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**Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET UNIVERSITY)**



Ph.D. (Second Semester-Summer) Examinations, April – 2026

**23SPPEME2012 – Advanced CNC Machining Techniques for Composite
Materials using AI & ML**

(Mechanical)

Time: 3 hrs

Maximum: 70 Marks

The figures in the right hand margin indicate marks.

Answer ANY FIVE Questions.	(14 x 5 = 70 Marks)	Marks
1. a. Describe how CNC technology enhances precision, dimensional accuracy, and quality in composite machining. Explain with suitable examples of tailored processing techniques.		7
b. Discuss the role of CNC machine parameters such as spindle speed, feed rate, depth of cut, and tool path strategy in achieving effective machining of composite materials.		7
2. a. Discuss the significance of tailored CNC processing techniques in improving machining efficiency and product quality		7
b. Describe recent advancements in CNC technology, such as multi-axis machining and adaptive control, and discuss their role in improving composite material processing.		7
3. a. Explain how machine learning models are used to predict tool wear and tool life in CNC machining. Discuss their significance in predictive maintenance.		7
b. Describe the role of artificial intelligence in developing proactive maintenance strategies through tool condition monitoring and failure prediction.		7
4. a. Describe how artificial intelligence technologies are applied for real-time monitoring and adaptive control in CNC machining processes.		7
b. Discuss the significance of AI-based feedback control systems in improving machining accuracy and operational performance.		7
5. a. Discuss the applications of intelligent process control systems in enhancing automation and decision-making in advanced CNC machining.		7
b. Explain how predictive analytics and machine learning models support condition-based maintenance in CNC machining systems.		7
6. a. Discuss the role of simulation and modeling tools in developing AI applications for CNC machining and supporting process optimization.		7
b. Explain how AI integration improves decision-making, reduces machining errors, and optimizes manufacturing workflows in CNC processes.		7
7. a. Evaluate recent advancements in AI-integrated CNC machining systems and their impact on intelligent manufacturing and Industry 4.0 implementation.		7
b. Explain how machine learning models improve process capability analysis and support intelligent quality monitoring in CNC machining.		7
8. a. How do AI and machine learning contribute to sustainable manufacturing by enhancing efficiency and reducing environmental impact in CNC machining of composites?		7
b. How can machine learning algorithms be applied to Statistical Process Control (SPC) for monitoring and improving CNC machining processes?		7

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