SCHEME OF COURSE WORK

COURSE DETAILS:

Course Title	Control Systems
Course Code	13EE1105
Program	B.Tech
Branch	Electrical & Electronics Engineering
Semester	III
Prerequisites	Mathematics-I, Mathematics-II and Basic Network Analysis
Course to which it is prerequisite	All Advanced Courses In Electrical Engineering

COURSE OUTCOMES:

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1	Identify and evaluate the performance of basic open loop and closed loop control systems.
2	Apply and characterize the performance of feedback control systems in time-domain.
3	Analyze and test the performance of feedback control systems in frequency-domain.
4	Explain the concept of root locus, effects of controllers and design compensators.
5	Apply the concept of state-space to test the performance of LTI systems.

COURSE OUTCOME/PROGRAM OUTCOMES:

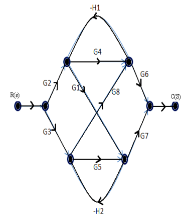
CO'S	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1		S	S				S	M	M	M	M	
CO-2		S	S				S	M	M	M	M	
CO-3		S	S				S	M	M	M	M	
CO-4		S	S				S	M	M	M	M	
C0-5		S	S				S	M	M	M	M	

Assessment Methods	Assignments/Quiz/Mid Exam/Seminar/Viva-Voce/End Exam

TEACHING LEARNING AND EVALUATION

Week	Topic/content	Course outcomes	Sample questions	Teaching-learning stategy	Assesment method & schedule
1	**Unit-I Mathematical Modeling And Transfer Function Representation**	CO-1	1). Compare open loop and closed loop control systems, 2).What are the effects of feedback	Lecture/discussion	Assignment-1 & quiz-1

	: Basic concept of simple control system – open loop – closed loop control systems. Effects of feedback. Types of feedback control systems – Liner time invariant, time variant systems and non linear control systems				
Week-2	Mathematical models and Transfer functions of Physical systems: Differential equations – Impulse response and transfer functions – translational and rotational mechanical systems. Block diagram algebra –	CO-1	1). Define transfer function, derive transfer function of given mechanical or electrical system, 2). Find the transfer function of a system given by block diagram	Lecture/discussion/problem solving	Assignment-1 & quiz-1
Week-3	signal flow graph – Mason's gain formulaComponents of control systems: DC servo motor – AC servo motor – synchro transmitter &Receiver:	CO-1 CO-2	1). using mason's gain formula, obtain $\frac{C(S)}{R(S)}$ ratio of figure shown below	Lecture/discussion/problem solving	Assignment-1 & quiz-1

	unit-II TIME DOMAIN ANALYSIS AND STABILITY: Standard test signals,transient response of first order standard test signals.		 . 2). Find the time response of first order system for standard test signals		
Week-4	Transient response of second order systems to standard test signals.Timedomain specifications - steady state response – steady state error and error constants. Effectof adding poles and zeros on over shoot, rise time, band width – dominant poles of transfer functions.	CO-2	1). Find the time response of second order system for standard test signals, 2. Explain the concept of steady state error analysis	Lecture/discussion/problem solving	Assignment-1 & quiz-1
Week-5	Stability analysis in the complex plane: Absolute, relative, conditional, bounded input – bounded output, zero input stability, conditions for stability, Routh –Hurwitz criterion.	CO-2	1). the open loop transfer function of a unity feedback is given by G(s) = $\frac{K}{(S+2)(S+4)(S^2+6S+25)}$ By applying Routh's criterion. Determine the values of K which will cause sustained Oscillations in the closed loop systems.	Lecture/discussion/problem solving	Assignment-1 & quiz-1

			What are the corresponding oscillations frequencies		
Week-6	**Unit-III FREQUENCY DOMAIN ANALYSIS**: Introduction – correlation between time and frequency responses – polar plots	CO-3	1). Derive expressions for correlation between time and frequency responses. (2). Draw plot, and Determine the range of 'k' for which closed loop system is stable ? $G(S)=\frac{K}{S(S+2)(S+10)}$, H(s) =1	Lecture/discussion/problem solving	Assignment-1 & quiz-1
Week-7	BODE plots,	CO-3	Draw the bode plot for the system having G(s) $=\frac{10}{S(1+0.01S)(1+0.1S)}$. Determine (i).the gain crossover frequency and corresponding phase margin. (ii). The phase cross frequency and corresponding gain margin	Lecture/discussion/problem solving	Assignment-1 & quiz-1
Week-8	Nyquist stability criterion – Nyquist plots.	CO-3	1). Distinguish between polar plots and Nyquist plots.	Lecture/discussion/problem solving	Assignment-1 & quiz-1
Week-9	MID TEST-1	CO-1,CO-2,CO-3			
Week-10	Assessment of relative stability using Nyquist criterion – closed loop frequency response.	Co-3	1).Draw nyquist plot, and Determine the range of 'k' for which closed loop system is stable ? $G(S)=\frac{K}{S(S+2)(S+10)}$	Lecture/discussion/problem solving	Assignment-2 & quiz-2

			, H(s) =1		
Week-11	**Unit-IV ROOT LOCUS AND COMPENSATION TECHNIQUES**: Introduction – construction of root loci, Effect of addition of open loop poles and zeros, stability analysis	CO-4	1). A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(s^2+4s+13)}$. Sketch the root locus plot and find the value of K for which the closed loop system be stable	Lecture/discussion/problem solving	Assignment-2 & quiz-2
Week-12	Introduction to Compensation Techniques, design of Lead, Lag, and Lead Lag Compensators in frequency domain by Bode plot,	CO-4	1). Explain different compensation techniques 2). The open loop transfer function of an unity feedback control system is given by $G(s) = \frac{k}{s(s+8)}$. The system is to meet the following specifications: a. Velocity error $K_v >$ 100 sec^{-1} b. Phase margin $\Phi_m \geq 50^0$ c. Gain margin $G_m \geq$ 20db. Design a suitable lead compensator	Lecture/discussion/problem solving	Assignment-2 & quiz-2
Week-13	Controllers- P, I, D, PD, PI, PID	CO-4	1). Explain the effects of controllers on systems, problems	Lecture/discussion/problem solving	Assignment-2 & quiz-2
Week-14	**Unit-V STATE SPACE ANALYSIS**:	CO-5	1), For the given transfer function find equivalent state space model	Lecture/discussion/problem solving	Assignment-2 & quiz-2

	Concepts of state, state variables and state models – diagonalisation		$\frac{C(S)}{R(S)} = \frac{10}{(S+1)(S+2)(S+}$		
Week-15	solution of state equations – state models for LTI systems- State Transition Matrix and it's Properties.	C0-5	1). a system represented by the state equation $X\dot{(t)} = Ax(t)$ $X(t)\begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ And $X(t)\begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$ Determine the system matrix A, and state transition matrix.	Lecture/discussion/problem solving	Assignment-2 & quiz-2
Week-16	Concepts of controllability and Observability.	CO-5	1). Explain the concept of controllability and observability 2). Test whether the given system is completely state controllable, observable or not	Lecture/discussion/problem solving	Assignment-2 & quiz-2
Week-17	revision				
Week-18	MID Exam-2	CO-3,CO-4,CO-5			
Week-19,20	End Exam	All co's			External exam