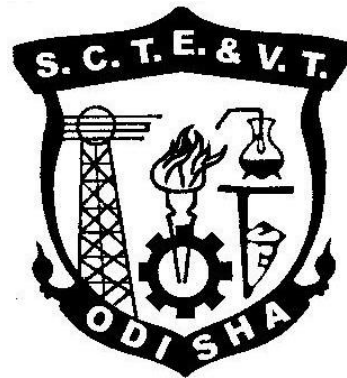


CURRICULLUM OF 6th SEMESTER

For

DIPLOMA IN AUTOMATION AND ROBOTICS ENGINEERING

(Effective FROM 2025-26 Sessions)



**STATE COUNCIL FOR TECHNICAL EDUCATION & VOCATIONAL TRAINING,
ODISHA, BHUBANESWAR**

STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA

TEACHING AND EVALUATION SCHEME FOR 6TH Semester (AUTOMATION & ROBOTICS.) (w.e.f2025-26)

Subject Number	Subject Code	Subject	Periods/week			Evaluation Scheme			
			L	T	P	Internal Assessment/ Sessional	End Sem Exams	Exams (Hours)	Total
			Theory						
Th.1		AI&ML	4		-	20	80	3	100
Th.2		HMI-SCADA	4		-	20	80	3	100
Th.3		CYBER SECURITY IN INDUSTRIAL AUTOMATION	4		-	20	80	3	100
Th.4(a)		ADVANCE MANUFACTURING SYSTEM (ELECTIVE-I)	4		-	20	80	3	100
Th.4(b)		INDUSTRIAL EQUIPMENT MAINTENANCE (ELECTIVE-II)			-				
		Total	16			80	320	-	400
		Practical							
Pr.1		AI& ML LAB	-	-	04	50	50	3	100
Pr.2		HMI-SCADA LAB	-	-	04	25	50	3	75
Pr.3		PROJECT WORK PHASE-II(MAJOR PROJECT)	-	-	10	50	100	3	150
Pr.4		SOFT SKILL LAB			02	25	-	-	25
		STUDENT CENTERED ACTIVITIES (SCA)			03				
		Total	-	-	23	150	200	-	350
		Grand Total	16	-	23	230	520	-	750

Abbreviations: L-Lecturer, T-Tutorial, P-Practical. Each class is of minimum 55 minutes duration

Minimum Pass Mark in each Theory subject is 35% and in each Practical subject is 50% and in Aggregate is 40%

SCA shall comprise of Extension Lectures/ Personality Development/ Environmental issues /Quiz /Hobbies/ Field visits/ cultural activities/Library studies/Classes on MOOCS/SWAYAM etc., Seminar and SCA shall be conducted in a section.

There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester

TH-1 Artificial Intelligence and Machine Learning Fundamentals

Name of the Course: Diploma in Automation and Robotics Engineering			
Course code	Th-1	Semester	6 th
Total No. of Periods	60	Duration of Examination	3 hrs.
No. of periods per week	4P/W	Internal Assessment	20 Marks
Total marks	100	End Semester Examination	80 Marks

A.RATIONALE:

Have a thorough understanding of classical and modern AI applications. Be able to implement a wide range of AI concepts using Prolog. Understand non-classical AI approaches such as genetic algorithms and neural networks. Be able to assess the potential of AI in research and real-world environments.

B.COURSE OUTCOMES:

After the completion of the course, the student shall be able to

1. Identify problems that are amenable to solution by AI methods.
2. Design and carry out an empirical evaluation of different algorithms on problem formalization and state the conclusions that the evaluation supports.
3. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
4. Able to design and implement various machine learning algorithms in a range of real-world applications.
5. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.

C.TOPIC WISE DISTRIBUTION OF PERIODS

SL. No.	Topic	Periods
1	Introduction	10
2	Search Techniques	15
3	Linear regression	15
4	Linear regression	10
5	Classification Problems	10
	TOTAL	60

D.COURSE CONTENTS

1.Introduction: History and foundations of AI, Fundamentals of ML, Application of AI/ML in Automation and Robotics

2. Search Techniques: Uninformed and informed Search; Adversarial Search: Two players' games, games with uncertainty; Robotics Constraint Satisfaction Problems and Constrained Optimization problems (complete and in complete techniques), Decision support systems and technologies; Knowledge representation, Reasoning, Planning (basics).

3.Machine Learning Basics: Decision trees, Ensemble learning, Reinforcement learning, Evolutionary computation, Neural networks, Problems, data, and tools; Visualization;

4. Linear regression: SSE; gradient descent; closed form; normal equations; features, Over fitting and complexity; training, validation, test data, and introduction to Mat lab/Python.

5.Classification Problems: Decision boundaries; Probability and classification, Bayes optimal decisions, Naïve Bayes and Gaussian class-conditional distribution

REFERENCES:

1. Russell, Norvig, Artificial intelligence: A modern approach, 2nd edition. Pearson/Prentice Hall.
2. M. C. Trivedi, A classical approach to Artificial Intelligence, Khanna Publishing House, New Delhi (2018)
3. V. K. Jain, Machine Learning, Khanna Publishing House, New Delhi(2018)
4. Ethem Alpaydin, Introduction to Machine Learning, Second Edition,

TH-2 SCADA & HMI

Name of the Course: Diploma in Automation and Robotics Engineering			
Course code	Th-2	Semester	6 th
Total No. of Periods	60	Duration of Examination	3 hrs.
No. of periods per week	4P/W	Internal Assessment	20 Marks
Total marks	100	End Semester Examination	80 Marks

A.RATIONALE:

In the present global scenario of manufacturing, industries are moving towards more and more automation. Small scale and medium scale industries require PLC and SCADA technology, So, it is very necessary for an Automation engineer to have knowledge of both PLC and SCADA. So, this course attempts to provide basic configurationally knowledge of these technologies to develop operational competency. Hence this course is very important for Automation engineers who want to specialize in industrial automation.

B.COURSE OUTCOMES:

After the completion of the course, the student shall be able to

- Compare Different SCADA systems based on given parameters.
- Use the relevant Network communication protocol for specific SCADA applications.
- Develop SCADA based applications in integration with PLC.
- Use the HMI Panel for given applications.
- Use the SCADA system to develop the given industrial applications.

C.TOPIC WISE DISTRIBUTION OF PERIODS

SL. No.	Topic	Periods
1	Basics of SCADA System	12
2	SCADA Network Communication	12
3	SCADA System Integration	12
4	Human Machine Interface (HMI)	12
5	SCADA Application development	12
	TOTAL	60

D.COURSE CONTENTS

1. Basics of SCADA System

1.1. Recall - Knowledge of Industrial automation Hierarchy. Typical SCADA Architecture / layout diagram. Components of SCADA system: RTU, MTU -functions, block diagram.

.2. Commercially available SCADA Softwares: Intouch , Vijeo citect , Rsvision32 (features, cost, network requirements, Specifications of these softwares)

2. SCADA Network Communication

2.1. Network topologies, Cables used in SCADA.

2.2. Modes of Network communication: Master-slave, Bus arbitration, Token passing, random bus access, CS (Client-server).

2.3. Modbus- TCP/IP, RTU.

2.4. Profibus: PA, DP.

2.5. Foundation fieldbus: H1, HSE

2.6. Database and DDE connectivity

3. SCADA System Integration

3.1.SCADA Software- Creating graphics, Real time and Historical Trends, Alarms and Events, database of

Tags, display charts, logs and reports, object Library (use of buttons, slider, pipe connection etc.).

3.2. Electric Drives: Need, types, block diagram, functions, characteristics, four quadrant operation. Comparison of AC/DC drives, VFD.

3.3. Introduction to OPC DA server (OLE for Process control) – functions, architecture.

3.4. Steps in Integrating PLC (RTU) with SCADA

- Developing PLC Based Applications.
- Configuring the OPC Data Access server
- Creating Tags database
- Configuring SCADA graphic objects, trends and alarms
- SCADA runtime environment

4. Human Machine Interface (HMI)

4.1. Different types of operator Interfaces – Textual, Graphical

4.2. Connection Wiring of HMI

4.3 .Data handling with HMI

4.4. Configuration and Interfacing to PLC and PC

5. SCADA Application development

5.1. Robotic pick and place mechanism

5.2. Temperature control system

5.3. Car washing system

5.4. Sorting and stacking system

5.5. Water level control system

(Study of PLC ladder program, OPC DA configuration, tag database, SCADA graphic screen for above examples)

5.6. Integrating Pneumatic components with SCADA through PLC: Single acting, double acting cylinders.

REFERENCE BOOKS:

1. Supervisory Control and Data acquisition, Boyar, S. A, ISA Publication (4th edition) ISBN: 978-1936007097
2. Practical SCADA for industry, Bailey David; Wright Edwin, Newnes (an imprint of Elsevier), 2003, ISBN: 0750658053
3. PLCs & SCADA -Theory and Practice, Rajesh Mehra, Vikrant Vij, Laxmi Publications Pvt Ltd; First edition, ISBN-10 : 9381159114
4. Instrument engineers' handbook: process software and digital networks, Béla G. Lipták, Published September 23, 2011 by CRC Press, ISBN 9781439817766

TH-3 CYBER SECURITY IN INDUSTRIAL AUTOMATION

Name of the Course: Diploma in Automation and Robotics Engineering			
Course code	Th-3	Semester	6 th
Total No. of Periods	60	Duration of Examination	3 hrs.
No. of periods per week	4P/W	Internal Assessment	20 Marks
Total marks	100	End Semester Examination	80 Marks

A. RATIONALE

With increasing connectivity in industrial systems, securing industrial control networks has become critical. This course equips students with the knowledge of industrial communication protocols, cybersecurity threats, standards, and risk management strategies to protect automation systems from cyberattacks and ensure safe, reliable, and resilient operations

B. COURSE OUTCOMES

After completion of this course the student will be able to

1. Understand the working of the internet along with the changing trends in cyber technologies.
2. Illustrate various security threats and vulnerabilities of the cyber world keeping inline with industrial trends.
3. Comprehend how web technology works, how web server capability is used in industry, and the security problems engendered by such use.
4. Pinpoint how web technologies can be used securely for industrial automation

C. TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPICS	NO. OF PERIODS
1	Fundamentals of Industrial Automation	12
2	Information System Security Technologies	08
3	Industrial Automation Culture vs. IT Security Paradigms	10
4	Risk Management in Industrial Systems	10
5	Trends, Approaches, and Issues in Industrial cyber security	08
6	Emerging Technologies and cyber security in Industrial Systems	12
TOTAL NO OF PERIODS		60

D. DETAILED CONTENTS

1. Fundamentals of Industrial Automation

- 1.1. Overview of industrial communication protocols; OSI Model; TCP/IP Model;
- 1.2. Object Linking and Embedding for Process Control (OPC UA); Modbus/TCP;
- 1.3. Distributed Network Protocol (DNP3); Controller Area Network (CAN); Ethernet/IP;
- 1.4. Open Safety Protocols.

2. Information System Security Technologies

- 2.1. Types and classes of cyber attacks;
- 2.2. Security policies, standards, guidelines, and procedures;
- 2.3. Malware and Attack vectors;
- 2.4. Firewall types and configurations;
- 2.5. Basics of cryptography;
- 2.6. Attacks on cryptographic systems

3. Industrial Automation Culture vs. IT Security Paradigms

- 3.1. Key differences in priorities between IT and industrial control environments;
- 3.2. Challenges in applying IT security in automation;
- 3.3. Typical threat vectors in industrial environments;
- 3.4. Convergence of IT and OT (Operational Technology).

4. Risk Management in Industrial Systems

- 4.1. Risk management principles for automation networks; ANSI/ISA-62443 standards;
- 4.2. Risk analysis and threat modeling techniques;
- 4.3. Addressing and mitigating cyber security risks;
- 4.4. NIST SP 800-39 and integrated risk management strategies..

5. Trends, Approaches, and Issues in Industrial Cyber security

- 5.1. Recent trends in industrial automation and cyber security; Standardization and formal methods;
- 5.2. Information Security Continuous Monitoring (ISCM); Smart Grid Maturity Model (SGMM);
- 5.3. Future challenges in smart grid and automation security.

6. Emerging Technologies and Cyber security in Industrial Systems

- 6.1. IoT in industrial automation;
- 6.2. OPC UA with enhanced security;
- 6.3. Big Data analytics and Industrial IoT (IIoT);
- 6.4. Security and privacy in CPS (Cyber-Physical Systems); NIST CPS Framework;
- 6.5. Security in critical infrastructure Asynchronous & Synchronous Transmission.
- 6.6. Introduction to software-defined control systems.

COVERAGE OF SYLLABUS UPTO INTERNAL EXAMS (I.A.): CHAPTERS 1,2,3,4

LEARNING REOURCES

- Ronald L. Krutz, "Industrial Automation and Control System Security Principles: Protecting the Critical Infrastructure", 2nd Edition, International Society of Automation, 2017.
- David J. Teumim, "Industrial Network Security, Second Edition", International Society of Automation, 2010.
- Lawrence M. Thompson and Tim Shaw, "Industrial Data Communications", Fifth Edition, International Society of Automation, 2015.
- Dick Caro, "Automation Network Selection: A Reference Manual", 3rd Edition, Paperback, International Society of Automation, 2016

TH-4(a) ADVANCE MANUFACTURING SYSTEM

Name of the Course: Diploma in Automation and Robotics Engineering			
Course code	Th-4	Semester	6 th
Total No. of Periods	60	Duration of Examination	3 hrs.
No. of periods per week	4 P/W	Internal Assessment	20 Marks
Total marks	100	End Semester Examination	80 Marks

A. RATIONALE

Advance manufacturing system involve nontraditional methods that transform raw materials into finished products with enhanced precision, efficiency and innovation .This course introduces students to modern machining techniques ,plastic processing , additive manufacturing and special purpose machinery , while also emphasizing the maintenance of machine Tools.

B. COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

1. Understand the working principle and application of modern machining processes.
2. Understand the fundamental of Plastic Processing.
3. Explore various additive manufacturing process and there application.
4. Familiarize themselves with Special Purpose Machines.
5. Understand the Maintenance of Machine Tools.

C. TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPICS	NO. OF PERIODS
1	Modern Machining Processes	20
2	Plastic Processing	10
3	Additive Manufacturing Process	15
4	Special Purpose Machines	07
5	Maintenance of Machine Tools	08
TOTAL NO OF PERIODS		60

D.DETAILED CONTENTS

1.0 Modern Machining Processes

- 1.1 Introduction – comparison with traditional machining.
- 1.2 Ultrasonic Machining: Principle, Description of equipment, Applications.
- 1.3 Electric Discharge Machining: Principle, Equipment Description, Dielectric fluid, Electrodes, Process Parameters, Output Characteristics, Applications.
- 1.4 Wire Cut EDM: Principle, Equipment Description, Controlling Parameters, Applications.
- 1.5 Abrasive Jet Machining: Principle, Equipment Description, Material Removal Rate, Applications.
- 1.6 Laser Beam Machining: Principle, Equipment Description, Material Removal Rate, Applications.
- 1.7 Electro Chemical Machining: Principle, Equipment Description, Applications.
- 1.8 Plasma Arc Machining: Principle, Equipment Description, Process Parameters, Performance Characterization, and Applications.
- 1.9 Electron Beam Machining: Principle, Equipment Description, Process Parameters, Performance Characterization and Applications.

2.0 Plastic Processing

- 2.1 Fundamentals of plastic material processing.
- 2.2 Moulding Processes: Injection, Compression, Transfer Moulding.
- 2.3 Extrusion and Casting: principles and application, calendaring process.

- 2.4 Fabrication Methods: Sheet Forming, Blow Moulding, Laminating (Sheets, Rods, Tubes), Reinforcing.
- 2.5 Applications of Plastics.

3.0 Additive Manufacturing Process

- 3.1 Introduction to additive manufacturing (AM) and its necessity.
- 3.2 AM Process Chain: detail description of steps and workflow.
- 3.3 Advantages and Limitations of AM, Common Terms Used.
- 3.4 Distinction between AM and CNC, Related Technologies.
- 3.5 Applications: Design, Aerospace, Automotive, Jewelry, Arts, Architecture, RP Medical & Bio-Engineering.
- 3.6 Web-Based Rapid Prototyping Systems.
- 3.7 introduction to Flexible Manufacturing and Concurrent Engineering,
- 3.8 Production Tools like Capstan and Turret Lathes, Rapid Prototyping.

4.0 Special Purpose Machines (SPM)

- 4.1 Concept and classification of SPM
- 4.2 General Elements of SPM , Productivity Improvement , Design Principles of SPM.

5.0 Maintenance of Machine Tools

- 5.1 Introduction to Maintenance and Types of Maintenance.
- 5.2 Repair/Maintenance Cycle Analysis and its complexity
- 5.3 Maintenance Manual and documentation.
- 5.4 Housekeeping practices and maintenance records.
- 5.5 Overview of Total Productive Maintenance (TPM).

Syllabus covered up to I.A - Chapters 1, 2 & 3

E-LEARNING RESOURCES

Sl. No.	Name of Authors	Title of the Book	Name of the Publisher
1	O.P. KHANNA	Production Technology – Vol-II	Dhanpat Rai Publication
2	B.S. Raghuwanshi	Workshop Technology, Vol – II	Dhanpat Rai Publication
3	HMT, Bangalore	Production Technology	Tata McGraw Hill
4	I. Chua C.K., Leong K.F., LIM C.S.	Rapid Prototyping: Principles and Applications	World Scientific Publication, 3rd Ed., 2010
5	Stephen F. Krar & Arthur Gill	Exploring Advanced Manufacturing Technologies	Industrial Press

TH-4(b) Industrial Equipment Maintenance:

Name of the Course: Diploma in Automation and Robotics Engineering			
Course code	Th-4	Semester	6 th
Total No. of Periods	60	Duration of Examination	3 hrs.
No. of periods per week	4 P/W	Internal Assessment	20 Marks
Total marks	100	End Semester Examination	80 Marks

A. RATIONALE

Industrial Equipment Maintenance as a subject aims to bridge the gap between theoretical knowledge and practical application by enabling students to understand not just how systems work, but also how to keep them working efficiently and safely. It equips diploma students with the essential skills to identify, troubleshoot, and rectify faults in various types of automation equipment and to implement preventive and predictive maintenance techniques. A trained technician or engineer who can perform effective maintenance is a valuable asset to any organization, as equipment downtime directly affects production efficiency and operational costs. This course helps students build competencies that are directly aligned with real-world industrial requirements, thereby enhancing their employability and readiness for roles such as Maintenance Engineer, Automation Technician, Field Service Engineer, and more.

B. COURSE OUTCOMES:

After completing this lab course, students will be able to:

1. Understand Maintenance Concepts and Strategies
2. Perform Electrical Equipment Maintenance
3. Maintain Mechanical Components
4. Service Pneumatic and Hydraulic Systems.
5. Calibrate and Troubleshoot Sensors and Instruments
6. Maintain PLC and HMI Systems
7. Apply Safety and Documentation Practices.
8. Use Tools and Technologies for Maintenance
9. Demonstrate Problem-Solving and Teamwork Skills

C. TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPICS	NO. OF PERIODS
1	Introduction to Maintenance Engineering	4
2	Electrical Equipment Maintenance	10
3	Mechanical Systems Maintenance	10
4	Pneumatic and Hydraulic System Maintenance	10
5	Sensors and Instrumentation Maintenance	06
6	PLC and HMI Maintenance	06
7	Maintenance Management Tools	04
8	CONDITION BASED MAINTENANCE	06
TOTAL PERIODS		60

D. COURSE CONTENTS

1. Introduction to Maintenance Engineering

- 1.1. Definition and Importance of Maintenance
- 1.2. Types of Maintenance: Preventive, Predictive, Breakdown, and Condition-Based
- 1.3. Maintenance Planning and Scheduling,
- 1.4. Safety Procedures and PPE

2. Electrical Equipment Maintenance

- 2.1. Motors (AC, DC, Servo, Stepper): Maintenance and Troubleshooting
- 2.2. Contactors, Relays, MCBs, Fuses, and Switchgear
- 2.3. Wiring Systems, Cabling, Earthing, and Insulation Testing

2.4. Power Supplies, Inverters, UPS Maintenance

3. Mechanical Systems Maintenance

3.1. Bearings, Gearboxes, Belts, Chains, and Couplings

3.2. Lubrication Methods and Schedule

3.3. Alignment and Balancing

3.4. Mechanical Vibration Analysis

4. Pneumatic and Hydraulic System Maintenance

4.1. Overview of Pneumatic and Hydraulic Circuits

4.2. Pumps, Cylinders, Valves, and Actuators Maintenance

4.3. Leakage Detection and Sealing Methods

4.4. Fluid Contamination Control and Filtration

5. Sensors and Instrumentation Maintenance

5.1. Types of Sensors (Proximity, Photoelectric, Limit Switches, etc.)

5.2. Calibration and Testing of Sensors and Instruments

5.3. Signal Conditioning and Data Acquisition

6. PLC and HMI Maintenance

6.1. PLC Hardware Components and Maintenance

6.2. Battery Backup, I/O Checks, and Wiring Issues

6.3. HMI Panel Diagnostics

6.4. Software Backup and Firmware Updates

7. Maintenance Management Tools

7.1. CMMS (Computerized Maintenance Management Systems)

7.2. Maintenance Logs, Checklists, and Reporting

7.3. Root Cause Analysis (RCA) and Failure Mode Effects Analysis (FMEA)

8. CONDITION BASED MAINTENANCE

8.1. Condition monitoring - Methods of load monitoring, temperature monitoring, lubrication monitoring, leak detection, corrosion monitoring.

8.2. .OFF - Load monitoring - crack detection, vibration monitoring.

8.3. Lubrication monitoring - debris deposited, debris in suspension,

8.4. Condition of used oil, Ferro graph.

8.5. Thermal monitoring, location of temperature measurement, temperature monitoring devices, sensors, optical pyrometer, radiation pyrometer.

8.6. Vibration and noise monitoring - causes, measurement, noise signals, signature analysis.

Learning Resources:

- **Maintenance Engineering and Management**
 - R. C. Mishra & K. Pathak
 - PHI Learning Pvt. Ltd.
- **Maintenance Engineering Handbook**
 - Keith Mobley
 - McGraw-Hill Education
- **Electrical Power Equipment Maintenance and Testing**
 - Paul Gill
 - CRC Press
- **Industrial Maintenance**
 - Michael E. Brumbach & Jeffrey A. Clade
- **Mechanical Maintenance of Machines**
 - S. K. Basu
- **Industrial Maintenance by HP - Chand & Co**
- **Testing of Machine Tools - Dr. George Schiesinger**
- **Management of Industrial Maintenance- A. Kelly & M.J. Harris**
- **Maintenance Engineering - L.C. Morrow**
- **Material Handling Equipment - Alexandrov MIR Pub.**
- **Mechanical Equipment Maintenance - ITB Manual**
- **Trouble shooting Electric Equipment - R.S. Khandpur**

PR-1 Artificial Intelligence and Machine Learning Laboratory

Practical: 4 Periods per week
Total Periods: 60 Periods
Term End Examination: 3 Hours

Term End Exam: 50 Marks
Sessional: 50 Marks
TOTAL MARKS : 100 Marks

A.RATIONALE:

This lab course introduces foundational tools and techniques in Artificial Intelligence and Machine Learning through hands-on experiments. It equips students with practical skills in logic programming, supervised and unsupervised learning, and deploying ML models using Python and essential libraries.

B.COURSE OUTCOMES:

After the completion of the course, the student shall be able to

1. Apply logic programming using Prolog to represent relationships and solve AI problems.
2. Utilize Python and its libraries for implementing AI and ML algorithms.
3. Implement supervised learning techniques like linear and logistic regression, and KNN.
4. Apply unsupervised learning algorithms such as K-Means and K-Medoids for data clustering.
5. Deploy simple machine learning models using web-based APIs.

DETAILED COURSE CONTENTS

Sl. No.	List of Experiments
1.	Logic programming with Prolog: To specify relationships among objects and properties of objects, problem solving
2.	Introduction to Python Programming: Learn the different libraries -NumPy, Pandas, SciPy, Matplotlib, Scikit Learn
3.	Predict a real valued output from input data using linear regression model
4.	Build decision trees and random forests
5.	Implementation of Uninformed search algorithms (BFS, DFS)
6.	Implementation of Informed search algorithms (A*, memory-bounded A*)
7.	Implement k-nearest neighbours classification using python
8.	Unsupervised Learning: K-Means clustering algorithm, K-medoid clustering algorithm.

REFERENCES:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson
2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & Tensor Flow, O'Reilly
4. Mark Lutz, Learning Python, O'Reilly
5. Witold Pedrycz, Shyi-Ming Chen, Machine Learning and Intelligent Systems, Springer

Web Resources

6. Scikit-Learn Documentation—<https://scikit-learn.org/stable/index.html>
7. SWI-Prolog Manual—https://www.swi-prolog.org/pldoc/doc_for?object=manual
8. Google Machine Learning Crash Course—<https://developers.google.com/machine-learning/crash-course>
9. Kaggle: Machine Learning Datasets and Notebooks—<https://www.kaggle.com/>
Python Official Documentation—<https://docs.python.org/3>

PR-2 SCADA & HMI LAB

Practical: 4 Periods per week

Total Periods: 60 Periods

Term End Examination: 3 Hours

Term End Exam: 50 Marks

Sessional: 25 Marks

TOTAL MARKS : 75 Marks

A.RATIONALE:

The SCADA & HMI systems laboratory is crucial for Automation & Robotics diploma students. It provides hands-on experience with real-time data acquisition, process control, and human-machine interface design. Students will learn to develop, implement, and troubleshoot industrial automation solutions, bridging theoretical knowledge with practical application.

B.COURSE OUTCOMES:

After the completion of the laboratory, the student shall be able to

1. Identify different cables, and network buses with their accessories used in SCADA communication
2. Develop SCADA graphic screen and integrate it with PLC
3. Interface the given Excel database sheet to the SCADA software using DDE connectivity.
4. perform hands-on practice to Identify features of any available SCADA software.
5. Configure available HMI panel and Interface it with PLC /PC

DETAILED COURSE CONTENTS:

SL NO	LIST OF EXPERIMENTS
1.	Identify different objects configuration, Dynamic properties (blinking, movement, filling etc.) in SCADA software.
2.	Identify different cables, and network buses with their accessories used in SCADA communication.
3.	Interface the given Excel database sheet to the SCADA software using DDE connectivity.
4.	Configure and perform hands on practice to Identify various features of any available open source OPC DA Server software in the laboratory.
5.	Study, understand and perform experiments on timers and counters.
6.	Develop interconnection of a given PLC with the available SCADA software using OPC DA Server.
7.	Develop SCADA graphic screen and integrate it with PLC to perform START STOP logic using two push buttons and one lamp
8.	Develop SCADA graphic screen and integrate it with PLC to perform the sequential ON-Off control of Lamps/motors.
9.	Measure the temperature of a given liquid using RTD or Thermocouple and integrate it in SCADA using PLC. Configure the alarm when measured temperature overshoots set temperature.
10.	Develop SCADA graphic screen and integrate it with PLC for pulse counting using limit switch /Proximity sensor.
11.	Configure available HMI panel and Interface it with PLC /PC
12.	Apply AND / OR logic using two manual controls for forward stroke of a double acting pneumatic cylinder.
13.	Perform the operation of two double acting cylinders electro pneumatically (Sequence of motion: A+B+B-A-)
14.	Develop and Test PLC program for Single and double Acting Pneumatic Cylinder using single solenoid valve and Inductive proximity sensors. Develop SCADA graphic screen and integrate it with PLC.
15.	Prepare a SCADA based system to control the street light as per the intensity of natural light.

WEB RESOURCES

- <https://www.matrikonopc.com/opc-server/opc-data-access-versions.aspx>
- <https://www.opcconnect.com/opcintro.php>
- <https://www.kepware.com/en-us/products/kepserverex/> for OPC software download.
- <http://thelearningpit.com/lp/logixpro.html>
- <https://wonderware-intouch.software.informer.com/> for SCADA/ HMI software download
- <https://rslinx-classic.software.informer.com/>
- <https://en.freownloadmanager.org/Windows-PC/Vijeo-Citect-FREE.html>

MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Sr. No.	Equipment Name with Broad Specifications
1	Computer system: Operating System: Windows 10 or higher Memory: minimum of 8 GB RAM, Minimum of Intel Core i5 or equivalent
2	IEC 1131-3 compatible PLC with programming Software and interfacing hardware, user manual.
3	Input and Output devices for PLC: like Lamp, DC Motor, Proximity sensors, Thermocouple/RTD, Red, green, yellow LEDs, limit switches, push button.
4	IEC standard compatible latest version of SCADA/HMI software from any reputed manufacturer of SCADA like Ellipse/ Vijeo Citect /Wonderware / RSView32 /WinCC / Cimplicity etc.
5	Open source OPC DA Server software
6	Coaxial Cable, UTP Cable, STP Cable, Fiber Optic Cable
7	Electro Pneumatic Trainer Kit
8	Electro-Pneumatic PLC trainer kit

Pr3. PROJECT Phase - II

Name of the Course: Diploma in Mechanical Engineering			
Course code:		Semester	6 th
Total Period:	150	Examination	3 hrs
Lab. periods:	10 P / week	Sessional	50
Maximum marks:	150	End Sem Examination	100

RATIONALE

Students' Project Work aims at developing innovative skills in the students whereby they apply the knowledge and skills gained through the course covered in many subjects and Labs, by undertaking a project. The prime emphasis of the project work is to understand and apply the basic knowledge of the principles of Mechanical engineering and practices in real life situations, so as to participate and manage a large Mechanical engineering projects, in future. Entire Project spreads over 5th and 6th Semester. Part of the Project covered in 5th Semester was named as *Project Phase-I* and balance portion to be covered in 6th Semester shall be named as *Project Phase-II*.

OBJECTIVES

After undergoing the Project Work, the student will be able to:

- Implement the theoretical and practical knowledge and skills gained through various subjects/courses into an application suitable for a real practical working environment, preferably in an industrial environment.
- Develop software packages or applications and implement these for the actual needs of the community/industry.
- Identify and contrast gap between the technological knowledge acquired through curriculum and the actual industrial need and to compensate it by acquiring additional knowledge as required.
- Carry out cooperative learning through synchronous guided discussions within the class in key areas, asynchronous document sharing and discussions, as well as prepare collaborative edition of the final project report.
- To achieve real life experience in Project design.
- To develop the skill of writing Project Report

Project Phase-I and Phase-II

The Project work duration covers 2 semesters(5th and 6th sem). The Grouping of students, selection of Project, assignment of Project Guide to the Group was done in the beginning of 5th semester under Project Phase-I. The students were allowed to study literature, any existing system and then define the Problem/objective of the Project. Preliminary work and Design of the system also have to be complete in Phase-I. Development may also begin in this phase. Project Milestones are to be set so that progress can be tracked .

In Phase-II Development, Testing, Documentation and Implementation have to be complete. Project Report have to be prepared and complete in Phase-II. All Project reports should be organized uniformly in proper order, irrespective of group. Teacher Guides can make suitable alteration in the components of Task and schedule.

At the end of Project Phase-II in 6th semester there shall be one presentation by each group on whole Project work undertaken by them.

A suggestive criterion for assessing student performance by the external (preferably person from industry) and internal (teacher) examiner is given in table below:

Sl. No.	Performance Criteria
1.	Selection of project assignment
2.	Planning and execution of considerations
3.	Quality of performance
4.	Providing solution of the problems or production of final product
5.	Sense of responsibility
6.	Self expression/ communication/ Presentation skills
7.	Interpersonal skills/human relations
8.	Report writing skills
9	Viva voce

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations to such an exhibition.

The Project Report need to be prepared as per standard format and following is the indicative format. The Teacher Guide may make minor alteration keeping the sense in tact.

Organization of Project Report

1. Cover page:

It should contain the following (in order)

- (i) Title of the Project
- (ii) Submitted in partial fulfillment of the requirements for the Diploma in <Branch Name>||
- (iii) By Name of the Student(s)
- (iv) Logo of the Institution
- (v) Branch Name/Depart Name and Institution Name with Address
- (vi) Academic Year

2. 1ST Inner page Certificate:

It should contain he following

This is to certify that the work in this Project Report entitled <Project Title> by <Name of student(s)> has been carried out under my supervision in partial fulfillment of the requirements for the Diploma in <Branch Name>|| during session <session > in <Branch /Department Name> of <Institute name> and this work is the original work of the above student(s).

Seal and signature of the Supervisor/Guide with date

3. 2nd Inner Page

Acknowledgement by the Student(s)

4. Contents.

5. Chapter wise arrangement of Reports

6. Last Chapter: Conclusion

It should contain

- (i) Conclusion
- (ii) Limitations
- (iii) Scope for further Improvement

7. References

Pr-4 LIFE SKILL (Common to All Branches)

Practical	2 Periods per week	Sessional	25 Marks
Total Periods	30 Periods	Total Marks	25 Marks

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

- Develop team spirit i.e. concept of working in team
- Apply problem solving skills for a given situation
- Use effective presentation techniques
- Apply task management techniques for given projects
- Enhance leadership traits
- Resolve conflict by appropriate method
- Survive self in today's competitive world
- Face interview without fear

DETAIL CONTENTS:

1. SOCIAL SKILL

Society, Social Structure, Develop Sympathy and Empathy

Swot Analysis – Concept, How to make use of SWOT

Inter personal Relation: Sources of conflict, Resolution of conflict ,
Ways to enhance interpersonal relation

2. PROBLEM SOLVING

Steps of Problem solving:

- Identify and clarify the problem,
- Information gathering related to problem,
- Evaluate the evidence,
- Consider alternative solutions and their implications,
- Choose and implement the best alternative,
- Review
- Problem solving techniques:

1) Trial and error, 2) Brain storming, 3) Lateral (Out of Box) thinking

3. PRESENTATION SKILL

Body language , Dress like the audience

Posture, Gestures, Eye contact and facial expression. STAGE FRIGHT,

Voice and language – Volume, Pitch, Inflection, Speed, Pause

Pronunciation, Articulation, Language, Practice of speech.

Use of AV aids such as Laptop with LCD projector, white board etc.

4. GROUP DISCUSSION AND INTERVIEW TECHNIQUES

Group Discussion:

Introduction to group discussion, Ways to carry out group discussion,
Parameters– Contact, body language, analytical and logical thinking,
decision making

Interview Technique :

Dress, Posture, Gestures, facial expression, Approach

Tips for handling common questions.

5. WORKING IN TEAM

Understand and work within the dynamics of a groups.

Tips to work effectively in teams,

Establish good rapport, interest with others and work effectively with them
to meet common objectives,

Tips to provide and accept feedback in a constructive and considerate way ,

Leadership in teams, Handling frustrations in group.

6. TASK MANAGEMENT

Introduction, Task identification, Task planning ,
organizing and execution, Closing the task

PRACTICAL

List of Assignment: (Any Five to be performed including Mock Interview)

1. SWOT analysis:-

Analyse yourself with respect to your strength and weaknesses, opportunities and threats. Following points will be useful for doing SWOT.

- a) Your past experiences,
- b) Achievements,
- c) Failures,
- d) Feedback from others etc.

2. Solve the True life problem assigned by the Teacher.

3. Working in a Team

Form a group of 5-10 students and do a work for social cause e.g. tree plantation, blood donation, environment protection, camps on awareness like importance of cleanliness in slum area, social activities like giving cloths to poor etc. (One activity per group where Team work shall be exhibited)

4. Mock Interview

5. Discuss a topic in a group and prepare minutes of discussion.

6. Deliver a seminar for 5 minutes using presentation aids on the topic given by your teacher.

7. Task Management

Decide any task to be completed in a stipulated time with the help of teacher. Write a report considering various steps in task management (with Break up into sub tasks and their interdependencies and Time)

Note: -1. Please note that these are the suggested assignments on given contents/topic. These assignments are the guide lines to the subject teachers. However the subject teachers are free to design any assignment relevant to the topic.

Note: -2. The following Topics may be considered for Seminar/GD in addition to other Topics at the discretion of the Teacher.

(Comparison with developed countries, Occupational Safety, Health Hazard, Accident & Safety, First-Aid, Traffic Rules, Global Warming, Pollution, Environment, Labour Welfare Legislation, Labour Welfare Acts, Child Labour Issues, Gender Sensitisation ,Harassment of Women at Workplace)

METHODOLOGY:

The Teacher is to explain the concepts prescribed in the contents of the syllabus and then assign different Exercises under Practical to the students to perform.

Books Recommended:-

Sl.No	Name of Authors	Title of the Book	Name of the Publisher
01	E.H. Mc Grath , S.J	Basic Managerial Skills for All	PHI
02	Lowe and Phil	Creativity and problem solving	Kogan Page (I) P Ltd
03	Adair, J	Decision making & Problem Solving	Orient Longman
04	Bishop , Sue	Develop Your Assertiveness	Kogan Page India
05	Allen Pease	Body Language	Sudha Publications Pvt. Ltd.

