Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

DEPARTMENT OF MECHANICAL ENGINEERING

Curriculum Structure and Syllabus of
Honor in Mechanical Engineering
Systems Engineering

(Regulation 2023)

Effective from Academic Year 2025-2026

Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers..

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

EOMS Policy

"We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute's social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS)."

Course Approval Summary

Board of study- Department of Mechanical Engineering

Sr. No.	Course Name	Course Code	Page Number	Signature and stamp of BoS
1	Foundations of Systems Engineering	BME25HN11	12	
2	Foundations of Systems Engineering Lab	BME25HN12	14	
3	Model Based System Engineering	BME26HN13	17	
4	Model Based System Engineering Lab	BME26HN14	19	
5	System Architecture and Design	BME27HN15/ BME28HN15	22	
6	System Architecture and Design Lab	BME27HN16/ BME28HN16	24	
7	Seminar/Mini-Project / MOOC / Industrial Training	BME27HN17/ BME28HN17	26	
8	Integrated Project	BME27HN18/ BME28HN18	29	

Approved by Academic Council:

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

Preface

Looking at Global Scenario to enhance the employability skills and impart deep knowledge in emerging/ multidisciplinary areas, an additional avenue is provided to passionate learners through the Minors and Honors Degree Scheme in academic structure.

For Honors degree program, student has to earn additional 20 credits in emerging area of one's own domain.

Objectives of Honors Degree

- To enable students to pursue allied academic interest in contemporary areas.
- To provide effective yet flexible options for students to achieve basic to intermediate level competence in the contemporary area.
- To enhance the employability skills with different combinations of competencies and flavors.
- To provide an academic mechanism for fulfilling demand of specialized areas from industries for higher order skill jobs.
- To provide a strong foundation to students aiming to pursue research/ higher studies in the Contemporary field of study.

Preface of Honor in Systems Engineering

This Honors course provides an introduction to the fundamentals of Systems engineering, System Architecture and Design, Model Based System Engineering and System Integration, Verification and Validation. The Students will learn how to model and design the cyber physical systems using their basic logical, behavioral, and physical principles. Engineering requirements for software and systems, interface design and modelling, system architecture, system verification and testing, and system simulation are some of the topics covered. The main focus is on modeling cyber physical systems with the aid of contemporary MBSE principles, techniques, and technologies.

Objectives

The course aims to:

- Develop a systems engineering plan for a realistic project.
- Apply systems engineering tools to realistic problems.
- Formulate an effective plan for gathering and using data.
- Design for and manage system lifecycle targets.

Course Outcomes:

At the successful completion of this Minor program, students will be able to:

- Explore opportunities and career in systems engineering
- Make decisions in the development of complex systems.
- Create context diagram of system showing its interaction with system environment
- Identify recent developments of few complex systems

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LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

Sr. No.	Abbreviation	Type of Course
1.	L	Lecture
2.	P	Practical
3.	T	Tutorial
4.	H	Hours
5.	CR	Credits
6.	FA	Formative Assessment
7.	SA	Summative Assessment
8.	TW	Term Work
9.	OR	Oral
10.	PR	Practical
11.	PROJ	Project

Credit distribution : semester wise						
1 Lecture hour = 1 Credit 2 Lab Hours = 1 Credit 1 Tutorial Hour = 1 Credit						
Sr. No.	**Course Title**	**Credits/Semester**				
		5	**6**	**7**	**8**	**Total**
1.	Foundations of Systems Engineering	3	0	0	0	3
2.	Foundations of Systems Engineering Lab	1	0	0	0	1
3.	Model Based System Engineering	0	4	0	0	4
4.	Model Based System Engineering Lab	0	1	0	0	1
5.	System Architecture and Design	0	0	3	0	3
6.	System Architecture and Design Lab	0	0	1	0	1
7.	Seminar/Mini-Project/MOOC/Industrial Training	0	0	2	0	2
8.	Integrated Project	0	0	0	5	5
	Total	**4**	**5**	**6**	**5**	**20**

Curriculum structure

Honors in Mechanical Engineering

SYSTEMS ENGINEERING

Honor-Systems Engineering
Curriculum structure

Systems Engineering Honor in Mechanical Engineering (Academic Regulations 2023)																	
(With effect from Academic Year 2025-26)																	
Course Type	**Course Code**	**Course Name**	**Credit Scheme**				**Teaching Scheme (Hrs/Week)**					**Evaluation Scheme and Marks**					
												FA		**SA**	**TW**	**PR**	**OR**	**Total**
			L	**P**	**T**	**Total**	**L**	**P**	**T**	**O**	**Total**	**FA1**	**FA2**					
PCC	BME25 HN11	Foundations of Systems Engineering	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**20**	**20**	**60**	**-**	**-**	**-**	**100**
PCC	BME25 HN12	Foundations of Systems Engineering Lab	**-**	**1**	**-**	**1**	**-**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**25**	**-**	**-**	**25**
PCC	BME26 HN13	Model Based System Engineering	**3**	**-**	**1**	**4**	**3**	**-**	**1**	**-**	**4**	**20**	**20**	**60**	**-**	**-**	**-**	**100**
PCC	BME26 HN14	Model Based System Engineering Lab	**-**	**1**	**-**	**1**	**-**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**25**	**-**	**25**	**50**
PCC	BME27 HN15/ BME28 HN15	System Architecture and Design	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**20**	**20**	**60**	**-**	**-**	**-**	**100**
PCC	BME27 HN16/ BME28 HN16	System Architecture and Design Lab	**-**	**1**	**-**	**1**	**-**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**25**	**-**	**-**	**25**
ELC	BME27 HN17/ BME28 HN17	Seminar/Mini-Project / MOOC / Industrial Training	**-**	**2**	**-**	**2**	**-**	**4**	**-**	**-**	**4**	**-**	**-**	**-**	**-**	**-**	**50**	**50**
ELC	BME27 HN18/ BME28 HN18	Integrated Project	**-**	**5**	**-**	**5**	**-**	**10**	**-**	**-**	**10**	**-**	**-**	**-**	**150**	**-**	**50**	**200**
		Total	**9**	**10**	**1**	**20**	**9**	**20**	**1**	**-**	**30**	**60**	**60**	**180**	**225**	**-**	**125**	**650**

Abbreviations are: **L**-Lecture, **P**-Practical, **T**-Tutorial, O- Other i.e. self-directed learning, (self- study),

FA-Formative Assessment, **SA**-Summative Assessment, **TW**-Term Work, **OR**-Oral, **PR**-Practical Exam

Course Syllabus

SYSTEMS ENGINEERING

Semester - V

Program:	Honor in Systems Engineering							Semester : V
Course :	Foundations of Systems Engineering							Code : BME25HN11
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	-	20	20	60	100

Prior knowledge of:

a. Design of Machine Elements
b. Problem-solving, analytical are essential

Course Objectives:

Students are expected to study,

1. Viewpoint and perspective of systems engineering
2. Relationship between systems life cycle and its management / manufacturing process
3. Hierarchy of Complex Systems
4. Interaction of system environment with the system
5. Basic system development process through the system life cycle
6. Role of systems engineering Project planning, management and control

Course Outcomes:

The Students will be able to,

1. Differentiate between systems engineering and other discipline of engineering
2. Understand opportunities and career in systems engineering
3. Draw hierarchy of Complex Systems which include system building blocks
4. Draw context diagram of system showing its interaction with system environment
5. Identify recent developments of few complex systems
6. Describe the general type of the organizational structure in systems engineering

Detailed Syllabus

Unit	Description	Duration (Hrs.)
1.	**Systems engineering and the world of modern systems:** The Systems Engineering Landscape, Systems Engineering Viewpoint, Perspectives of Systems Engineering, Examples of Systems Requiring Systems Engineering.	7
2.	**Systems engineering activities and products:** Systems Engineering Activities and Products, Systems Engineering as a Profession, Systems Engineer Career Development Model.	8
3.	**System building blocks :** System Elements and Interfaces, Hierarchy of Complex Systems, System Building Blocks.	7
4.	**The system environment:** The System Environment, Interfaces and Interactions, Complexity in Modern System.	8
5.	**The system development process:** Systems Engineering Through the System Life Cycle, System Life Cycle, Evolutionary Characteristics of the Development Process, The Systems Engineering Method, Testing Throughout System Development.	7
6.	**Systems engineering management:** Managing System Development, Work Breakdown Structure, Systems Engineering Management Plan, Organization of Systems Engineering.	8
	Total	45

Text Books:

1. Systems Engineering Principle and Practice , Alexander Kossiakoff, Samuel J. Seymour, David A. Flanigan, Steven M. Biemer, John Wiley & Sons, Inc., 3rd Edition, 2020.

Reference books:

1. Systems Engineering Fundamentals and Applications, Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.
2. NASA Systems Engineering Handbook, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.

3. Systems Engineering: Design Principle and Models, Dahai Liu, CRC Press Taylor & Francis Group, 2016.
4. Systems Engineering Guidebook-A process for developing systems and Products, James N Martin, CRC Press, 2000.

Program:	Honor in Systems Engineering						Semester : V	
Course:	Foundations of Systems Engineering Lab						Code : BME25HN12	
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Lecture	Practical	Tutorial	Other	TW	PR	OR	Total
1	-	2	-	-	25	-	-	25

Prior Knowledge: Problem -solving skills, Basic STEM knowledge.

Course Objectives:

1. To make the learners difference between traditional Systems engineering and MBSE: need of MBSE to solve complex problem.
2. To understand the various SysML Diagrams.
3. To understand the Problem domain, Solution domain, Black box and White box perspective of SysML.
4. To make the learners conversant with System behaviour, system parameters, system context.

Course Outcomes:

After learning the course, the learners will be able,

1. to analyze traditional Systems engineering and MBSE: need of MBSE to solve complex problem.
2. to apply MBSE using SysML to solve complex engineering problem
3. to apply the Problem domain and solution domain concept on entire system level
4. to evaluate the performance of the system by requirement traceability through SysML.

Detailed Syllabus

Expt. No.	Description	Duration (Hrs.)
1.	Introduction to Model Based System Engineering and SysML. Using the concept of MBSE define **problem domain** for coffee machine. Draw Package Diagram for Coffee Machine using SysML.	2
2.	**Black-box perspective** for coffee machine. Draw Requirement Diagram for stakeholder needs of Coffee Machine using SysML. Create a table for stakeholder needs.	2
3.	**System context:** Organize the coffee machine model for the system context. Create an ibd for a system context, capture participants of the system context, the interaction between them and add item flows to the system context.	2
4.	**Use cases**: Organize the coffee machine model for the use cases. Create Use Case Diagram for Coffee Machine using SysML and add item flows to the use case.	2
5	**Measures of Effectiveness**: Organize the coffee machine model for MoE's. Create a block for capturing MoEs for the solution.	2
6	**White-box perspective**: Organize the coffee machine model for **Functional analysis.** Create an Activity Diagram to decompose the function of a Coffee Machine using SysML.	2
7	**Conceptual Subsystems**: Organize the coffee machine model for **conceptual subsystems communication.** Create a Block Definition Diagram for Coffee Machine conceptual interfaces and specify interactions among them using SysML.	2
8	**Solution Domain**: Organize the coffee machine model for subsystem interactions. Create a sequence Diagram for Coffee Machine using SysML.	2
9	**System behaviour:** Organize the coffee machine model for systems behaviour. Create a State Machine Diagram for Coffee Machine using SysML.	2
10	**System Parameters:** Organize the coffee machine model for systems parameters. Create a parametric Diagram for Coffee Machine using SysML.	2
11	**Black-box perspective** for Vehicle climate control system. Draw Requirement Diagram for stakeholder needs of Vehicle climate control using SysML. Create a table for stakeholder needs.	2
12	**System context:** Organize the Vehicle climate control system model for the system context. Create an ibd for a system context, capture participants of the system context, the interaction between them and add item flows to the system context.	2
13	**Use cases**: Organize the Vehicle climate control system model for the use cases. Create Use Case Diagram for Vehicle climate control system using SysML and add item flows to the use case. **Measures of Effectiveness**: Organize the Vehicle climate control system model for MoE's. Create a block for capturing MoEs for the solution.	2

14	**White-box perspective**: Organize the Vehicle climate control system for **Functional analysis.** Create an Activity Diagram to decompose the function of a Vehicle climate control system using SysML. **Conceptual Subsystems**: Organize the Vehicle climate control system model for **conceptual subsystems communication.** Create a Block Definition Diagram for Vehicle climate control system conceptual interfaces and specify interactions among them using SysML.	**2**
15	**Solution Domain**: Organize the Vehicle climate control system model for subsystem interactions. Create a sequence Diagram for Vehicle climate control system using SysML. **System Parameters:** Organize the Vehicle climate control system model for systems parameters. Create a parametric Diagram for Vehicle climate control system using SysML.	**2**
	Total	**30**

Text Books:

1. Aiste Aleksandraviciene, et.al. MagicGrid Book of Knowledge: A Practical Guide to Systems Modeling using MagicGrid from Dassault Systemes, Vitae Litera.
2. International Council of Systems Engineering (INCOSE), Systems Engineering Handbook: A guide for system life cycle processes and activities. Wiley, 5th Edition 2024

Reference books:

1. Alexander Kosslakoff, et.al. Systems Engineering Principle and Practice. John Wiley & Sons, Inc, 3rd edition 2020
2. Reinhard Haberfellner , et. al. Systems Engineering Fundamentals and Applications, Springer Nature Switzerland AG 2019.
3. Systems Engineering Fundamentals and Applications, Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.
4. NASA Systems Engineering Handbook, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.
5. Systems Engineering: Design Principle and Models, Dahai Liu, CRC Press Taylor & Francis Group, 2016.
6. Systems Engineering Guidebook-A process for developing systems and Products, James N Martin, CRC Press, 2000.

Course Syllabus

SYSTEMS ENGINEERING

Semester - VI

Program:	Honor in Systems Engineering						Semester: VI	
Course :	Model Based System Engineering						Code : BME26HN13	
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
4	3	-	1	-	20	20	60	100

Prior knowledge of:

a. CAD software,
b. Foundations of Systems Engineering,
c. System Architecture and Design……..are essential

Course Objectives: Students are expected to study:

1. Fundamentals of systems and subsystems and system hierarchy
2. Stages of MBSE and differentiate between traditional document-based and model-based system engineering
3. Three pillars of MBSE and system modeling
4. System modeling language
5. Process and requirement modeling with

Course Outcomes: The Students will be able to,

1. Understand Fundamentals of systems and subsystems
2. Differentiate between traditional document based and model based system engineering
3. Analyze three pillars of MBSE: languages, methods, and tools
4. Create models and diagrams using SysMl
5. Create system definition , parametric and requirement diagram using SysMl
6. Apply MBSE approach for Engineering problems

Detailed Syllabus

Unit	Description	Duration (Hrs.)
1.	**Introduction To Mbse** Systems, subsytems and levels, Abstracting the system Visualizing the model Defining the approach Grouping the MBSE concepts	7
2.	**The Evolution Of Mbse** Stage 1 – document-based systems engineering, Stage 2 – document-centric systems engineering, Stage 3 – model-enhanced systems engineering, Stage 4 – model-centric systems engineering, Stage 5 – MBSE, Cross-cutting concerns, , difference between traditional document-based and model-based system engineering	8
3.	**Three Pillars Of Mbse** Modeling methods, Modeling tools , Modelling language	7
4.	**Systems Modeling Language (Sysml)** What Sysml Is (And What It Is Not), The Sysml Diagrams, Example Structural Modelling, Example Behavioral Modelling, Relationship Between Behavioral Diagram And Structural Diagram	8
5.	**Systems Modelling** The Sysml Notation, Block Definition Diagrams, Parametric Diagrams, Requirement Diagrams, Diagramming Guidelines	7
6.	**Process And Requirement Modeling With Mbse** The Process Modelling, Using the process modelling framework, The Requirements modelling Framework , Using the Requirements modelling Framework (ACRE Process)	8
	Total	45

Text Books:

1. Model Based System Engineering : Fundamentals and Methods , Patrice Micouin, John Wiley & Sons, Inc. 1st Edition, 2014

Reference books:

1. System Requirements Analysis, Jeffrey O. Grady, Elsevier, 2nd Edition, 2016.
2. System Verification: Proving the Design Solution Satisfies the Requirements, Jeffery O. Grady, Elsevier, 2007.
3. Systems Engineering Fundamentals and Applications, Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.
4. NASA Systems Engineering Handbook, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.
5. Systems Engineering: Design Principle and Models, Dahai Liu, CRC Press Taylor & Francis Group, 2016.
6. Systems Engineering Guidebook-A process for developing systems and Products, James N Martin, CRC Press, 2000.

Program:	Honor in Systems Engineering						Semester : VI	
Course :	Model Based System Engineering Lab						Code : BME26HN14	
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Lecture	Practical	Tutorial	Other	TW	PR	OR	Total
1	-	2	-	-	25	-	25	50

Prior Knowledge: Problem -solving skills, Basic STEM knowledge and Foundations of Systems Engineering.

Course Objectives:

1. To make the learners understand MODSIM to solve complex problem.
2. To understand the parametric design concepts.
3. To gain preliminary knowledge about the UAF framework to solve real-world engineering problems.
4. To make the learners conversant with Requirement Management and Traceability.

Course Outcomes:

After learning the course, the learners will be able to,

1. Perform static structural analysis, define optimization parameters and generate alternate design based on optimization results.
2. Apply MBSE and use the UAF framework to design space program within a system of systems.
3. Apply the Requirement Management and Traceability on entire system level.
4. Evaluate the performance of the system using trade of studies through MBSE.

Detailed Syllabus

Expt. No	Description	Duration (Hrs.)
1.	**Introduction to Modeling and Simulation (MODSIM). Simulate frame of a Kick-Scooter** - Perform Static Structural Analysis case.	2
2.	**Define Parametric Design Study** - Define parametric optimization study	2
3.	**Review Parametric Design Study Results** - Perform Parametric Optimization.	2
4.	**Parametric Design Change Study** - Generate design alternatives based on optimization results. - Review study results.	2
5	**Design a Space Program within a System of Systems** Use MBSE knowledge about the UAF framework to solve the problem.	2
6	**Design a Space Program within a System of Systems** Use MBSE knowledge about the UAF framework to solve the problem.	2
7	**Modeling Cross Cutting Relationships with Matrices, Table** Explore the techniques and methods for modeling cross-cutting relationships using matrices, tables, and maps.	2
8	**Modeling Cross Cutting Relationships with Matrices, Table** Explore the techniques and methods for modeling cross-cutting relationships using matrices, tables, and maps.	2
9	**Requirement Management and Traceability**. learn about end-to-end requirement management, traceability analysis, and their verification and validation.	2
10	**Overview of Requirement Management and Traceability Learning Module**	2
11	**Capture Stakeholder Needs** Capture stakeholder needs effectively explore the customer need document and capture these needs using Reqtify.	2
12	**Manage Requirements** Manage system requirements effectively import requirements into the 3DEXPERIENCE platform and create a customized dashboard for the landing gear project.	2
13	**Perform Operational Analysis** Manage system requirements effectively, import requirements into the	2

	3DEXPERIENCE platform and create a customized dashboard for the landing gear project.	
14	**Perform Traceability Analysis** Import requirements into CATIA Magic using DataHub, creating links between different SysML elements.	**2**
15	**Verify, Validate and Generate Report** Associate requirements with verification test cases and generate comprehensive reports from project data.	**2**

Text Books:

1. Aiste Aleksandraviciene, et.al. MagicGrid Book of Knowledge: A Practical Guide to Systems Modeling using MagicGrid from Dassault Systemes, Vitae Litera
2. International Council of Systems Engineering (INCOSE), Systems Engineering Handbook: A guide for system life cycle processes and activities. Wiley, 5th Edition 2024

Reference books:

1. **System Requirements Analysis**, Jeffrey O. Grady, Elsevier, 2nd Edition, 2016.
2. **System Verification**: Proving the Design Solution Satisfies the Requirements, Jeffery O. Grady, Elsevier, 2007.
3. **Systems Engineering Fundamentals and Applications,** Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.
4. **NASA Systems Engineering Handbook**, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.
5. **Systems Engineering: Design Principle and Models, Dahai Liu,** CRC Press Taylor & Francis Group, 2016.
6. **Systems Engineering Guidebook-A process for developing systems and Products,** James N Martin, CRC Press, 2000.
7. Alexander Kosslakoff, et.al. Systems Engineering Principle and Practice. John Wiley & Sons, Inc, 3rd edition 2020
8. Reinhard Haberfellner , et. al. Systems Engineering Fundamentals and Applications, Springer Nature Switzerland AG 2019.

Course Syllabus

SYSTEMS ENGINEERING

Semester – VII/VIII

Program:	Honor in Systems Engineering				Semester : VII/VIII			
Course :	System Architecture and Design				Code :BME27HN15/ BME28HN15			
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	-	20	20	60	100

Prior knowledge of

a. Foundations of Systems Engineering,
b. Problem-solving, analytical,
c. Advanced mathematics skills is essential

Course Objectives:

Students are expected to study,

1. a valid operational need (or potential market) that exists for a new system or a major upgrade to an existing system, and a feasible approach to fulfilling the need at an affordable cost and within an acceptable level of risk.
2. a well-documented justification for initiating the development of a new system
3. Functions to describe the system's activities, interactions, and operations.
4. Examination of different technological approaches, generally offering a more diverse source of alternatives.
5. The architecture in associated with structures, their relationships, and expectation for their design.
6. The decisions typically made by systems engineers in the development of complex systems.

Course Outcomes:

The Students will be able to,

1. Identify the need of new system and show that such a system offers a sufficient improvement in capability to warrant the effort to bring it into being.
2. Convert the operationally oriented view of the system derived in the needs analysis phase into an engineering-oriented view required in the concept definition and subsequent phases of development.
3. Select, from a number of alternative system concepts, of a specific configuration that will constitute the baseline for development and engineering.
4. Provide the decision makers with a variety of choices for the system concept.
5. Bring form to function, bring order out of chaos, or convert the partially formed ideas of a client into a workable conceptual model.
6. Make decisions in the development of complex systems.

Detailed Syllabus

Unit	Description	Duration (Hrs.)
1.	**Needs analysis :** Originating a New System, Systems Thinking, Operations Analysis, Feasibility Definition, Needs Validation.	7
2.	**Requirements analysis :** Developing the System Requirements, Requirements Development and Sources, Requirements Features and Attributes, Requirements Development Process, Requirements Hierarchy, Requirements Metrics, Requirements Verification and Validation, Requirements Development: TSE vs. Agile.	8
3.	**Functional analysis :**	7

	Selecting the System Concept, Functional Analysis and Formulation, Functional Allocation, Functional Analysis Products, Traceability to Requirements, Concept Development Space.	
4.	**Evaluation and selection :** Evaluating and Selecting the System Concept, Alternatives Analysis, Operations Research Techniques, Economics and Affordability, Events and Decisions for Consideration, Alternative Concept Development and Concept Selection, Concept Validation, Traditional vs. Agile SE Approach to Concept Evaluation.	**8**
5.	**Systems architecting :** Architecture Introduction, Types of Architecture, Architecture Frameworks, Architectural Views, Architecture Development, Architecture Traceability, Architecture Validation.	**7**
6.	**Decision analysis and support :** Decision Making, Modeling Throughout System Development, Modeling for Decisions, Simulation, Trade-Off Analysis, Evaluation Methods.	**8**
	Total	**45**

Text Books:

1. Systems Engineering Principle and Practice , Alexander Kossiakoff, Samuel J. Seymour, David A. Flanigan, Steven M. Biemer, John Wiley & Sons, Inc., 3rd Edition, 2020.

Reference books:

1. System Requirements Analysis, Jeffrey O. Grady, Elsevier, 2nd Edition, 2016.
2. System Verification: Proving the Design Solution Satisfies the Requirements, Jeffery O. Grady, Elsevier, 2007.
3. Systems Engineering Fundamentals and Applications, Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.
4. NASA Systems Engineering Handbook, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.
5. Systems Engineering: Design Principle and Models, Dahai Liu, CRC Press Taylor & Francis Group, 2016.
6. Systems Engineering Guidebook-A process for developing systems and Products, James N Martin, CRC Press, 2000.

Program:	Honor in Systems Engineering				Semester : VII/VIII			
Course :	System Architecture and Design Lab				Code : BME27HN16 / BME28HN16			
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Lecture	Practical	Tutorial	Other	TW	PR	OR	Total
1	-	2	-	-	25	-	-	25

Prior knowledge of

a. Foundations of Systems Engineering,

b. Problem-solving,

c. Analytical and advanced mathematics skills is essential.

Course Objectives:

Students are expected to study,

1. A valid operational need (or potential market) that exists for a new system or a major upgrade to an existing system, and a feasible approach to fulfilling the need at an affordable cost and within an acceptable level of risk.
2. A well-documented justification for initiating the development of a new system
3. Functions to describe the system's activities, interactions, and operations.
4. Examination of different technological approaches, generally offering a more diverse source of alternatives.
5. The architecture in associated with structures, their relationships, and expectation for their design.
6. The decisions typically made by systems engineers in the development of complex systems.

Course Outcomes:

The Students will be able to,

1. Identify the need of new system and show that such a system offers a sufficient improvement in capability to warrant the effort to bring it into being.
2. Convert the operationally oriented view of the system derived in the needs analysis phase into an engineering-oriented view required in the concept definition and subsequent phases of development.
3. Select, from a number of alternative system concepts, of a specific configuration that will constitute the baseline for development and engineering.
4. Provide the decision makers with a variety of choices for the system concept.
5. Bring form to function, bring order out of chaos, or convert the partially formed ideas of a client into a workable conceptual model.
6. Make decisions in the development of complex systems.

Detailed Syllabus

Practical: **(Both I and II Compulsory)**

I. Any 3 topics from topics listed below

1. Assume that you have a business in garden care equipment and are planning to develop one or two models of lawn tractors to serve suburban homeowners. Consider the needs of the majority of such potential customers and write at least six operational requirements that express these needs. Remember the qualities of good requirements as you do so. Draw a context diagram for a lawn tractor.

2. To meet future pollution standards, several automobile manufacturers are developing cars powered by electricity. Develop five requirements for new electric-powered cars.
3. Develop a top-level function list for an automated teller machine (ATM) system. Limit yourself to no more than 12 functions.
4. Given the personal automobile as the predecessor system to transport users from their homes to their offices, develop five to seven alternative concepts. Organize them by technology used and develop three to five criteria for which to compare all alternatives.
5. Develop functional architecture views for a public transportation system concept; generate a functional architecture that contains eight to ten functions.

II. Design any one real life application using the Cameo Software/ Dymola

a. The design of a traffic light at a new intersection.

b. The design of a new weather satellite.

c. The choice of a communications subsystem on a new mid-ocean buoy designed to measure ocean temperature at various depths.

d. The choice of a security subsystem for a new power plant.

Text Books:

1. Systems Engineering Principle and Practice , Alexander Kossiakoff, Samuel J. Seymour, David A. Flanigan, Steven M. Biemer, John Wiley & Sons, Inc., 3rd Edition, 2020.

Reference books:

1. System Requirements Analysis, Jeffrey O. Grady, Elsevier, 2nd Edition, 2016.
2. System Verification: Proving the Design Solution Satisfies the Requirements, Jeffery O. Grady, Elsevier, 2007.
3. Systems Engineering Fundamentals and Applications, Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.
4. NASA Systems Engineering Handbook, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.
5. Systems Engineering: Design Principle and Models, Dahai Liu, CRC Press Taylor & Francis Group, 2016.
6. Systems Engineering Guidebook-A process for developing systems and Products, James N Martin, CRC Press, 2000.

Program:	Honor in Systems Engineering				Semester : VII/VIII			
Course:	Seminar/Mini-Project/MOOC/Industrial Training				Code: BME27HN17/ BME28HN17			
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Lecture	Practical	Tutorial	Other	TW	PR	OR	Total
2	-	4	-	-	-	-	50	50

Course Content

Prior knowledge of

a. Foundations of Systems Engineering
b. System Architecture and Design
c. Model Based System Engineering is essential

Course Objectives:

Students are expected to study,

1. Systems Engineering in product design and development processes.
2. Various activities involved in the project and its planning to channelize the work.
3. Building, designing, analysis, and implementation of real-time applications using available platforms.

Course Outcomes:

The students will be able to,

1. Understand and plan a project based on Systems concept.
2. Design a real-time application using Systems Engineering approach from trusted sources.
3. Prepare a technical report with context diagrams.
4. Deliver technical presentation based on the work carried out.

Seminar/Mini-Project/MOOC/Industrial Training is a course requirement where in under the guidance of a faculty member a student is expected to do an in depth study on the topic relevant to latest trends in the field of concerned Honors degree selected by him / her and approved by the authority; by doing literature survey, understanding different aspects of the problem and arriving at a status report in that area. While doing Seminar/Mini-Project/MOOC/Industrial Training, the student is expected to learn investigation methodologies, study relevant research papers, correlate work of various authors/researchers critically, study concepts, techniques, prevailing results etc., analyze it and present a seminar report. It is mandatory to give a presentation on Seminar/Mini-Project/MOOC/Industrial Training before a panel constituted for the purpose. The grading is done on the basis of the depth of the work done, understanding of the problem, report and presentation by the student concerned.

Guidelines for Seminar

1. Guidelines for the Preparation of Seminar/Mini-Project/MOOC/Industrial Training

- Report should have at least 20 and at most 30 pages.
- The entire pages of the report should be in A4 size strictly, with 1" top and bottom margin and 1.25" left and right margin.
- The entire report should be typed in Times New Roman with (12 Pt.)
- The title and main headings of the paragraphs are to be in bold.
- Report may be divided into the number of chapters as required, with chapter number assigned on the top left corner and chapter name immediately below it (with single line spacing) using Times New Roman (16 Pt. Bold).
- Every sub heading should be given decimal of whole number of the heading. (e.g1.1).
- The complete text should be justified in the report (no left or right aligning).
- No short forms are to be used in the report besides the specified areas.
- Numbering of each figure and table should be done according to the chapter number.
- Numbering of each page should be done in the footer section at the bottom right corner.

- Each line should be separated by a line spacing of 1.5, and each paragraph by line spacing of 2.

2. List of Contents in the Report:

- The Cover
- Cover page. (Same as The Cover)
- Certificate from Department
- Acknowledgement.
- Abstract.
- Table of content.
- List of figures and tables
- The report.
- References and appendices.

3. Guidelines for Presentation:

The presentation shall be limited to 15 minutes plus 10 minutes questions and answers.

Course Syllabus

SYSTEMS ENGINEERING

Semester – VII/ VIII

Program:	Honor in Systems Engineering				Semester : VII/VIII			
Course :	Integrated Project				Code : BME27HN18/ BME28HN18			
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Lecture	Practical	Tutorial	Other	TW	PR	OR	Total
5	-	10	-	-	150	-	50	200

Prior knowledge of:

a. Foundations of Systems Engineering,
b. System Architecture and Design,
c. Model Based System Engineering and System Integration,
d. Verification and Validation is essential

Course Objectives:

Students are expected to study,

1. Systems Engineering in product design and development processes.
2. Various activities involved in the project and its planning to channelize the work.
3. Building, designing, analysis, and implementation of real-time applications using available platforms.

Course Outcomes:

The students will be able to,

1. Understand, plan and execute a project based on Systems Engineering concept.
2. Design a real-time application using Systems Engineering approach.
3. Prepare a technical report with required System Engineering based diagrams.
4. Deliver technical content based on the project work carried out.
5. Understand publication and copyright process of research

Guidelines: Total: 24 h (contact) + 48 h(non-contact/implementation)

1. A group of 3 to 4 students needs to design and demonstrate the project under the guidance of the allocated guide.
2. Students can choose the project considering their implementation in Major Project.
3. The hardware implementation and or software simulation is compulsory.
4. Project Report should be submitted in compliance with term work associated with the subject.
5. Paper publication associated with the project as research outcome is appreciable.
6. Project work preferably should be completed in the laboratory/ industry.

Detailed Syllabus

Sr. No.	Activity	Duration (Hrs.)
1.	Semester VIII (week 1&2): Project guide allotment, Finalization of topic and platform, Planning of the work, Literature review, identifying a problem, and formulating the problem for the project	20
2.	Semester VIII (week 3 & 4): Methodology finalization, finalizing project proposal, Review 1 for finalization of topic and specification.	20
3.	Semester VIII (week 5 & 6): Simulation of Ideas on appropriate software tools and finalization of hardware platform	30
4.	Semester VIII (week 7 & 8): Understanding platform implementation and related software flow and execute the block-level design, Review 2 to understand the progress of the project	30
5.	Semester VIII (week 9 & 10): Project Report writing and publication or copyright planning and execution.	30
6.	Semester VIII (week 11 & 12): Demonstration of Project work and Final Review for submission and term work compliances.	20
	Total	150

VISION

To be the department of sustainable academic excellence, fostering innovation, skill development, and work ethics leading to globally competent mechanical engineers.

जागतिक स्तरावर सक्षम यांत्रिक अभियंत्यांना मार्गदर्शन करणारा नावीन्य, कौशल्य विकास आणि कामाच्या नैतिकतेला चालना देणारा शाश्वत शैक्षणिक उत्कृष्टतेचा विभाग बनणे.

MISSION

1. **Nurture cohesive learning environment and develop matching ecosystem.**

   एकसंध शिक्षण वातावरण जोपासणे आणि जुळणारी परिसंस्था विकसित करणे.

2. **Cultivate excellent work ethics and right attitude among students by imparting essential skills and knowledge.**

   आवश्यक कौशल्ये आणि ज्ञान देऊन विद्यार्थ्यांमध्ये उत्कृष्ट कार्य नैतिकता आणि योग्य दृष्टिकोन विकसित करणे.

3. **Instill a sense of creativity, social responsibility and environmental awareness among students.**

   विद्यार्थ्यांमध्ये सर्जनशीलता, सामाजिक जबाबदारी, आणि पर्यावरण विषयक जागरुकता निर्माण करणे.

DEPARTMENT OF MECHANICAL ENGINEERING

Program Educational Objectives

1. To cultivate knowledge and skills in formulating, analyzing, and solving interdisciplinary engineering problems among the mechanical engineering graduates.
2. To inculcate right attitude and awareness about codes of professional practice, social commitment, and life-long learning among the mechanical engineering graduates.
3. To enhance professional competence for catering to the needs and expectations of society as a profound Mechanical Engineer.

Program Specific Outcomes

1. Conceptualize, design, model, simulate, and analyze mechanical components, systems and processes in complex interdisciplinary applications.
2. Develop sustainable solutions to real-life mechanical engineering problems in products and process industries.
3. To practice professional codes and conducts, safety norms, industrial engineering and management principles while working in the industry or as an entrepreneur.