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GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR

(GIET UNIVERSITY)

Ph.D. (Second Semester-Summer) Examinations, May – 2025

23SPPEME2012 - Advanced CNC Machining Techniques for Composite Materials Using AI & ML

(Mechanical Engineering)

The figures in the right hand margin indicate marks.

Answer *ANY FIVE* Questions. (14 x 5 = 70 Marks) **Marks**

1.a.	How do the core components of a CNC machine—such as the controller, drive system, machine tool, feedback system, and user interface—interact to achieve precise and automated machining operations?	8
b.	How does the automation inherent in CNC machining contribute to increased safety and efficiency in manufacturing environments dealing with composite materials?	6
2.	Explain how predictive maintenance strategies, enabled by ML-based tool wear prediction, can improve operational uptime and reduce maintenance costs in CNC machining.	14
3.a.	Discuss the role of AI in automating toolpath generation and optimization within CAM software. How does this automation compare to traditional methods in terms of accuracy and productivity?	7
b.	How can real-time data collected from CNC machines be leveraged in AI-driven projects to enhance machining performance and product quality?	7
4.	Discuss the challenges and solutions associated with implementing AI-based quality control systems in existing CNC machining workflows.	14
5.a.	Examine the role of AI in facilitating the recycling and reuse of composite materials within CNC machining workflows.	7
b.	What emerging AI technologies hold the most promise for advancing sustainability in CNC machining of composite materials?	7
6.a.	What are the potential benefits and limitations of implementing AI-driven energy management systems in CNC machining facilities?	7
b.	Examine case studies where computer vision has been successfully implemented for quality improvement in composite machining, highlighting the outcomes and lessons learned.	7
7.	Discuss the importance of data quality and quantity in training effective AI/ML models for CNC applications. How can manufacturers ensure they collect and manage data appropriately?	14
8.a.	What types of simulations are most beneficial when integrating AI into CNC machining processes, and how do these simulations aid in decision-making?	7
b.	What are the essential components of a hands-on project aimed at integrating AI with CNC machining, and how can such projects facilitate learning and innovation?	7

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