NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Affiliated to

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

Evaluation Scheme & Syllabus

For

Bachelor of Technology

Mechanical Engineering (ME)

Fourth Year

(Effective from the Session: 2023-24)

NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Bachelor of Technology
Mechanical Engineering
Evaluation Scheme
SEMESTER - VII

Sl. No.	Subjet Codes	Subject Name	Periods			Evaluation Schemes				End Semester		Total	Credit
			L	T	P	CT	TA	TOTAL	PS	TE	PE		
WEEKS COMPULSORY INDUCTION PROGRAM													
1	AME0701	Elements of Flexible Manufacturing System and Process Engineering	3	0	0	30	20	50		100		150	3
2		Departmrntal Elective- V	3	0	0	30	20	50		100		150	3
3		Open Elective-II	3	0	0	30	20	50		100		150	3
4		Open Elective-III	3	0	0	30	20	50		100		150	3
5	AME0751	Model Based System Engineering Lab.	0	0	2				25		25	50	1
6	AME0759	Internship Assessment-III	0	0	2				50			50	1
7		MOOCs (Essential for Hons. Degree)											
		Total										**700**	**14**

List of MOOCs (Coursera) Based Recommended Courses for Fourth Year (Semester-VII) B. Tech Students

S. No.	Subject Code	Course Name	University/ Industry Partner Name	N. of Hours	Credits
1.	AMC0169	MBSE: Model-Based Systems Engineering	University at Buffalo, The state University of New York	21	1.5
2.	AMC0154	Cyber Security in Manufacturing	University at Buffalo, The state University of New York	21	1.5

PLEASE NOTE:-

- **Internship (3-4 weeks) shall be conducted during summer break after semester-VI and will be assessed during Semester-VII**

List of Department Elective :-

S.No.	Subject Code	Subject Name	Bucket Name	Semester
1	**AME0711**	**Autonomous vehicles**	**Automotive Engineering**	**VII**
2	**AME0712**	**Smart Manufacturing**	**Industry 4.0**	**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.

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Bachelor of Technology
Mechanical Engineering
Evaluation Scheme
SEMESTER - VIII

Sl. No.	Subject Codes	Subject Name	Periods			Evaluation Schemes				End Semester		Total	Credit
			L	T	P	CT	TA	TOTAL	PS	TE	PE		
1		Open Elective-IV	2	0	0	30	20	50		100		150	2
2	AME0859	Capstone Project/Industrial Internship	0	0	18				200		350	550	10
3		MOOCs (Essential for Hons. Degree)	0	0	0								
		Total										**700**	**12**

List of MOOCs (Coursera) Based Recommended Courses for Fourth Year (Semester-VIII) B. Tech Students

S. No.	Subject Code	Course Name	University/ Industry Partner Name	N. of Hours	Credits
1.	AMC0176	3D Printing Hardware	University of Illinois urbana-Champaign	31	2.5
2.	AMC0196	Roadmap to Success in Digital Manufacturing & Design	University at Buffalo, The state University of New York	18	1

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.

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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 Coursera 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 Coursera 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

B.TECH FOURTH YEAR

Course Code	AME0701	L T P	Credit
Course Title	**Elements of Flexible Manufacturing System and Process Engineering**	3 0 0	3

Course objective:

The objective of a course on Flexible Manufacturing Systems (FMS) is to provide students with a comprehensive understanding of the principles, concepts, and applications of flexible manufacturing systems in modern manufacturing environments. FMS is a highly automated production system that integrates various manufacturing processes and components to improve efficiency, productivity, and adaptability in manufacturing operations.

Pre-requisites: Knowledge of manufacturing processes & machining centers

Course Contents / Syllabus

UNIT-I	Basics of FMS	8 hours

Introduction and classification of FMS, Automated production cycle, Need, concept and measurement of flexibility, Types of flexibilities and its measurement, Economic justification and Functional requirements of FMS, FMS processing and quality assurance equipment, e.g., turning and machining centers, Co-ordinate measuring machines, Cleaning and deburring machines, AMHS equipment, cutting tool and tool management, Future trends of Flexible Manufacturing System.

UNIT-II	Group Technology	8 hours

Introduction of GT, Part family formation-coding and classification systems; Part-machine group analysis, Methods for cell formation, Use of different algorithms, mathematical programming and graph theoretic model approach for part grouping. Determination of machining parameters: effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

UNIT-III	Data bases in Flexible Manufacturing systems and its implementation	8 hours

Manufacturing data systems, manufacturing data flow, computer-aided design and manufacturing considerations when planning for FMS, Implementation objectives, acceptance testing, Performance goals and expectation, maintenance

UNIT-IV	Introduction to CAPP	8 hours

Introduction to CAPP: Role of process planning, advantages of conventional process planning over CAPP, Generative CAPP system: Importance, principle of Generative CAPP system. Determination of manufacturing tolerances: Methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances. Determination of optimal index positions for executing fixed sequence, Quantitative methods.

UNIT-V	Material Handling systems & Computer Aided Process Planning	8 hours

Conveyors - AGVs – industrial robots in material handling - AS/RS. Generative and variant types, backward and forward approach, feature based and CAD based CAPP.

Course outcome: After completion of course students will be able to

CO 1	The understanding about factors responsible for the growth of FMS, FMS types and applications, Economic justification for FMS, Co-ordinate measuring machines, Cleaning and deburring machines, FMS system support equipment	K_2
CO 2	Ability to know about the concept of GT, Part family formation-coding and classification systems, mathematical programming and graph theoretic model approach for part grouping, Cellular vs. FMS production.	K_3

CO 3	Ability to understand CAPP system: Importance, principle of Generative CAPP system.	K_2
CO 4	Ability to understand the concept of Quantitative methods, Implementation techniques for CAPP, criteria for selecting a CAPP system and benefits of CAPP	K_2
CO 5	Apply materials planning and control techniques to effectively manage the flow of materials within the organization	K_3

Text books :

1. Handbook of Flexible Manufacturing System – Editor:Nand K. Jha (Academic Press, San Diego,California
2. Automation, Production System & Computer Integrated Manufacturing-Groover (PHI)
3. Flexible Manufacturing System – Wernecks (Spring- Verlag).
4. Flexible Manufacturing Cells and systems – W. W.Luggen (PHI)
5. CAD/CAM- P. N. Rao(Tata McGraw Hill)
6. Mikell P. Groover, Automation, Production systems and Computer Integrated Manufacturing System, Prentice Hall, 2007.

Reference Books:

1. Handbook of Flexible Manufacturing System – Editor:Nand K. Jha (Academic Press, San Diego,California).
2. Automation, Production System & Computer Integrated Manufacturing-Groover (PHI).
3. Performance Modelling of Automated Manufacturing Systems –Vishwanathan&Narahari (PHI)

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://onlinecourses.nptel.ac.in/noc21_me83
Unit 2	https://www.youtube.com/watch?v=OG-1Xy1OpUM
Unit 3	https://www.youtube.com/watch?v=kgCMJIVI5XE
Unit 4	https://www.youtube.com/watch?v=20_K7c65Swg
Unit 5	https://www.youtube.com/watch?v=g-zMhN4S8yY

B.TECH FOURTH YEAR

Subject Code	AME0751	L	T	P	Credit
Subject Name	Model Based System Engineering Lab	0	0	2	1

Course Objective- The course aims to provide students with a comprehensive understanding of Model-Based Systems Engineering (MBSE) principles and techniques. Throughout the course, students will delve into various aspects of MBSE, including requirements elicitation and modeling, system architecture design and analysis, behavioral modeling and simulation, trade-off analysis, and decision-making.

Course outcome:	At the end of course, the student will be able to	
CO1	understand of the fundamental principles, methodologies, and best practices of MBSE, including requirements elicitation, system architecture design, and behavioral modeling.	K2
CO2	use MBSE tools and software to create and manage system models, perform analysis and simulations, and facilitate collaboration and communication among team members.	K2
CO3	to apply MBSE techniques, such as use case diagrams, activity diagrams, and requirements diagrams, to effectively capture, model, and analyze system requirements, behavior, and interactions.	K2
CO4	acquire skills in designing and analysing system architectures, performing trade-off analysis, considering factors like cost, performance, reliability, and risk, and making informed design decisions based on MBSE models.	K2
CO5	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	K2

Total No. of Practical

List of Practical:-

1	Objective: Elicit system requirements from stakeholders and create a requirements model using MBSE techniques such as use case diagrams, activity diagrams, and requirements diagrams.
2	Objective: 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	Objective: 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 Objective: 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.

B.TECH FOURTH YEAR

Course Code	AME0711	L	T	P	Credit
Course Title	**Autonomous vehicles**	3	0	0	3

Course objective:

To integrate systematic approaches to self-driven vehicles. To develop ability to employ state-of-the-art technology in vehicle hardware and software architectures. To develop safety assurance for Autonomous vehicles. To introduce the latest trends and technology vehicle dynamic modelling to familiarize with the concepts of vehicle longitudinal control.

Pre-requisites: Understanding of AI & logistics. Basics of self-driving cars & control systems. Knowledge of Mechatronics.

Course Contents / Syllabus

UNIT-I	**Introduction to Self-Driving Vehicles**	**8 hours**
Definition, The Requirements for Autonomy, Driving Taxonomy, Perception, and Driving Decisions, Driving Taxonomy, Perception, and Driving Decisions..		
UNIT-II	**Self-Driving Hardware and Software Architectures**	**8 hours**
Characteristics of Autonomous Vehicle Hardware, Software and Environment Representation**,** Sensors and Computing hardware, hardware computing design		
UNIT-III	**Safety Assurance for Autonomous Vehicles**	**8 hours**
Industry methods for safety assurance and testing, safety frameworks for self-driving.		
UNIT-IV	**Vehicle Dynamic Modeling**	**8 hours**
Kinematic modeling in 2D, Kinematic bicycle model, Dynamic modeling in 2D, Lateral Dynamics		
UNIT-V	**Vehicle Longitudinal Control**	**8 hours**
Proportional-Integral-Derivative (PID), Longitudinal speed control with PID, Feed forward speed control.		

Course outcome: After completion of course students will be able to

CO 1	Understand the concept of self-driven vehicles.	K_3
CO 2	Explain the basic concepts of hardware and software architectures.	K_3
CO 3	Know on the safety assurance for Autonomous vehicles.	K_3
CO 4	Understand and explain latest trends and technology in vehicle dynamic modeling	K_4
CO 5	Understand the concept related to vehicle longitudinal control.	K_3

Text books :

1. Autonomous Vehicles (by Dimitrakopoulos George)
2. Automated Driving and Driver Assistance Systems by Tom Denton

Reference Books:

Autonomous Vehicles for Safer Driving by Ronald K. Jurgen, SAE International

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://onlinecourses.nptel.ac.in/noc21_me83
Unit 2	https://www.youtube.com/watch?v=kpDohGBhR_0&list=PL_GRDTAcxPdUPJZrW9bO85Ab2fESTMRHU&index=1
Unit 3	https://www.youtube.com/watch?v=oE_2rBxNrfc
Unit 4	https://www.youtube.com/watch?v=powT52Isd-Q&list=PLEzzQIuBvBkoqJOP2IL3Elt6Ra8j4zFL3
Unit 5	https://www.youtube.com/watch?v=LZ82iANWBL0&list=PLbMVogVj5nJTW50jj9_gvJmdwFWHaqR5J

B.TECH FOURTH YEAR

Course Code	AME0712	L	T	P	Credit
Course Title	**Smart Manufacturing**	3	0	0	3

Course objective:

This course is intended to make the students learn the fundamentals of digital twins, including their types, benefits, challenges, and best practices. Also, the understanding of the various components of a smart factory and the role they play in optimizing the production process, principles and techniques used to design, analyze, and implement Cyber Physical Systems. connected manufacturing, which is the integration of digital technology into industrial processes and lastly the fundamental principles and methods used in cognitive systems.

Pre-requisites:

Course Contents / Syllabus

UNIT-I	Digital Twins	8 hours

Introduction - Definition and history of digital twins, Types of digital, Applications of digital twins in various industries. Benefits of digital twins, Challenges of digital twins. Tools and Techniques - Digital twin software and platforms, Data acquisition and integration techniques, Modeling and simulation techniques. Applications in Industry - Digital twins in manufacturing, Digital twins in healthcare, Digital twins in construction. Miscellaneous - Ethical, Legal, and Social Implications of Digital Twins, Future of Digital twins, Emerging Trends and Opportunities, Implications for society and the economy.

UNIT-II	Self-Driving Hardware and Software Architectures	8 hours

Introduction - Definition of smart factory, Historical perspective of manufacturing, Key drivers for smart factory implementation, Components of smart factory. Architecture of Smart Factory - Layers of smart factory architecture, Communication protocols in smart factory, Cloud computing and edge computing in smart factory. Benefits of Smart Factory - Increased productivity, Enhanced quality, Improved safety, Better flexibility and customization, Reduced costs. Challenges and Risks - Data security and privacy concerns, Workforce reskilling and training, Integration with legacy systems, Initial costs and Return on Investment.

UNIT-III	Cyber Physical Systems	8 hours

Introduction - Definition of CPS, Historical development and current trends, Examples of CPS applications. **Devices used in CPS** - Sensors and Actuators, Sensor fusion and data integration, Actuator control and feedback, PID controllers, Model-based control. **Real-Time Systems** - Real-time scheduling, Deadline analysis, Timing analysis. **Networking for CPS** - Wired and wireless networks, Network protocols for CPS, Quality of Service (QoS) in CPS. **Security** and Privacy challenges in CPS. **Future trends** and Opportunities in CPS.

UNIT-IV	Connected Manufacturing	8 hours

Introduction – Definition, History and evolution of connected manufacturing, Key components of connected manufacturing, Benefits of connected manufacturing. IoT and Connected Devices - Overview of IoT and its applications in industrial settings, Sensors and connected devices in manufacturing, Security and privacy considerations. Artificial Intelligence - Applications of AI in manufacturing, Use of AI for predictive maintenance and quality control. Data Analytics and Cloud Computing - Overview of data analytics and its applications in industrial settings, Use of cloud computing for data storage and processing, Real-time data analytics and its impact on manufacturing processes. Future of connected manufacturing.

UNIT-V	Cognitive Systems	8 hours

Introduction - Overview of the field of cognitive systems, Historical background, Key challenges in cognitive systems. Cognitive Architectures - Introduction to cognitive architectures, Comparison of different architectures. Perception and Attention – Overview, Models of visual and auditory perception,

Attention and its role in cognition. Memory and Learning - Introduction to memory and learning in cognitive systems, Models of human memory and learning. Decision-Making - Overview of decision-making in cognitive systems, Rational and heuristic decision-making models. Natural Language Processing - Introduction to natural language processing in cognitive systems, Models of syntax and semantics. Case Studies: Cognitive systems in real-world applications (e.g., robotics, human-computer interaction), Discussion of ethical and social implications of cognitive systems.

Course outcome: After completion of course students will be able to

CO 1	Define the concept of digital twins and identify their types and applications.	K2
CO 2	Define the concept of a smart factory and its various components and Understand the architecture of a smart factory	K2
CO 3	Understand the fundamental principles and concepts of Cyber-Physical Systems	K2
CO 4	Define connected manufacturing and understand its various components and analyze its impact on industrial processes.	K2
CO 5	Understand the key concepts and theories in cognitive systems research	K2

Text books :

1. "Industry 4.0: The Industrial Internet of Things" by Alasdair Gilchrist, published by Wiley.
2. "Smart Factory: Concepts and Technologies" by Liang Xu, Jiafu Wan, and Hong Wang, published by Springer.
3. "Digital Twin Technologies and Smart Cities" by Subhasish Dasgupta, published by CRC Press

Reference Books:

1. "Cyber-Physical Systems: From Theory to Practice" by Rajeev Alur and Insup Lee, published by The Institution of Engineering and Technology (IET)
2. "Cognitive Systems: Human Cognitive Models in Systems Design" by Chris Forsythe and Wayne Gray, published by Psychology Press.

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	(207) What is a Digital Twin? - YouTube
Unit 2	(207) Industry 4.0 - "Smart Factory" explained - YouTube
Unit 3	Introduction to Cyber-Physical Systems - YouTube
Unit 4	Connected Manufacturing webinar recording - YouTube
Unit 5	(207) Cognitive Systems Colloquium Introduction - YouTube