GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (COMMUNICATION SYSTEMS ENGG) (05)
LINEAR SYSTEM THEORY
SUBJECT CODE: 2720508
M.E. SEM-II

Type of course: Major Elective - III

Prerequisite: Signals and Systems , Digital Signal Processing

Rationale:
The practical systems require the system characteristics to be linear.The linear systems are easy to realize. Controllability and obseravability are also easier in linear systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Mathematical Descriptions of Systems Causality and Lumpedness,Linear Systems,Linear Time-Invariant Systems,Linearization,Discrete-Time Systems	4	10
2	Linear Algebra Basis,Representation and Orthonormalization,Linear Algebric Equations,Similarity Transformation,Diagonal Form and Jordan Form,Functions of a square matrix,Lyapunov Equation,Quadratic Form and Positive Definiteness,Singular Value Decomposition,Norms of Matrices	8	20
3	State-Space Solutions and Realizations Solution of LTI state equations,Equivance of state equations,Realizations,Solution of Linear Time-Varying(LTV) equations,Equivalent Time-Varying Equations,Time-Varying Realizations	8	20
4	Stability Input-Output stability of LTI systems,Internal stability,Lyapunov Theorm,Stability of LTV Systems	4	10
5	Controllabilty and Observability Controllabilty,Observability,Canonical Decomposition,Conditions in Jordan-Form Equations,Discrete-Time State Equations,Controllability after Sampling,LTV State equations	8	10
6	Controllabilty and Observability Controllabilty,Observability,Canonical Decomposition,Conditions in Jordan-Form Equations,Discrete-Time State Equations,Controllability after Sampling,LTV State equations	8	10
‘7	State Feedback and State Estimators State feedback,Regulation and tracking,State estimator,Feedback from	4	10

	estimated states,State feedback – Multivariable case,State estimators-Multivariable case,Feedback from Estimated States – Multivariable case		
8	Pole Placement and Model Matching Unity-Feedback Configuration-Pole placement,Implementable transfer functions,Multivariable unity-feedback system,Multivariable Model matching-two parameter configuration	4	10

Books:

1. Chi-Tsong Chen,"Linear System Theory and Design",Oxford Press,1999
2. Anderson,B.D.O. and Moore J.B.,"Optimal Control Linear Quadratic methods" Englewood cliffs, N.J.,Prentice Hall,1990
3. Antsaklis,A.J. and Michel A.N. , " Linear Systems ", New York , Mcgraw Hill , 1997
4. Callier,F.M. and Desoer , C.A. ," Linear System Theory " , New York , Spriner-Verlag , 1991
5. Rugh, W."Linear System Theory", 2nd ed. , Upper Saddle River , NJ , Prentice Hall , 1996

Course Outcome:

By the end of this course, the student should be able to do the followings

1. To Analyze linear vector space

2. To Analyze state variable modeling of continuous and discrete time systems

3. To solve state equations of linear time invariant and time varying systems

4. To find controllability and observability of dynamic systems

5. To implement minimal realization of linear systems and canonic forms

6. To check stability using Liaunov's stability theory for linear dynamic systems

List of Experiments:

Based on the above syllabus

Design based Problems (DP)/Open Ended Problem:

1. Derive state equations for one and two link pendulum systems.
2. Consider the soft landing phase of a lunar module descending on the moon.Define state variables and find state-space equations.
3. Propose a model for an aircraft. Assume aircraft is in equilibrium at certain pitched angle , elevator angle and cruising speed.Find the state equations of the system.
4. Find a time-varying realization and a time invariant realization of the system $g(t) = t^2 e^{\lambda t}$
5. Find full-dimensional and reduced dimensional state estimators for the state equation that you may assume.Assume suitable eigen values of the estimators.

List of Softwares:MATLAB

List of Open Source Software: SCILAB

Learning website:www.nptel.ac.in

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.