Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav School of Management

Choice Based Credit System (CBCS) in Light of NEP-2020
MBA+Ph.D. - III SEMESTER (2022-2024)

MBAI301C ADVANCEDHUMAN VALUES AND PROFESSIONAL ETHICS

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MBAI301C	AECC	Advanced Human Values and Professional Ethics	60	20	20	-	-	3	-	-	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical: **C** - Credit; **AECC**- Ability Enhancement Compulsory Course

***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objective

The objective of the course is to disseminate the theory and practice of moral code of conduct and familiarize the students with the concepts of "right" and "good" in individual, social and professional context

Examination Scheme

The internal assessment of the students' performance will be done out of 40 Marks. The semester Examination will be worth 60 Marks. The question paper and semester exam will consist of two sections A and B. Section A will carry 36 Marks and consist of five questions, out of which student will be required to attempt any three questions. Section B will comprise of one or more cases / problems worth 24 marks.

Course Outcomes

1. Help the students to understand right conduct in life.
2. To equip students with understanding of the ethical philosophies, principles, models that directly and indirectly affect personal and professional life.

COURSE CONTENT

Unit I: Inculcating Values at Workplace

1. Values: Concept, Sources, Essence
2. Classification of Values.
3. Values in Indian Culture and Management: Four False Views, Value Tree
4. Eastern and Western Values; Values for Global Managers

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MBAI301C	AECC	Advanced Human Values and Professional Ethics	60	20	20	-	-	3	-	-	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical: **C** - Credit; **AECC**- Ability Enhancement Compulsory Course

***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Unit II: Professional Ethics

1. Ethics: Concept, Five P's of Ethical Power, Organisational Tools to Cultivate Ethics
2. Theories of Ethics: Teleological and Deontological
3. Benefits of Managing Ethics in an Organisation
4. Ethical Leadership

Unit III: Indian Ethos and Management Style

1. Indian Ethos and Workplace
2. Emerging Managerial Practices
3. Ethical Considerations in Decision Making and Indian Management Model
4. Core Strategies in Indian Wisdom and Ethical Constraints

Unit IV: Human Behavior – Indian Thoughts

1. Guna Theory
2. Sanskara Theory
3. Nishkama Karma
4. Yoga: Types, Gains; Stress and Yoga

Unit V: Spirituality and Corporate World

1. Spirituality: Concept, Paths to Spirituality
2. Instruments to achieve spirituality
3. Vedantic Approach to Spiritual and Ethical Development
4. Indian Spiritual Tradition.

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MBAI301C	AECC	**Advanced Human Values and Professional Ethics**	60	20	20	-	-	3	-	-	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical: **C** - Credit; **AECC**- Ability Enhancement Compulsory Course

***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Suggested Readings

1. Kausahl, Shyam L. (2006). ***Business Ethics – Concepts, Crisis and Solutions***. New Delhi: Deep and Deep Publications Pvt. Limited
2. Murthy, C.S.V. (2012). ***Business Ethics –Text and Cases.*** Himalaya Publishing House: Mumbai
3. Chakraborty, S. K. (1999). ***Values and Ethics for Organizations***. Oxford university press
4. D.Senthil Kumar and A. SenthilRajan (2008). ***Business Ethics and Values.*** Himalaya Publishing House: Mumbai

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SEMESTER I

COURSE CODE	Category	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTMAN 101	BS	Advanced Mathematics	60	20	20	-	-	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based on the following components: Quiz/Assignment/Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

To introduce the students to advanced mathematics.

Course Outcomes (COs):

After the successful completion of this course students will be able to:

A. understand the concept of a vector space, subspace, basis, dimensions and their properties.
B. find solution/numerical solution of PDE.
C. explain fundamental principles of probability theory.
D. understand the concept of Markov process and Queuing theory.
E. demonstrate the ability to solve mathematical problem with fuzzy logic.

Syllabus

UNIT – I

Linear Algebra:

Vector Space , Subspace, Basis & dimensions, Change of Basis, Linear Transformation, Matrix Representation of Linear Transformation.

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MTMAN 101	BS	Advanced Mathematics	60	20	20	-	-	3	0	0	3

UNIT – II

Numerical Solution of Partial Differential Equations:

Classification of second order equations, Finite difference approximation to derivatives, Elliptic equations, Solution of Laplace's equation, Solution of Poisson's equations, Parabolic equations, Solutions of Heat equations, Hyperbolic equations.

UNIT – III

Probability & Statistics:

Probability, Compound probability, Discrete Random Variable, Binomial and Poisson distribution, Continuous random variable, Normal distribution, Sampling distribution, Theory of hypothesis.

UNIT – IV

Stochastic Process & Queuing Theory:

Introduction of random or stochastic processes, Markov processes, Markov chain, Queuing theory: M/M/1: ∞/∞/FCFS, M/M/1: N/∞/FCFS.

UNIT – V

Fuzzy Set and Theorems:

Fuzzy sets, Fuzzy relation, Fuzzy arithmetic, Fuzzy logic.

Texts:

1. Higher Engg. Mathematics: B. S. Grewal, Khanna Publishers, Delhi
2. Higher Engg. Mathematics: E. Kreyzig, John Wiley & Sons (Asia) Pvt. Ltd.
3. Operation Research: S. D. Sharma, Kedar Nath and Ram Nath, Delhi.
4. Probability, Random variables & Random processes: Schaum's outlines.
5. Stochastic processes: J. Medhi, New age international publishers.
6. Calculus of finite differences and Numerica Analysis: Gupta and Malik.
7. Fuzzy logic in Engineering: T. J. Ross.
8. Fuzzy set theory and its applications: H. J. Zimmersoms.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRA101		Fundamentals of Robotics	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. Understand the various architecture of an industrial robot.
2. Identify the vector transformation applied to robotics.
3. Apply the forward and inverse kinematics applied to serial manipulator robots.
4. Emphasize on the various actuators and transmission elements used in robots. Also to define various control strategies used in manipulator robotics

Course Outcomes (COs):

After the successful completion of this course, the student will be able to:

1. Understand the architecture and basic technical terms used in robotics.
2. Apply vector transformations in robotics.

Syllabus:

UNIT I **6 Hrs.**

Robot Definition and Basics: Understanding what constitutes a robot. Coordinate Frames: Mapping: The concept of using coordinate frames for understanding the positioning of robots. Robot Kinematics: Forward and inverse kinematics as tools to model robot motion.

UNIT II **7 Hrs.**

Evolution of Robotics: The history and development of robotics. Sensor requirements: Types and characteristics of sensors required for robotic operation. Sensing: Introduction to sensors and how robots perceive their environment. Statics of Manipulators: The study of forces and torques in stationary robotic systems.

UNIT III **7 Hrs.**

Laws of Robotics and Kinematics: Ethical and operational guidelines. Mapping Between Rotated Frames: Understanding transformations when rotating frames. Forward Kinematics: Techniques for determining the position of the robot's end-effector. Environment Sensors: Role in quality control and robot perception.

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MTRA101		Fundamentals of Robotics	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

UNIT IV **6 Hrs.**

Robot Anatomy and Control: Links, joints, and structure of robots. Inverse Kinematics: Calculating the required joint configurations for a desired end-effector position. Sensors for Safety and Control: How sensors ensure safe operation.

UNIT V **7 Hrs.**

Kinematics and Sensors: Forward/Inverse Kinematics, Kinematics for robots with varying degrees of freedom. Work Volume: The operational space of a robot. Specifications and Transformations: Describing objects in space for robotic interaction. Degrees of Freedom: Manipulating the robot in three degrees of freedom. Sensor Selection: Matching the right sensor to the task.

Text Books

1. J. J. Craig, *Introduction to Robotics: Mechanics and Control*, 4th ed., Upper Saddle River, NJ, USA: Pearson, 2017.
2. K. M. Lynch and F. C. Park, *Modern Robotics: Mechanics, Planning, and Control*, Cambridge, UK: Cambridge Univ. Press, 2017.
3. P. Corke, *Robotics, Vision and Control: Fundamental Algorithms in MATLAB*, 3rd ed., Cham, Switzerland: Springer, 2022.

Reference Books

1. M. W. Spong, S. Hutchinson, and M. Vidyasagar, *Robot Modeling and Control*, 2nd ed., Hoboken, NJ, USA: John Wiley & Sons, 2020.
2. B. Siciliano, O. Khatib, F. Groen, G. Hirzinger, and H. Hirukawa, Eds., *Springer Handbook of Robotics*, 2nd ed., Cham, Switzerland: Springer, 2016.

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRA101		Fundamentals of Robotics	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

List of Experiments:

1. Understanding different robot structures: Cartesian, Cylindrical, Spherical, SCARA, and Articulated.
2. Analysis of various grippers: Mechanical, Collect, Vacuum, Magnetic, Fragile-object, and Expandable grippers.
3. Familiarization with GUI, loading skeleton and industrial robot models, and modifying DH parameters.
4. Visualization of DH parameters and calculation of transformation matrices.
5. Performing forward kinematics for 2-DOF planar and SCARA robots using transformation matrices and RoboAnalyzer.
6. Analytical and simulation-based solution of inverse kinematics for planar and SCARA robots.
7. Analysis of joint torques/forces using Euler–Lagrange and Newton–Euler methods with RoboAnalyzer.
8. Study of trajectory generation (joint space vs Cartesian space) and simulation of robot motion.
9. Visualization of robot work envelopes for different configurations and comparison using RoboAnalyzer.
10. Simulation of real-world robotic tasks (e.g., pick-and-place, welding, assembly) using RoboAnalyzer and analysis of efficiency.

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MTRA102		VFD & HMI Programming	60	20	20	30	20	3	0	4	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. Understand the concepts of Human Machine Interface or GOT.
2. Understand the concepts of VFD and V/F control mechanisms.
3. Understand the principles of inverter operation, multi-speed control, and variable frequency drives (VFDs).
4. Develop skills in communication protocols and HMI programming.

Course Outcomes (COs):

After the successful completion of this course, the student will be able to:

1. Configure V/F control parameters and implement multi-speed drive operations.
2. Apply servo motor control for speed, torque, and position regulation.
3. Develop HMI/GOT screens with alarms, monitoring, and visualization features.
4. Integrate PLCs with HMI, VFD, and servo systems for industrial automation tasks.

Syllabus:

UNIT I **6 Hrs.**

Basics of Inverter: Introduction, Inverter selection criteria, Inverter overload duty, selection of peripheral devices, motor types, power and signal connections. Mitsubishi Inverters Overview.

UNIT II **7 Hrs.**

Concepts of V/F control- Introduction to various operation modes of the inverter (VFD), Significance of parameters and their configuration values, Different types of load patterns, JOG operation mode, and Input-Output assignment. Multi-speed Operations.

UNIT III **8 Hrs.**

Servo Control System- Speed, Torque, and Positioning control, Homing Function and Parameter Setting, Servo Motor Basics & Structure, Speed Operation, Absolute & Incremental Systems for Positioning, Types of Encoders, and Built-in Positioning function.

UNIT IV **8 Hrs.**

Introduction to GOT/HMI: Types of screens, different types of objects, selection criteria, OS selection and installation, User Alarm (Alarm configuration and Alarm display).

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COURSE CODE	CATE-GORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
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MTRA102		**VFD & HMI Programming**	60	20	20	30	20	3	0	4	**5**

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Backup and Monitoring of Screens on HMI, Selection of Peripheral Devices for Trend and Batch Monitoring, Numerical Display and Visualization on HMI.

UNIT V **5 Hrs.**

Applications of HMI & VFD: HMI/GOT communication with PLC (Human Machine Interface), VFD interfacing with PLC and HMI/GOT, Inverter Autotuning, Servo Motor & Inverter Control Operations.

Text Books:

1. Malcolm Barnes, *Practical Variable Speed Drives and Power Electronics*, Newnes 2003.
2. Gary D. Anderson, *Variable Frequency Drives: Installation & Troubleshooting*, 2020.
3. Krishnamoorthi Govindaraj, *The Basis of VFDs: An Ultimate Guide for A New Industrial Technician to Configure & Program VFD*, 2017.

Reference Books:

1. Avinash Malekar, *Advanced PLC Programming using studio 5000 Part 1: Practical lessons on ladder logic instructions, module configuration, machine safety, VFD, etc. (Industrial automation Book 3)*, Kindle Edition.
2. Williams Robertson, *PLC Programming & Touch Panel Introduction to Creation Mitsubishi Electric GX Works2 and GT Designer3 GOT2000 series*, 2023.
3. George W. Younkin, *Industrial Servo Control Systems: Fundamentals and Applications*, CRC Press, 2002.
4. Bill Hollifield, Ian Nimmo, *High-Performance HMI Handbook*, 2008.

List of Experiments:

1. To study various types of VFD and their industry applications.
2. To study hardware specifications of VFD-800 series training kit.
3. To understand the working environment of FR configurator software and perform the configuration of VFD.
4. To learn the basic instructions in the ladder logic program using GXWorks3 for iQF and iQR PLC.

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MTRA102		**VFD & HMI Programming**	60	20	20	30	20	3	0	4	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

5. To study different types of HMI/GOT2000 and their industry applications.
6. To understand the working environment of GTDesigner3 software and perform the simulation analysis.
7. To perform hardware interfacing of iQF PLC and GOT2000.
8. To perform hardware interfacing of iQR PLC and GOT2000.
9. To perform VFD interfacing with iQF PLC and GOT2000.
10. To perform VFD interfacing with iQR PLC and GOT2000.

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTES113		Cryptography and Network Security	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C – Credit.
***Teacher Assessment** shall be based on the following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To understand basics of security and various Cryptographic Methods.
2. To be able to secure a network over insecure channel by various means.
3. To understand various attacks for system security and its counter measures to protect against the threats in the networks.

Course Outcomes (COs):

After completion of this course the students are expected to be able

1. Provide security of the data over the network.
2. Implement various methods for the system security.
3. Apply necessary approaches and techniques to build protection mechanisms to secure computer networks.

Syllabus

UNIT I **6 Hrs.**

Basics of Security

Introduction to Security Aspects: Security Trends, Security attacks, Security services, Security Mechanism, Model for Network Security.

Classical Encryption Techniques: Substitution Techniques, Transposition Techniques.

UNIT II **7 Hrs.**

Symmetric Ciphers

Block Ciphers: Data Encryption Standard, Strength of DES, Advance Encryption Standard, Multiple Encryption and Triple DES, Block Cipher modes of operation, Stream Cipher, Random Number Generation.

UNIT III **7 Hrs.**

Public Key Encryption and Hash Function

Public Key Cryptography: Principle of Public Key Cryptosystem, RSA algorithm.

Key Management: Diffie Hellman Key Exchange, Elliptical Curve Cryptography.

Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs, Digital Signature.

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UNIT IV **6 Hrs.**

Network Security Applications

Authentication Applications: Kerberos, X.509 Authentication Service.
E-Mail Security: Pretty Good Privacy, S/MIME.
IP Security: IP Security Architecture, Key Management.
Web Security: Secure Socket Layer, Transport Layer Security.

UNIT V **5 Hrs.**

System Security

Intruders: Intrusion Detection, Password Management.
Malicious Software: Viruses, Threats, Virus Counter measures, Distributed Denial of Service Attack.
Firewalls: Firewall Design Principles, Trusted Systems, IT Security Evaluation.

Text Books:

1. William Stalling, "Cryptography and Network Security - Principles and Practice", 7th Edition Pearson, 2017.
2. Behrouz A. Forouzan, "Cryptography and Network Security", McGraw- Hill, 2007.
3. J. Katz and Y. Lindell, "Introduction to Modern Cryptography: Principles and Protocols", 3rd ed. CRC Press, 2020.

Reference Books:

1. Atul Kahate, "Cryptography and Network Security", 4th Edition McGraw-Hill, 2003
2. Prakash Gupta, "Cryptography and Network Security", PHI Learning 2015.
3. R. Anderson, "Security Engineering: A Guide to Building Dependable Distributed Systems", 3rd ed. Wiley, 2020.
4. B. Schneier, "Applied Cryptography: Protocols, Algorithms, and Source Code in C", 2nd ed. Wiley, 2015.

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COURSE CODE	CATE-GORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRA123		Industrial Process Automation	60	20	20	-	-	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To highlight the significance of automation techniques in process industries.
2. To explain the role of PLCs in industrial automation.
3. To familiarize with various control methods used in process automation.

Course Outcomes (COs):

After the successful completion of this course, the student will be able:

1. To identify the significance of automation in process industry.
2. To describe the implementation of PLC in industrial automation.
3. To explain various control methods used in process automation.

Syllabus:

UNIT I **8 Hrs.**

Introduction to computer based Industrial Automation: Direct Digital Control (DDC), Distributed Control System (DCS) and Supervisory Control and Data Acquisition (SCADA) based architectures

UNIT II **6 Hrs.**

SCADA in RTU: Introduction, evolution, architecture, SCADA: Station Master.

UNIT III **7 Hrs.**

Programmable Logic Controller (PLC): Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Design of alarm and interlocks.

UNIT IV **6 Hrs.**

Distributed Control System: Local Control Unit (LCU) architecture, LCU Process Interfacing Issues, Block diagram and Overview of different LCU security design approaches, Networking of DCS.

UNIT V **7 Hrs.**

Process Safety Automation: Levels of process safety through use of PLCs, Integrating Process safety PLC and DCS, Application of international standards in process safety control.

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MTRA123		Industrial Process Automation	60	20	20	-	-	3	0	0	3

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Text Books:

1. M.P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 5th edition, 2018.
2. O. Akande, "Industrial Automation from Scratch: A Hands-On Guide to Using Sensors, Actuators, PLCs, HMIs, and SCADA to Automate Industrial Processes", Packt Publishing, 2023.
3. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.

Reference Books

1. B. Kleinjohann, "Industrial Automation and Information Technology", Springer, 2019.
2. Krishna Kant, "Computer Based Industrial Control", EEE-PHI, 2nd edition, 2010.
3. Tiess Chiu Chang& Richard A. Wysk, "An Introduction to Automated Process Planning Systems", Prentice-Hall, 1985.
4. N. Viswanandham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", PHI, 1st edition, 2009.

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRA133		Digital Manufacturing	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
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Course Educational Objectives (CEOs):

1. To understand digital manufacturing and system architecture.
2. To gain skills in CNC/DNC and CAD/CAM.
3. To learn additive, micro, and nano-fabrication methods.

Course Outcomes (COs):

1. After the successful completion of this course, the student will be able to:
2. Explain digital manufacturing concepts.
3. Apply CNC/DNC programming and CAD/CAM modeling.
4. Develop additive manufacturing workflows.
5. Evaluate micro- and nano-fabrication techniques.

Syllabus:

UNIT I **6 Hrs.**

Overview of Digital manufacturing process Introduction to Digital Manufacturing Science, Operation mode and architecture, Operation reference model, System Architecture, Computation in Digital Manufacturing, case studies.

UNIT II **7 Hrs.**

CNC machines and Programming Introduction to Numerical Control, Components of NC System, NC system Controls, Adaptive. Control for NC System, N Words, NC programming, Examples, CNC, DNC combined DNC/CNC system, Computer Integrated manufacturing system, Machine Tools and related Equipment, Materials handling and Storage system, computer system Tool Path Generation in CAM Software for different operations.

UNIT III **7 Hrs.**

CAD CAM Modelling and Machine Control Basics of Computer Graphics, Elementary Transformations in CAD, computer programming for graphics, Computer graphics Software and Database: Configuration, Graphics Packages. 48Programme Scheme & Syllabi M. Tech. (Robotics & Automation) Constructing the Geometry, Design process and role of CAD, Types and applications of design models, Solid modelling -Parametric modelling.

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MTRA133		Digital Manufacturing	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

UNIT IV **6 Hrs.**

Additive Manufacturing Process Introduction to Tableau, Creating Basic Visualizations, Tableau Desktop UI, Connecting to Data, Review of Tableau Desktop, Making Visualizations, Creating Effective Dashboards.

UNIT V **7 Hrs.**

Micro-fabrication and Nano-fabrication Methods Introduction to different methods for manufacturing components by additive manufacturing, Overview of different RP Processes, STL file generation; file verification & repair, STL/AMF Slicing CURA, Pre-processing and post processing techniques.

Text Books:

1. Z. Zhou, S. Xie, and D. Chen, *Fundamentals of Digital Manufacturing Science*. London, U.K.: Springer, 2012.
2. M. P. Groover, *Automation, Production Systems and Computer-Integrated Manufacturing*. Upper Saddle River, NJ, USA: Prentice Hall, 2008.
3. A. K. Kamrani and E. A. Nasr, *Rapid Prototyping: Theory and Practice*. New York, NY, USA: Springer, 2006.

Reference Books:

1. Z. Bi, *Practical Guide to Digital Manufacturing: First-Time-Right for Design of Products, Machines, Processes and System Integration*. Cham, Switzerland: Springer, 2021.
2. R. K. Amit, K. S. Pawar, R. P. Sundarraj, and S. Ratchev, Eds., *Advances in Digital Manufacturing Systems: Technologies, Business Models, and Adoption*. Singapore: Springer, 2023.
3. Y. K. Singla, A. Kumar, and M. R. Maughan, Eds., *Digital Manufacturing in Industry 5.0*. Cham, Switzerland: Springer, 2025.
4. K. Kumar, D. Zindani, and J. P. Davim, *Digital Manufacturing and Assembly Systems in Industry 4.0*. Boca Raton, FL, USA: CRC Press, 2019.

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MTRA104		PLC Lab	0	0	0	30	20	0	0	4	2

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***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To introduce students to PLC hardware, software, and basic programming.
2. To develop skills in implementing ladder logic for industrial applications.

Course Outcomes (COs):

After the successful completion of this course, the student will be able:

1. Explain PLC hardware and software environment.
2. Develop ladder logic programs using basic, timer, and counter instructions.
3. Apply PLC programming concepts to simple automation tasks.

List of Experiments:

1. To study various types of PLC.
2. To study hardware specifications of iQF-FX5U series PLC training kit.
3. To study hardware specifications of iQR series PLC training kit.
4. To understand the working environment of GXWorks3 software for PLC programming.
5. To learn the basic instructions in the ladder logic program.
6. To write a program for all logic gates using basic instructions of ladder logic programming.
7. To learn the application-based instructions in the ladder logic program.
8. To write a program based on timer & counter related instructions in the ladder logic program.

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