SARVAJANIK UNIVERSITY
SarvajanikCollege of Engineering and Technology
Bachelor of Technology

B.Tech. Semester VI

Subject Name: Modern Control System **Subject Code: BTEL15603**

Type of course: **Professional Open Elective**
Prerequisite: Control Syatems
Rationale: 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.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15			

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Mathematical Preliminaries:** Fields, Vectors and Vector Spaces, Linear combinations and Bases, Linear Transformations and Matrices, Scalar Product and Norms, Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators, The concept of state, State Equations for Dynamic systems, Time invariance and Linearity, Non-uniqueness of state model, State diagrams for Continuous-Time State models.	5	15
2.	**State Variable Analysis:** Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations, Solutions of Linear Time Invariant Continuous-Time State Equations, State transition matrix and its properties. General concept of controllability, General concept of Observability, Controllability tests for	12	25

	Continuous-Time Invariant Systems, Observability tests for Continuous-Time Invariant Systems, Controllability and Observability of State Model in Jordan Canonical form, Controllability and Observability Canonical forms of State model.		
3.	**Non Linear Systems:** Introduction, Non Linear Systems, Types of Non-Linearities, Saturation, Dead-Zone, Backlash, Jump Phenomenon etc;– Singular Points, Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems, Describing function–describing function analysis of nonlinear systems, Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.	13	25
4.	**Stability Analysis:** Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems, Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method Generation of Lyapunov functions, Variable gradient method, Krasooviski's method. State feedback controller design through Pole Assignment, State observers: Full order and Reduced order.	10	20
5.	**Optimal Control:** Introduction to optimal control, Formulation of optimal control problems, calculus of variations, fundamental concepts, functional, variation of functional, fundamental theorem of theorem of Calculus of variations, boundary conditions, constrained minimization, formulation using Hamiltonian method, Linear Quadratic regulator.	5	15

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**30**	**20**	**25**	**10**	**0**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students andteachers. The actual distribution of marks in the question paper may vary slightly from above table.

POE: Professional Open Elective

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Understand the concepts of state variable analysis	25
CO-2	Apply the knowledge of basic and modern control system for the real time analysis an design of control systems.	25
CO-3	Analyze the concept of stability of nonlinear systems.	25
CO-4	Analyze the concept optimal control	25

Reference Text Books:

- Modern Control System Theory by M.Gopal, New Age International -1984
- Control System Engineering, Nagrath and Gopal, New Age International, Fourth Edition
- Optimal control by Kirck , Dover Publications
- Advanced Control Theory A. Nagoor Kani, RBA Publications, 1999
- Modern Control Engineering by Ogata. K – Prentice Hall – 1997

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