GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (07)

NON-LINEAR CONTROL SYSTEM
SUBJECT CODE: 2720718
SEMESTER: II

Type of course: Non-Linear Control Syatem

Prerequisite: NA

Rationale: NA

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#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Examples – violin strings, heart rhythms, double pendulum, van der Pol oscillator. Existence and uniqueness of solutions.	04	05
2	Analysis: Linearization through Taylors series, Hartman-Grobmann Theorem, local stability. Multiple equilibria, limit cycles, bifurcations.	04	10
3	Second-order systems: Phase plane techniques, Poincare-Bendixson Theorem.	04	10
4	Input-output analysis and stability: Small gain theorem, passivity, describing functions.	04	10
5	Mathematical background: Contraction mapping theorem, homeomorphisms, norms	04	10
6	Lyapunov stability theory: Basic stability and instability theorems. Uniform stability, asymptotic stability, exponential stability. LaSalles Theorem, indirect method.	08	20
7	Feedback linearization: Input-output linearization, full-state linearization, stabilization, tracking. Zero dynamics, MIMO systems, non-minimum phase systems, singularities.	08	20
8	Sliding mode control: Sliding surfaces, differential inclusions, solutions in the sense of Filippov.	04	10
9	Gain scheduling: Controller and scheduling design	02	05

Reference Books:

1. S. Sastry, Nonlinear Systems: Analysis, Stability, and Control, Springer 1999.
2. H. Khalil, Nonlinear Systems, Prentice Hall, 2002.

Course Outcome:

After learning the course the students should be able to:

- Fundamentals of nonlinear systems analysis and control.
- Analysis of nonlinear systems, driven by a number of real-world examples, and some preliminary mathematical background.
- Stability through Lyapunov techniques and input-output analysis.
- Control of nonlinear systems, through feedback linearization, sliding mode control, and gain scheduling.

List of Experiments and Open Ended Problems: The course coordinator may assign a MATLAB based simulation relevant to the course content.

List of Open Source Software/learning website: MATLAB, SCILAB, NPTEL Videos

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