Printed page: 03 **Subject Code: BME0611**

Roll No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM:VI- THEORY EXAMINATION (2025-2026)

Subject: - Smart Manufacturing

Time: 3 Hours **Max. Marks:100**

General Instructions:

IMP: Verify that you have received question paper with correct course, code, branch etc.

1. *This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*
2. *Maximum marks for each question are indicated on right hand side of each question.*
3. *Illustrate your answers with neat sketches wherever necessary.*
4. *Assume suitable data if necessary.*
5. *Preferably, write the answers in sequential order.*
6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

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SECTION – A 20

1. Attempt all parts:-

(1.1) Which of the following layers in an IIoT architecture is responsible for data processing and analytics? (CO1, K1) 1

A) Perception Layer
B) Network Layer
C) Application Layer
D) Transport Layer

(1.2) Which computing paradigm processes data closest to the data source to reduce latency? (CO1, K1) 1

A) Cloud Computing
B) Edge Computing
C) Grid Computing
D) Distributed Computing

(1.3) Which of the following best defines Machine Learning in manufacturing? (CO2, K1) 1

A) Manual programming of machines
B) Machines learning patterns from data to make decisions
C) Increasing machine speed only
D) Replacing sensors in systems

(1.4) AI-based adaptive control in machining primarily helps in: (CO2, K1) 1

A) Increasing tool weight
B) Adjusting cutting parameters in real-time
C) Eliminating machines
D) Reducing operator salary

(1.5) Model synchronization in Digital Twins ensures: (CO3, K1) 1
A) Reduction of machine size
B) Real-time alignment between physical and virtual systems
C) Increased manual work
D) Elimination of sensors

(1.6) Factory-level Digital Twins are mainly used for: (CO3, K1) 1
A) Painting operations
B) Production planning and control
C) Worker hiring
D) Raw material extraction

(1.7) Which of the following is a characteristic of industrial robots? (CO4, K1) 1
A) Only manual operation
B) Reprogrammable and multifunctional
C) Limited to one task forever
D) No sensors required

(1.8) End effectors are primarily used for: (CO4, K1) 1
A) Power supply
B) Data storage
C) Interaction with the workpiece
D) Robot programming

(1.9) Augmented Reality (AR) differs from Virtual Reality (VR) because AR: (CO5, K1) 1
A) Creates a completely virtual world
B) Overlays digital information on the real world
C) Does not use sensors
D) Is only used for gaming

(1.10) Blockchain technology is best described as: (CO5, K1) 1
A) Centralized database system
B) Distributed and immutable ledger
C) Temporary storage system
D) Manual record system

2. Attempt all parts:-

(2.1) Explain how edge computing enhances real-time decision-making in an IIoT-based manufacturing system compared to cloud computing. (CO1, K2) 2

(2.2) Explain how AI helps in predictive modelling of process parameters in metal forming. (CO2, K2) 2

(2.3) Explain the role of Digital Twins in assembly sequence planning and virtual commissioning. (CO3, K2) 2

(2.4) How are robots used for automated loading/unloading and in-process adjustments in forming operations? (CO4, K2) 2

(2.5) How is AR/VR used for training and maintenance support in manufacturing industries? (CO5, K2) 2

SECTION – B 30

Answer any <u>one</u> of the following-

(3.1) Compare cloud computing, edge computing, and fog computing in the context of IIoT. Highlight their advantages, limitations, and suitable industrial applications. (CO1, K3) 6

(3.2) Discuss how IIoT is used for tool condition monitoring and predictive maintenance in machining processes. Explain the role of sensors, data acquisition, and analytics. (CO1, K2) 6

Answer any <u>one</u> of the following-

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(3.3)	Explain the importance of AI and ML in modern manufacturing systems, highlighting key benefits and challenges. (CO2, K2)	6
(3.4)	Discuss how AI techniques are used for optimization of casting parameters and microstructure prediction. (CO2, K2)	6

Answer any one of the following-

(3.5)	Explain how Digital Twins are used in virtual machining and fixture design. (CO3, K2)	6
(3.6)	Describe the role of Digital Twins in build process simulation and part performance prediction. (CO3, K3)	6

Answer any one of the following-

(3.7)	Discuss how robotics enables flexible assembly systems and human-robot collaboration. (CO4, K2)	6
(3.8)	Explain the role of robotics in multi-axis 3D printing and hybrid manufacturing systems. (CO4, K2)	6

Answer any one of the following-

(3.9)	Discuss how big data analytics is used for production optimization and quality control in manufacturing. (CO5, K2)	6
(3.10)	Explain the role of Manufacturing Execution Systems (MES) and their integration with shop floor systems. (CO5, K2)	6

SECTION – C 50

4. Answer any one of the following-

(4.1)	Illustrate how Smart Factory technologies can be used to improve manufacturing efficiency.(CO1, K3)	10
(4.2)	Analyze the impact of Digital Twins on society and the economy with examples. (CO2, K3)	10

5. Answer any one of the following-

(5.1)	Apply Smart Factory architecture concepts to design a basic manufacturing system. (CO2, K3)	10
(5.2)	Explain the benefits of Smart Factories in terms of safety, flexibility, and cost reduction. (CO2, K2)	10

6. Answer any one of the following-

(6.1)	Explain the challenges and solutions involved in data integration and real-time model synchronization in Digital Twin systems. Discuss the role of IoT, cloud computing, and data analytics. (CO3, K2)	10
(6.2)	Analyze security risks in a CPS application and suggest possible solutions. (CO3, K3)	10

7. Answer any one of the following-

(7.1)	Discuss the key components of Connected Manufacturing systems. (CO4, K2)	10
(7.2)	Apply AI techniques to improve production efficiency in a manufacturing setup. (CO4, K3)	10

8. Answer any one of the following-

(8.1)	Compare different cognitive architectures used in Cognitive Systems. (CO5, K2)	10
(8.2)	Explain the concept of Natural Language Processing in Cognitive Systems. (CO5, K2)	10

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