



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3172428

Semester – VII

Subject Name: **Systems Engineering**

Type of course: Open Elective Course

Prerequisite: --Nil--

Rationale: Systems engineering is an approach that utilizes an inter-disciplinary problem-solving methodology across the entire systems like military, industrial, commercial, or civil applications. This course intends to help students to develop the capability of systems thinking by introducing classical and advanced systems engineering theory, methods, and tools.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	1	0	3	70	30	0	0	100

Content:

Sr. No.	Course Content	Total Hrs.
1	Introduction: System- Its Types, Systems Engineering (SE), System Versus Systems Engineering, Systems Thinking and SE. The State of SE and System Development Performance, Understanding the Problem: Root Cause Analysis; Industry, Government, Academic, Professional, and Standards Organizations Solutions, Defining the Problem, Engineering Education Challenges and Opportunities.	7
2	System Attributes, Properties, and Characteristics: Analytical Representation of a System, System Stakeholders: User and End User Roles, System Attributes, System Properties, System Characteristics, The System's State of Equilibrium and the Balance of Power System/Product Life Cycle Concepts, System Acceptability: Challenges for Achieving Success.	8
3	System Concepts Formulation and Development: Conceptualization of system operations, the system operations model, formulating and developing the system concepts. System Phases of Operation: introduction to system modes and states, enterprise perspective-engineered system states, engineering perspective-modes and states, applying phases, modes, and states of operation, modes and states constraints.	8
4	System Levels of Abstraction, Semantics, and Elements: Establishing and bounding the system's context, system levels of abstraction and semantics, system decomposition versus integration entity relationships, logical-physical entity relationship (er) concepts, architectural system element concepts	6
5	Architectural Frameworks of the SOI and System Behavioral Response Model: Definitions of Key Terms, Approach to this Chapter, Introduction to the SOI Architecture, Understanding the OE Architecture, Other Architectural Frameworks Understanding the	10



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	System Threat Environment, SOI Interfaces. System Command & Control (C2) Interaction Constructs, Modeling System Control Flow and Data Flow Operations, Modeling Mission System and Enabling System Operations, Modeling an Operational Capability, Nested Operational Cycles, Model-Based Systems Engineering (MBSE).	
6	Analytical Problem-Solving & Solution Development Synthesis and System Modeling & Simulation (M&S): System Engineering and Analysis Concepts, Synthesis, shifting to a New Systems Engineering Paradigm, The Four Domain Solutions Methodology. Technical Decision-Making Aids, Simulation-Based Models, Application Examples of System Modeling and Simulation (M&S), M&S Challenges and Issues.	6

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	25	10	10	10	05

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

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

Suggested Reading:

1. System Engineering Analysis Design, And Development: Concepts, Principles, and Practices by Charles S.Wasson (Wiley Pub.)
2. Systems Engineering Tools and Methods by Edited by Ali K. Kamrani & Maryam Azimi (CRC Press).
3. Systems Engineering Fundamentals by Defense Acquisition University Press.
4. Systems Engineering by Kossiakoff William N. Sweexander (Wiley Pub.)

Course Outcomes: At the end of this course, students will be able to clarify.

Sr. No.	CO statement	Topics of the Syllabus	Marks % weightage
CO1	To acquire foundational knowledge of systems engineering processes and practices.	1,2	25
CO2	To understand the system concepts formulation and development	3,4	20
CO3	To analyze the system behavioral response model.	5	20
CO4	To apply various systems engineering tools.	4	25
CO5	To identify the value and limitations of modeling and simulation.	6	10

<https://nptel.ac.in/courses/110/104/110104074/>