relay, pneumatic actuator, gyroscopes (elementary ideas only. No derivations)	7	15%

	FIRST INTERNAL EXAMINATION		
III	System response- Time response of first and second order systems, steady state errors and error constants, specifications in time domain. Effect of pole locations, Concept of stability, Routh's stability criterion	**7**	**15%**
IV	Root locus method of analysis and design. Lead and lag compensation	**7**	**15%**
SECOND INTERNAL EXAMINATION			
V	Frequency response analysis- relationship between time & frequency response, Bode's plot, stability in frequency domain, gain margin and Phase margin	**7**	**20%**
V1	Polar plots, Nyquist stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin.	**7**	**20%**
END SEMESTER EXAMINATION			

Question Paper Pattern

Maximum marks: 100 **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.