



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part Time)

Subject Code: 2961106

Semester – VI

Subject Name: Systems Engineering

Type of course: Programme Elective Course

Prerequisite: Knowledge of Control Theory, microprocessor/microcontroller hardware, programming concept in C, MATLAB : System Level Software.

Rationale: Systems Engineering plays crucial role in today's industry, where system level design, planning and implementation is generally achieved by interdisciplinary mode involving various branches of engineering to solve real life problems. It involves the project policies standards, human factor engineering in production lines.

Systems engineering is a discipline that utilizes an inter-disciplinary problem-solving approach across the entire technical effort irrespective of whether the systems or the systems of systems are for military, industrial, commercial or civil applications. This course will provide an overview of both theory and practice of the systems engineering discipline along with systems engineering design approach. The aim of the course is also to equip students with capability to develop system solutions that optimally fulfill customer objectives with available resources. Focus will be on creating now-how on solving open-ended problems, utilizing creativity, problem formulation, generation of need statements, requirements analysis, alternative solutions generation and examination, concurrent engineering design, enforcing various realistic aspects such as safety, reliability, manufacturability, operations, aesthetics, ethics, and sustainability.

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	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Fundamentals of Systems Engineering, Discipline specific Engineering Standards: Systems Engineering: History and Examples, System Engineering as Profession, Power of System Engineering, Systems Engineering view Point, Perspectives, Domains, fields, approaches, activities and products, System Engineering Management(SEM), Program, /Project Life Cycle, Lifecycle Integration, Engineering standards	5
2	Complex System Structure: Building blocks, hierarchy, interfaces , environment, interactions, life cycle, evolutionary characteristics, Systems Engg method , Systems testing throughout development , Concept of Real Time Systems	4
3	Engineering Concept Stage: Concept exploration, validating requirements, Concept definition – selection and validation, functional analysis and allocation Systems architecture, System modeling languages, Model-Based Systems Engg (MBSE) Decision making, modeling for decisions Simulation, Trade-	4



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	off analysis (Power, Area, Speed, Design Time etc)	
4	Engineering Development Stage: Program risk reduction, prototype development for risk mitigation, Development testing, risk reduction, Revision of functional analysis and design, Overview of probability data analysis, Hypothesis testing, Architecture to Testing Mechanism (Design for Test, Design for Manufacturability)	4
5	Engineering Design Stage: Implementing system building blocks, component design, Design validation, Change management, Concepts of reliability, redundancy, Concepts of maintainability, availability, predictability, User interface design and GUI, Performance benchmarking against ref/standard	4
6	Integration, testing and evaluation of Total system: Test planning and preparation, system integration Developmental and operational test and evaluation Engineering for production, transition from development to production, Production operations Installation, maintenance and upgrading, Installation testing In-service support Upgrades and modernization.	5

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	15	25	10	10	5

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.

Reference Books:

1. NASA Systems Engineering Handbook, NASA/SP-2007-6105 Rev 1. Military Bookshop,
2. INCOSE,. Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities. 4th ed. Wiley, 2015. p. 304. ISBN: 9781118999400.
3. ISO/IEC/IEEE 15288:2015, Systems and Software Engineering—System Life Cycle Processes.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Describe the most important Systems Engineering standards and best practices as well as newly emerging approaches	10%



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CO-2	Structure the key steps in the systems engineering process starting with stakeholder analysis and ending with transitioning systems to operations	20%
CO-3	Analyze the important role of humans as beneficiaries, designers, operators and maintainers of aerospace and other systems	30%
CO-4	Apply some of the fundamental methods and tools of systems engineering to a simple cyber-electro-mechanical system as a stepping stone to more complex and real world projects	40%

List of Experiments:

(General guidelines.. Institute may change list of experiments based on laboratory set up available)

1. Study of Project Management Software Platform/Tools
2. Study of Project Life Cycle Software Platform/ Tools
3. Study of Need Analysis Software Platform/ Tools
4. Study of Requirement Analysis Software Platform/ Tools
5. Study of Model Based System Engineering Software Platform/Tools (UML/ SysML, MATLAB, Simulink, LABVIEW etc.)
6. Study of Design Synthesis Software Platform/Tools
7. Design of cyber-electro-mechanical system
8. System Design of Unmanned Aerial Vehicle (UAV) System
9. System Design of Battery Operated Electric Vehicle
10. System Design of Automated Robotic arm
11. System Design of Underwater Vehicle
12. System Design of Nano Satellite for Local Communication
13. System Design of Smart Meter for Air Quality Monitoring /Control
14. System Design of Smart Meter for Water Quality/Water Management Monitoring /Control
15. System Design of Smart Meter for Electricity Distribution/Management Monitoring /Control