M.E Semester: 1
Electrical Engineering (Electrical Power System)
Subject Name: Modern Control Systems

A. Course Objectives:

The educational objectives of this course are

- To understand the basic concepts of modern control theory in relation to the stability of a system.
- To co relate the concepts of control theory with the field of electrical engineering.

B. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
CODE	NAME	L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
		Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
MEEPS102	Modern Control Systems	4	0	2	6	5	3	70	30	20	30	150

C. Syllabus

SR No.	Unit No	Topic	No. of Hours	Weightage In Exam.
1	**Unit:1**	**Mathematical background**: Matrices: Definition of Matrices; Matrix Algebra; Matrix Multiplication and Inversion;Rank of a Matrix; Differentiation and Integration of Matrices.	8	10%
2	**Unit: 2**	**State Variable Analysis:** Introduction, concepts of state, state variables and state model, state-space representation for linear continuous-time systems and discrete-time systems.Time, domain solution of state equations: Solution of homogeneous state equations, state transition matrix, evaluation of matrix exponential (e^{At}), solution of non- homogeneous state equations. **State space representation:** State-space representation of high-order differential equations, state space representation of transfer function in controllable, observable and diagonal form, relationship between state equations and transfer function. Signal flow graph of state equations, decomponsition of transfer function, diagonalization, eigen values and eigen vectors, modal matrix.	20	30%

© 2013. KSV University. All Rights Reserved.

4	**Unit: 3**	**Controllability and Observalibitly:** Concept of Controllability and Observability; Controllability and Observability tests for continuous time system; Controllability and Observability of discrete time system; Controllability and Observability of state model in Jordan canonical form; Loss of Controllability and Observability for sampling	10	15%
5	**Unit: 4**	**Models of Digital control devices and systems** Introduction to z-transform, ROC in z-transform, basic discrete time signals, time domain models of discrete time systems, transfer function models, stability on z-plane and jury stability criteria, z-domain description of sampled continous time plants, , z-domain description of systems with dead time, Implementation of digital controllers, Tunable PID controllers, Methods of tuning industrial PI, PID controllers	12	25%
6	**Unit: 5**	**Nonlinear systems :**Introduction, common physical nonlinearities-saturation,dead-zone,relay,relay with dead zone, hysteresis, backlash, etc, jump resonance, limit cycle.Phase-plane analysis-phase plane and phase trajectory, singular points, construction of phase trajectory, evaluation of time, stability analysis.	10	20%

D. Instructional Methods

- At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
- Two internal exams may be conducted and average of the same may be converted to equivalent of 15 marks as a part of internal theory evaluation.
- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of five marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

© 2013. KSV University. All Rights Reserved.

- The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

E. Student Learning outcomes:

- After completion of the course, students will be able to apply concepts of modern control theory in power system control.

F. Recommended Study Materials

- **Reference Books:**

1. *'Digital control and state variable methods'*, M. Gopal, TATA McGraw Hill Company
2. *'Discrete time control systems'*, Katsushiko Ogata, Prentice Hall Publication,©1995.
3. *'Modern Control Systems'*, M.Gopal, TATA McGraw Hill Company
4. '*Digital control systems*', Benjamin C. Kuo, Oxford University Press, USA, ©1995.

© 2013. KSV University. All Rights Reserved.