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 Systems Engineering

(Regulation 2020)

Effective from Academic Year 2024-25

(Updated with minor changes)

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)."

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

Course Approval Summary

Board of study -Department of Mechanical Engineering

Sr. No.	Course Name	Course Code	Page Number	Signature and Stamp of BoS Chairman
1	Foundations of Systems Engineering	HME5981	11	
2	Foundations of Systems Engineering Lab	HME5982	12	
3	Model Based System Engineering	HME6983	14	
4	Model Based System Engineering Lab	HME6984	15	
5	System Architecture and Design	HME7981/ HME8981	17	
6	System Architecture and Design Lab	HME7982/ HME8982	19	
7	Seminar/Mini-Project /MOOC/Industrial Training	HME7983/ HME8983	21	
8	Integrated Project	HME7984/ HME8984	24	

Chairman
BoS, Mechanical Engineering
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Approved by Academic Council:

Chairman, Academic Council

Pimpri Chinchwad College of Engineering

Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

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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

SYSTEMS ENGINEERING

Honors in Mechanical Engineering

Curriculum structure
SYSTEMS ENGINEERING
Honor in Mechanical Engineering

Semester	Course Code	Course Name	Teaching Scheme					Evaluation Scheme					
			L	P	T	H	CR	FA	SA	TW	PR	OR	Total
V	HME5981	Foundations of Systems Engineering	3	-	-	3	3	40	60	-	-	-	100
V	HME5982	Foundations of Systems Engineering Lab	-	2	-	2	1	-	-	25	-	-	25
VI	HME6983	Model Based System Engineering	3	-	1	4	4	40	60	-	-	-	100
VI	HME6984	Model Based System Engineering Lab	-	2	-	2	1	-	-	25	-	25	50
VII/VIII	HME7991/ HME8991	System Architecture and Design	3	-	-	3	3	40	60	-	-	-	100
VII/VIII	HME7992/ HME8992	System Architecture and Design Lab	-	2	-	2	1	-	-	25	-	-	25
VII/VIII	HME7993/ HME8993	Seminar/Mini-Project/MOOC/Industrial Training	-	4	-	4	2	-	-	-	-	50	50
VII/VIII	HME7994/ HME8994	Integrated Project	-	10	-	10	5	-	-	150	-	50	200
Total			9	20	1	30	**20**	170	180	225	-	125	**650**

***Abbreviations are: L**-Lecture, **P**-Practical, **T**-Tutorial, **H**- Hours, **FA**- Formative Assessment, **SA**- Summative Assessment, **TW** –Term work, **OR** - Oral*

Course Syllabus

SYSTEMS ENGINEERING

Semester - V

Program:	Honor in Systems Engineering			Semester : V		
Course :	Foundations of Systems Engineering			Code : HME5981		
Teaching Scheme				Evaluation Scheme		
Lecture	Practical	Credit	Hours	FA	SA	Total
3	-	3	3	40	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 (H)
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 : HME5982	
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Credit	Hours	TW	PR	OR	Total
-	2	1	2	25	-	-	25

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 (All are compulsory)

1. For each of the following areas, list and explain how at least two major technological advances/breakthroughs occurring since 2010 that have radically changed them. In each case, explain how the change was effected.
   (a) Transportation
   (b) Communication
   (c) Financial management
   (d) Manufacturing
   (e) Distribution and sales
   (f) Entertainment
   (g) Medical care
2. What characteristics of an airplane would you attribute to the system as a whole rather than to a collection of its parts? Explain why
3. List the hierarchy consisting of a typical subsystem, component, subcomponent, and part for (i) a terminal air traffic control system, (ii) a personal computer system, (iii) an automobile, and (iv) an electric power plant. For each system you need only name one example at each level.
4. Draw a context diagram for a standard washing machine and coffee maker machine. Make sure to identify all of the external entities, and label all of the interactions.
5. Identify a recent development (since 2010) of a complex system (commercial or military) of which you have some knowledge. Describe the need it was developed to fill and the principal ways in which it is superior to its predecessor(s). Briefly describe the new conceptual approach and/or technological advances that were employed.
6. Describe the general type of the organizational structure in which you work. Discuss instances where this structure has been beneficial, and those where it has not been so beneficial to programs you have been involved in or have some knowledge of.

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.

Course Syllabus

SYSTEMS ENGINEERING

Semester - VI

Program:	Honor in Systems Engineering					Semester: VI
Course :	Model Based System Engineering					Code : HME6983
Teaching Scheme				Evaluation Scheme		
Lecture	Practical	Tutorial	Credit	FA	SA	Total
3	-	1	4	40	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 (H)
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 : HME6984				
Teaching Scheme				Evaluation Scheme				
Lecture	Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
-	2	-	1	2	25	-	25	50

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

Practical (Both I and II Compulsory)

I. **Any 3 topics from topics listed below**

1. MBSE holds the promise of simplifying reviews and enabling more rapid assessment of model quality. What implications does this have for team structure, cost, and program timing?
2. The United States Department of Defense has enumerated five goals as part of its Digital Engineering Strategy. Which of these do you think is the most critical? Which is the hardest to achieve? Why?
3. Execution of Document-Intensive Systems Engineering (DISE) is made more difficult because documents are not inherently synchronized; over time, the relevant artifacts associated with a program may "drift" and become inconsistent. What are some potential negative consequences of this?
4. Test plans are one of the DISE artifacts that risk becoming disconnected from the system architecture and requirements; what benefits result from modeling the test architecture in concert with the system architecture?
5. Not all system elements must be modeled with the same level of detail; more effort can be spent on novel or high-risk elements to fully characterize them (and lower-fidelity elements may be revisited if analysis indicates the effort is warranted). What elements would you model at lower fidelity in an autonomous automobile? A satellite? An e-commerce system?
6. Craftsman approach has been proposed as a method for developing competent system modelers (with senior modelers mentoring and training junior modelers). Why is this approach a viable alternative? How does it compare with other methods (e.g. lectures, self-directed exercises)?

II. **Design any one real life application consisting of atleast 3 sub systems using the Cameo Software/ Dymola**

Text Books: 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.

Course Syllabus

SYSTEMS ENGINEERING

Semester – VII/VIII

Program:	Honor in Systems Engineering			Semester : VII/VIII		
Course :	System Architecture and Design			Code : HME7991/ HME8991		
Teaching Scheme				Evaluation Scheme		
Lecture	Practical	Credit	Hours	FA	SA	Total
3	-	3	3	40	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 (H)
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 :** Selecting the System Concept, Functional Analysis and Formulation, Functional Allocation, Functional Analysis Products, Traceability to Requirements, Concept Development Space.	7

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 : HME7992/ HME8992	
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Credit	Hours	TW	PR	OR	Total
-	2	1	2	25	-	-	25

Prior knowledge of

a. Foundations of Systems Engineering,

b. Problem-solving,

c. Analytical and advanced mathematics skills……..are 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: HME7993/ HME8993			
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Credit	Hours	TW	PR	OR	Total
-	4	2	4	-	-	50	50

Course Content

Prior knowledge of

a. Foundations of Systems Engineering
b. System Architecture and Design
c. Model Based System Engineering ……..are 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 : HME7994/HME8994
Teaching Scheme				Evaluation Scheme		
Lecture	Practical	Credit	Hours	TW	OR	Total
-	10	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……..are 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 (H)
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