**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR**
**(An Autonomous Institute)**

**Affiliated to**

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR PRADESH LUCKNOW**

# Evaluation Scheme & Syllabus

For

## B.Tech in Mechanical Engineering (ME)

## Fourth Year

**(Effective from the Session: 2026-27)**

# NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA
## (An Autonomous Institute)

## B. TECH (ME)
## Evaluation Scheme
### SEMESTER VII

| Sl. No. | Subject Codes | Subject Name | Types of Subjects | Periods | | | Evaluation Schemes | | | | End Semester | | Total | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | CT | TA | TOTAL | PS | TE | PE | | |
| 1 | BME0701 | Industrial Engineering & Management | Mandatory | 3 | 0 | 0 | 30 | 20 | 50 | | 100 | | 150 | 3 |
| 2 | | Departmental Elective - V | Departmental Elective | 3 | 0 | 0 | 30 | 20 | 50 | | 100 | | 150 | 3 |
| 3 | | Open Elective II | Open Elective | 3 | 0 | 0 | 30 | 20 | 50 | | 100 | | 150 | 3 |
| 4 | | Open elective III | Open Elective | 3 | 0 | 0 | 30 | 20 | 50 | | 100 | | 150 | 3 |
| 5 | BME0751 | Model Based System Engineering Lab | Mandatory | 0 | 0 | 2 | | | | 25 | | 25 | 50 | 1 |
| 6 | BME0759 | Internship Assessment | Mandatory | 0 | 0 | 2 | | | | 50 | | | 50 | 1 |
| 7 | BME0758 | Capstone Project - I | Mandatory | 0 | 0 | 4 | | | | 50 | | 50 | 100 | 2 |
| 8 | | *Massive Open Online Courses (For B.Tech. Hons. Degree) | *MOOCs | | | | | | | | | | | |
| | | **TOTAL** | | **12** | **0** | **8** | **120** | **80** | **200** | **125** | **400** | **75** | **800** | **16** |

*** List of MOOCs (Infosys) Based Recommended Courses for Fourth year B. Tech Students**

| S. No. | Subject Code | Course Name | University/ Industry Partner Name | N. of Hours | Credits |
|---|---|---|---|---|---|
| 1. | BMC0123 | Internet of Things | Infosys Wingspan (Infosys Springboard) | 30h 9m | 2 |
| 2. | BMC0040 | Data Structures and Algorithms using Python - Part 2 | Infosys Wingspan (Infosys Springboard) | 37h 41m | 3 |

**List of Department Elective (if any):-**

| S.No. | Subject Code | Subject Name | Bucket Name | Semester |
|---|---|---|---|---|
| 1 | BME0711 | Sustainable Manufacturing | Industry 4.0 | VII |
| 2 | BME0712 | Hybrid and Electric Vehicles | Automotive Engineering | VII |

**Abbreviation Used:**

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., PE: Practical End Semester Exam, CE: Core Elective, OE: Open Elective, DE: Departmental Elective, CA: Compulsory Audit,

MOOCs: Massive Open Online Courses.

# NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA
## (An Autonomous Institute)
## B. TECH (ME)
## Evaluation Scheme
### SEMESTER VIII

| Sl. No. | Subject Codes | Subject Name | Types of Subjects | Periods | | | Evaluation Schemes | | | | End Semester | | Total | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | CT | TA | TOTAL | PS | TE | PE | | |
| 1 | | Open Elective - IV | Open Elective | 2 | 0 | 0 | 30 | 20 | 50 | | 50 | | 100 | 2 |
| 2 | BME0859/ BME0858 | Industrial Internship/ Capstone Project - II | Mandatory | 0 | 0 | 16 | | | | 200 | | 200 | 400 | 8 |
| 3 | | *Massive Open Online Courses (For B.Tech. Hons. Degree) | *MOOCs | | | | | | | | | | | |
| | | **TOTAL** | | **2** | **0** | **16** | **30** | **20** | **50** | **200** | **50** | **200** | **500** | **10** |
| **Mini Project or Internship (3-4 weeks) shall be conducted during summer break after II semester and will be assessed during III semester** | | | | | | | | | | | | | | |

*** List of MOOCs (Infosys) Based Recommended Courses for Fourth year B. Tech Students**

| S. No. | Subject Code | Course Name | University/ Industry Partner Name | N. of Hours | Credits |
|---|---|---|---|---|---|
| **1.** | BMC0150 | TQM Applicability in Industries | Infosys Wingspan (Infosys Springboard) | 15h 21m | 1 |
| **2.** | BMC0151 | Project Management Professional | Infosys Wingspan (Infosys Springboard) | 22h 4m | 1.5 |

**Abbreviation Used:**

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., PE: Practical End Semester Exam, CE: Core Elective, OE: Open Elective, DE: Departmental Elective, CA: Compulsory Audit,

MOOCs: Massive Open Online Courses.

# NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA
## (An Autonomous Institute)

**AICTE Guidelines in Model Curriculum:**

A student will be eligible to get Under Graduate degree with Honours only, if he/she completes the additional MOOCs courses such as Infosys Springboard/NASSCOM/CISCO (as applicable) certifications, or any other online courses recommended by the Institute (Equivalent to 20 credits). During Complete B.Tech. Program Guidelines for credit calculations are as follows.

1. For 6 to 12 Hours =0.5 Credit
2. For 13 to18 =1 Credit
3. For 19 to 24 =1.5 Credit
4. For 25 to 30 =2 Credit
5. For 31 to 35 =2.5 Credit
6. For 36 to 41 =3 Credit
7. For 42 to 47 =3.5 Credit
8. For 48 and above =4 Credit

For registration to MOOCs Courses, the students shall follow Infosys Springboard/NASSCOM/CISCO (as applicable) registration details as per the assigned login and password by the Institute these courses may be cleared during the B. Tech degree program (as per the list provided). After successful completion of these MOOCs courses, the students shall provide their successful completion status/certificates to the Controller of Examination (COE) of the Institute through their coordinators/Mentors only.

The students shall be awarded Honours Degree as per following criterion.

i. If he / she secures 7.50 as above CGPA.
ii. Passed each subject of that degree program in the single attempt without any grace.
iii. Successful completion of MOOCs based 20 credits

| Course Code: BME0701 | Course Name: Industrial Engineering &Management | L | T | P | C |
|---|---|---|---|---|---|
| Course Offered in: ME | | 3 | 0 | 0 | 3 |

**Pre-requisite:** Computer block diagram, Generation of programming languages, Translators, Flowchart

**Course Objectives: Production engineering**

The objective of the Industrial Engineering & Management course is to provide students with a comprehensive understanding of the principles and functions of industrial engineering and management. It aims to equip students with the knowledge of modern industrial practices such as ERP, logistics. Students will learn project management techniques using CPM and PERT, including network diagram construction, critical path determination. students will explore the use of operations research in management decision-making.

**Course Outcome:** After completion of the course, the student will be able to

| | |
|---|---|
| 1. Apply the principles of industrial engineering and management, and modern industrial practices such as ERP, logistics, JIT, and supply chain management, to enhance efficiency and decision-making in industrial environments. | K3 |
| 2. Apply the principles of Production Planning and Control (PPC), and project management tools such as Gantt charts, CPM, and PERT to effectively plan, and schedule. | K4 |
| 3. Understand the principles of material management and inventory control and apply techniques inventory models to optimize resource utilization and cost efficiency. | K3 |
| 4. Apply the concepts of work study, including method study and work measurement techniques to improve productivity and value through value analysis methods | K3 |
| 5. Apply operations research techniques such as linear programming, transportation and assignment models to solve decision-making problems in various functional areas of management using graphical, simplex, Hungarian and MODI methods. | K4 |

**CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)**

| CO-PO Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 2 | 1 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 2 |

**Course Contents / Syllabus**

| Unit 1 | Introduction to industrial management, operation management | 10 hours |
|---|---|---|

Introduction to industrial engineering, Management, functions of industrial management.

**Organizational structure:** Introduction, types, Advantages and disadvantages.

**Operations management**: Objectives Types of production system (Job, Batch and Mass Production). Plant Location, Factors, Urban & Rural sites Comparison, Types of plant Layouts, Design of product Layout, Line balancing.

**Recent trends in industrial management:** ERP (Enterprise resource planning) concept, features and applications, Logistics: concept, need and benefits, Just in Time (JIT):, concept and benefits, Supply chain management: concept and benefits

| Unit 2 | Production planning and control (PPC) , Scheduling Techniques | 09 hours |
|---|---|---|

**PPC:** Definition and functions of PPC, introduction to scheduling, GANTT chart, Forecasting methods. MRP I&MRPII

**CPM & PERT:** meaning, features, difference, applications. Understand different terms used in network diagram. Draw network diagram Determination of critical path on network. Floats, its types and determination of floats. Crashing of network..

| Unit 3 | Materials Management and Queuing theory | 8 hours |
|---|---|---|

**Material management:** definition, functions, importance, relationship with other departments.

**Inventory control:** Definition. Objectives. Derivation for expression for Economic Order Quantity (EOQ) and numeric examples. ABC analysis and other modern methods of analysis. Various types of inventory models, Break Even analysis.

**Queuing Theory:** Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Classification of Queuing model. numerical problems on queuing models.

| Unit 4 | Work study and value engineering | 8 hours |
|---|---|---|

**Work study:** Introduction Definition-Objectives, Steps in work study, Method Study definition, objectives- steps of method study. Work measurement: purpose, types of study, stop watch methods, steps, key rating, allowances, standard time calculations, work sampling.

**Value Analysis:** definition, terms used, process and importance. value analysis flow diagram. DARSIRI method of value analysis.

Waste-types, sources and ways to reduce them.

| Unit 5 | Operational Analysis | 10hours |
|---|---|---|

**Linear programming problems:** Introduction and applications of operations research in functional areas of management. Linear Programming-formulation, solution by graphical methods.

**Transportation Models:** (Minimizing and Maximizing Problems), Balanced Problems, Initial Basic feasible solution by N-W Corner Rule, least cost and Vogel's approximation methods. Check for optimality. Solution by MODI Case of Degeneracy.

**Assignment Models**: (Minimising and Maximising Problems), Balanced Problems. Solution by Hungarian and Branch and Bound Algorithms. Travelling Salesman problem.

| | |
|---|---|
| **Total Lecture Hours** | **45 hours** |

**Textbook:**

1. Industrial Engineering Management by Ravi Shankar.
2. Industrial Engineering and Production management. By Martand T Telsang.

**Reference Books:**

1. Modern Production Management by Buffa.
2. Materials Management by N. Nair.
3. Operations research: An Introduction by Hamdy A. Taha
4. Operations research PK Gupta, DS Hira.
5. Production and Operations Management: Concepts, Models and Behavior by Evertt E. Adam, Jr. Ronald J. Ebert

| Self-Study Content Links: | | Duration (in Hrs) |
|---|---|---|
| MOOCs | NPTEL :: Mechanical Engineering - NOC:Principles of Industrial Engineering | 50-60 |
| Video Lectures | NPTEL :: Mechanical Engineering - NOC:Work System Design<br>NPTEL :: Management - NOC:Management of Inventory Systems | 20-30 |
| Web References | https://www.newtondesk.com/wp-content/uploads/2018/05/Industrial-Engineering-study-notes.pdf | 30 |

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

| Course Code: BME0711 | Course Name: Sustainable Manufacturing | L | T | P | C |
|---|---|---|---|---|---|
| Course Offered in: ME | | 3 | 0 | 0 | 3 |

**Pre-requisite:** Basic knowledge of automobile engineering, electrical machines, and power electronics.

**Course Objectives:**

To equip students with the principles and practices of sustainable manufacturing, emphasizing the integration of environmental, economic, and social considerations into manufacturing processes. The course aims to develop competencies in life cycle assessment, green manufacturing techniques, and sustainable supply chain management.

**Course Outcome:** After completion of the course, the student will be able to

| | |
|---|---|
| Explain the fundamental concepts of sustainability and their relevance to manufacturing. | K2 |
| Analyze energy and resource efficiency in manufacturing processes using sustainability metrics. | K3 |
| Apply green manufacturing techniques to reduce waste and energy consumption. | K3 |
| Apply sustainable manufacturing tools (e.g., Lean-Green, Industry 4.0) for process optimization. | K3 |
| Explain sustainable manufacturing system considering environmental, economic, and social factors. | K2 |

**CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)**

| CO-PO Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | - | 1 | 1 | - | 3 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | - | 1 | 1 | - | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | - | 1 | - | 1 | 1 | - | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | - | 1 | 1 | - | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | - | 1 | 1 | - | 3 | 2 | 3 |

**Course Contents / Syllabus**

| Unit 1 | Introduction to Sustainable Manufacturing | 08 hours |
|---|---|---|

Definition, need, and drivers of sustainability, Evolution of Sustainable Manufacturing, Triple Bottom Line (TBL) approach, Global standards, Environmental impacts of manufacturing

| Unit 2 | Sustainable Materials & Processes | 09 hours |
|---|---|---|

Sustainability metrics, Eco-friendly materials, Energy-efficient processes, Additive manufacturing for sustainability,

| Unit 3 | Green and Clean Manufacturing | 10 hours |
|---|---|---|

Zero-waste manufacturing, Remanufacturing & closed-loop systems, Recycling strategies, clean production techniques, Circular economy

| Unit 4 | Tools for Sustainable Manufacturing | 09 hours |
|---|---|---|

Life Cycle Assessment (LCA), Various phases, Life Cycle Cost Analysis, Lean-Green synergy, Digital tools (IoT, AI for sustainability)

| Unit 5 | Future Trends & Policy | 09 hours |
|---|---|---|

Green logistics, reverse logistics, sustainable procurement, Smart factories (Industry 4.0), Carbon neutrality strategies, Govt. policies (EU Green Deal, India's NAPCC).

| | Total Lecture Hours | 45 hours |
|---|---|---|

**Textbook:**


1. Dornfeld, D. A. (2013). *Green Manufacturing: Fundamentals and Applications*. Springer..
2. Allwood, J. M., & Cullen, J. M. (2012). *Sustainable Materials – With Both Eyes Open*. UIT Cambridge
3. Jawahir, I. S., Dillon Jr., O. W., & Jayal, A. D. (2010). "Sustainable manufacturing: Trends and research." CIRP.
4. UNEP (2021). *Resource Efficiency and Climate Change*.
5. Gopalakrishnan, B., Yusuf, Y. Y. (2011). *Sustainable Manufacturing: Metrics, Standards and Practices*.

**Reference Books:**

1. Graedel, T. E., & Allenby, B. R. (2010). *Industrial Ecology and Sustainable Engineering*. Pearson.
2. Hesselbach, J., & Herrmann, C. (2011). *Globalized Solutions for Sustainability in Manufacturing*.
3.NPTEL Course Text – *Sustainability through Green Manufacturing Systems*, Prof. Ramesh Babu, IIT Madras

| Self-Study Content Links: | | Duration (in Hrs) |
|---|---|---|
| MOOCs | Sustainable Manufacturing Course | 20 Hrs |
| Video Lectures | Sustainability through Green Manufacturing Systems | 15 Hrs |
| Web References | Sustainable Manufacturing Elective | 10 Hrs |

| Course Code: BME0712 | Course Name: Hybrid and Electric Vehicles | L | T | P | C |
|---|---|---|---|---|---|
| Course Offered in: ME | | 3 | 0 | 0 | 3 |

**Pre-requisite:** Basic knowledge of automobile engineering, electrical machines, and power electronics.

**Course Objectives:**

1. To develop an understanding of the fundamentals, architecture, and performance characteristics of hybrid and electric vehicles.
2. To provide knowledge of hybrid and electric drive-train topologies, propulsion systems, and power flow control strategies used in HEVs and EVs.
3. To familiarize students with electric propulsion units, energy storage technologies, and drive system sizing methods for vehicle applications.
4. To enable students to analyze energy management strategies and evaluate their impact on vehicle efficiency, fuel economy, and sustainability.

**Course Outcome:** After completion of the course, the student will be able to

| | |
|---|---|
| 1. Apply the fundamentals of hybrid and electric vehicles, vehicle performance analysis, and drivetrain characteristics to evaluate modern transportation systems. | K3 |
| 2. Apply hybrid and electric drive-train topologies, power flow control strategies, and fuel efficiency characteristics of HEVs and EVs. | K3 |
| 3. Apply the configuration and control principles of electric propulsion systems including DC, induction, permanent magnet, and switched reluctance motor drives. | K3 |
| 4. Apply various energy storage technologies, drive system sizing methods, and hybridization techniques used in hybrid and electric vehicles. | K3 |
| 5. Evaluate different energy management strategies and their impact on fuel economy, emissions, battery performance, and overall vehicle efficiency. | K4 |

**CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)**

| CO-PO Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | - | 1 | 1 | - | 3 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | - | 1 | 1 | - | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | - | 1 | - | 1 | 1 | - | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | - | 1 | 1 | - | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | - | 1 | 1 | - | 3 | 2 | 3 |

**Course Contents / Syllabus**

| Unit 1 | Introduction to Hybrid Electric Vehicles | 08 hours |
|---|---|---|

Introduction: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Apply the concepts of sustainable transportation and evaluate the social and environmental impact of hybrid and electric vehicles. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

| Unit 2 | Hybrid & Electric Drive-trains | 09 hours |
|---|---|---|

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Apply the principles of hybrid traction and electric traction systems in vehicle applications.

| Unit 3 | Electric Propulsion Unit | 10 hours |
|---|---|---|

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency Apply electric motor drive concepts in hybrid and electric vehicles.

| Unit 4 | Energy Storage | 09 hours |
|---|---|---|

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage

| | | |
|---|---|---|
| technology, Communications, supporting subsystems. Examine communication systems and supporting subsystems in HEV and EV architectures. | | |
| **Unit 5** | **Energy Management Strategies** | **09 hours** |
| Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Analyze different energy management strategies and their implementation. | | |
| | **Total Lecture Hours** | **45 hours** |

**Textbook:**

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004

**Reference Books:**

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011

| Self-Study Content Links: | | Duration (in Hrs) |
|---|---|---|
| MOOCs | https://nptel.ac.in/courses/108103009 | 20 Hrs |
| Video Lectures | https://youtu.be/WfiTscWVfWI | 15 Hrs |
| Web References | https://afdc.energy.gov/vehicles/electric-basics-hev | 10 Hrs |

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

| Course Code | Course Name: Model Based System Engineering | L | T | P | Credit |
|---|---|---|---|---|---|
| Course Offered in: ME | | 0 | 0 | 2 | 1 |

**Pre-requisites: Knowledge of system design**

**Course Objectives:**

**Suggested list of Experiment**

| Sr. No. | Name of Experiment |
|---|---|
| 1 | Elicit system requirements from stakeholders and create a requirements model using MBSE techniques such as use case diagrams, activity diagrams, and requirements diagrams. |
| 2 | Design and analyze the system architecture using MBSE tools, focusing on components, interfaces, and interactions. Perform structural and behavioral analysis of the architecture model. |
| 3 | Model the system behavior using dynamic behavior diagrams (e.g., activity diagrams,statecharts) and simulate the behavior using MBSE tools. Analyze the system performance and validate the model against the desired behavior. |
| 4 | Perform trade-off analysis using MBSE models to evaluate and compare different design alternatives. Consider factors such as cost, performance, reliability, and risk to make informed design decisions. |
| 5 | Design and execute validation tests based on the system model to ensure that the system meets the specified requirements. Analyze the test results and refine the system model accordingly. |
| 6 | Manage system changes using MBSE tools and techniques. Introduce changes to the system model, analyze their impact, and update the model accordingly. Evaluate the effectiveness of the change management process. |
| 7 | System Integration and Interface Design Design and manage system interfaces using MBSE tools. Ensure proper integration and communication between system components. Analyze the impact of interface changes on the system behavior. |
| 8 | Analyze the performance of the system model, such as response time, throughput, and resource utilization. Apply optimization techniques to improve system performance and validate the optimized model. |
| 9 | Perform safety analysis using MBSE techniques (e.g., fault trees, hazard analysis) to identify potential hazards and mitigate risks. Update the system model to incorporate safety requirements. |
| 10 | Collaborate with team members using MBSE tools to enable concurrent engineering, version control, and efficient communication of system design information. Evaluate the effectiveness of collaboration processes. |

**Course outcome:** After completion of the course, the student will be able to

| | | |
|---|---|---|
| CO 1 | Understand the fundamental principles, methodologies, and best practices of MBSE, including requirements elicitation, system architecture design, and behavioral modeling. | K5 |
| CO 2 | Use MBSE tools and software to create and manage system models, perform analysis and simulations, and facilitate collaboration and communication among team members. | K5 |
| CO 3 | Apply MBSE techniques, such as case diagrams, activity diagrams, and requirements diagrams, to effectively capture, model, and analyze system requirements, behavior, and interactions. | K5 |
| CO4 | Acquire skills in designing and analyzing system architectures, performing trade-off analysis, considering factors like cost, performance, reliability, and risk, and making informed design decisions based on MBSE models. | K5 |
| CO 5 | Demonstrate the ability to identify system performance bottlenecks, analyze system behavior, and apply optimization techniques to improve system performance and meet desired requirements. Develop problem-solving skills by addressing real-world challenges in system integration, safety analysis, change management, and validation testing using MBSE approaches | K5 |