SYLLABUS

Minor *in*

AUTOMATION SYSTEMS

OFFERED BY: Department of Electronics and Communication Engineering (EC)

ELIGIBLE DEPARTMENTS:AD, CA, CC, CE, CS, EE, EC, ER, ME

2024 SCHEME

Semester IV, V & VI

www.sjcetpalai.ac.in

Signed By: Devassia V P
Reason: Approved by SJCET Academic Council held on 25.11.2025

CURRICULUM

Minor in Automation Systems											
Sl. No	Semester	Course Code	Course Title	Credit Structure			SS	Total Marks		Credits	Hrs./ Week
				L	T	P		CIA	ESE		
1	3	24SJMNECT309	INTRODUCTION TO SENSORS AND ACTUATORS*/ MOOC#	3	1	0	5	40	60	4	4
2	4	24SJMNECT409	BASICS OF INDUSTRIAL HYDRAULICS & PNEUMATICS*/ MOOC#	3	1	0	5	40	60	4	4
3	5	24SJMNECT509	DATA ACQUISITION & PLC SYSTEMS*/ MOOC#	3	0	0	5	40	60	3	3
4	6	24SJMNECT609	ADVANCED AUTOMATION SYSTEMS* /MOOC#	4	0	0	5	40	60	4	4
Total							**20**			**15**	**15**

**Students must register for theory courses listed in the 3rd and 4th semesters of the Minor curriculum.*

#Students who fail a theory course listed in the Minor curriculum are permitted to register for an alternate MOOC course specified in the Minor curriculum.

SEMESTER 4 (S4)

BASICS OF INDUSTRIAL HYDRAULICS & PNEUMATICS

Course Code	**24SJMNECT409**	**CIE Marks**	**40**
Teaching Hours/Week (L: T:P: R)	**3:1:0:0**	**ESE Marks**	**60**
Credits	**4**	**Exam Hours**	**2 Hrs. 30 Mins**
Prerequisites (if any)	**Nil**	**Course Type**	**Theory**

Preamble:

This course enables students to analyse, design and implement hydraulic and pneumatic systems for automation in industries.

Course Outcomes		**Bloom's Knowledge Level (KL)**
CO 1	Explain the principles of hydraulic and pneumatic fluid power systems, including force, pressure, energy, and power relationships.	**K2**
CO 2	Identify and describe various fluid power components such as pumps, actuators, valves, and auxiliary elements used in hydraulic and pneumatic systems.	**K3**
CO 3	Design and construct hydraulic and pneumatic circuits for industrial and automation applications.	**K4**
CO 4	Apply logic control concepts and troubleshooting techniques in fluid power systems to ensure effective operation and maintenance.	**K3**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	2	-	-	-	-	-	2	-	-
CO2	2	2	2	-	-	-	-	-	2	-	-
CO3	3	2	2	-	-	-	-	-	2	-	-
CO4	2	2	2	-	-	-	-	-	2	-	-

Syllabus

Module 1 (10 Hours)

Fluid power system: components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications.

Fluids for hydraulic system: types, properties, and selection. Additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, and quick acting couplings. Pressure drop in hoses/pipes. Fluid conditioning through filters, strainers; sources of contamination and contamination control

Module 2(11 Hours)

Pumps: Classification of pumps, pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump selection factors, problems on pumps.

Accumulators: Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensor, Temperature switches/sensor, Level sensor. Actuators: Classification cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, problems on cylinders. Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power, flow rate, and hydraulic motor performance; numerical problems. Symbolic representation of hydraulic actuators (cylinders and motors).

Module 3 (11 Hours)

Components: Classification of control valves, Directional Control Valves-symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, and check valves. Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.

Hydraulic Circuit Design: Control of single and Double -acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counter balance valve application, hydraulic cylinder sequencing circuits, cylinder synchronizing circuit using different methods, hydraulic circuit for force multiplication; speed control of hydraulic cylinder metering in, metering out and bleed off circuits. Pilot pressure operated circuits. Hydraulic circuit examples with accumulator.

Module 4 (12 Hours)

Introduction to pneumatic systems: Pneumatic power system – advantages, limitations, and applications. Choice of working medium. Characteristics of compressed air and air compressors. Structure of pneumatic control systems and air preparation units – dryers and FRL unit.

Pneumatic actuators: Linear cylinders – types, construction, working, end-position cushioning, seals, mounting arrangements, and applications. Rotary cylinders – types, construction, and applications.

Pneumatic control valves: Directional control valves (poppet, spool, suspended-seat, and slide types), pressure control valves, flow control valves, quick exhaust valve, time delay valve, shuttle valve, twin-pressure valve, and memory valve.

Pneumatic control circuits: Direct and indirect actuation of cylinders, speed control of cylinders by supply-air and exhaust-air throttling. Logic elements and signal processing – use of OR and AND gates in pneumatic applications with simple practical examples.
Multi-cylinder applications: Coordinated and sequential motion control, cascading method – principle and practical examples (up to two cylinders) using reversing valves.
Electro-pneumatic control: Principles of electro-pneumatics – signal input and output, pilot-assisted solenoid operation of directional control valves, use of relays and contactors, and control circuitry for simple single- and multi-cylinder applications.

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE): 40 Marks

Attendance (Weightage: 12.5%)	Assignment/ Microproject (Weightage: 37.5%)	Internal Examination-1 (Written) (Weightage: 25%)	Internal Examination-2 (Written) (Weightage: 25%)	Total
5	15	10	10	40

End Semester Examination Marks (ESE) : 60 marks

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

1. Anthony Esposito, “Fluid Power with applications”, Pearson edition,2000.
2. Majumdar S.R., “Oil Hydraulics”, Tata McGRawHllL, 2002.
3. Majumdar S.R., “Pneumatic systems - Principles and Maintenance”, Tata McGraw-Hill, New Delhi, 2005

Reference Books

1. John Pippenger, Tyler Hicks, “Industrial Hydraulics”, McGraw Hill International Edition, 1980.
2. 2. Andrew Par, Hydraulics and pneumatics, Jaico Publishing House, 2005.
3. 3. FESTO, Fundamentals of Pneumatics, Vol. I, II and III.
4. 4. Herbert E. Merritt, “Hydraulic Control Systems”, John Wiley and Sons, Inc.
5. 5. Thomson, Introduction to Fluid power, PrentcieHaIl, 2004.
6. 6. John Watton, “Fundamentals of fluid power control”, Cambridge Univ. Press, 2012.

SEMESTER 5 (S5)

DATA ACQUISITION & PLC SYSTEMS

Course Code	**24SJMNECT509**	**CIE Marks**	**40**
Teaching Hours/Week (L: T:P: R)	**3:0:0:0**	**ESE Marks**	**60**
Credits	**3**	**Exam Hours**	**2 Hrs. 30 Mins**
Prerequisites (if any)	**Nil**	**Course Type**	**Theory**

Preamble:

To explain the evolution, architecture, and functional aspects of Programmable Logic Controller (PLC) systems, illustrate the use of various PLC instructions, and design automation solutions using PLC programming techniques. To describe the significance of computer control in automation, outline the architecture and operation of PC-based data acquisition systems, and emphasize their role in industrial monitoring and control.

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the evolution and architecture of PLC systems.	**K2**
CO2	Understand the various PLC instructions and design specific applications using PLC	**K2**
CO3	Understand the need of computer control in automation	**K2**
CO4	Understand PC based data acquisition systems. .	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2			1					1
CO2	3	3	2			2					2
CO3	3	3	3		3	3					3
CO4	3	2	2			1					2

Syllabus

Module 1 (9 Hours)

Definition and History of PLC-PLC advantage and disadvantages- Over all PLC systems-CPU and Programmer/Monitors-PLC input and output models – Architecture- PLC Programming language – Relay logic – Ladder logic – Programming of Gates – Flow charting as a programming method – connecting PLC to computer - PLC Troubleshooting and Maintenance.

Module 2 (9 Hours)

Programming of Timers – Introduction - ON delay, OFF delay, Retentive Timers – PLC Timer functions – Examples of timer function Industrial application. Programming Counters – up/down counter – Combining counter - Examples of counter function Industrial application. PLC Arithmetic Functions – PLC number Comparison function PLC Program Control Instructions: Master Control Reset - Skip – Jump and Move Instruction. Sequencer instructions.Case study of Tank level control system, bottle filling system and Sequential switching of motors.

Module 3 (9 Hours)

Need of computer in a control system-Functional block diagram of a computer control system-Data loggers- Supervisory computer control- Direct digital control-Digital control interfacing-SCADA.

Module 4 (9 Hours)

Sampling theorem – Sampling and digitizing – Aliasing – Sample and hold circuit – Practical implementation of sampling and digitizing – Definition, design and need for data acquisition systems – Interfacing ADC and DAC with Microprocessor / Multiplexer - Multiplexed channel operation Microprocessor/PC based acquisition systems.

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE): 40 Marks

Attendance (Weightage: 12.5%)	Assignment/ Microproject (Weightage: 37.5%)	Internal Examination-1 (Written) (Weightage: 25%)	Internal Examination-2 (Written) (Weightage: 25%)	Total
5	15	10	10	40

End Semester Examination Marks (ESE): 60 marks

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

[1] Petrezeulla, "Programmable Logic Controllers", McGraw Hill, 1989.

[2] Curtis D. Johnson," Process Control Instrumentation Technology", 8th edition Prentice Hall June 2005

[3] D.Roy Choudhury and Shail B.Jain, " Linear Integrated Circuits", New age International Pvt. Ltd,

Reference Books

[1] Hughes .T, "Programmable Logic Controllers", ISA Press, 1989.

[2] G.B.Clayton," Data Converters", The Mac Millian Press Ltd., 1982.

[3] John w.Webb & Ronald A.Reis., "Programmable logic controllers- principles and applications", 5th Edition – PHI Learning Pvt. LTd, New Delhi -2010.

SEMESTER 6 (S6)

ADVANCED AUTOMATION SYSTEMS

Course Code	**24SJMNECT609**	**CIE Marks**	**40**
Teaching Hours/Week (L: T:P: R)	**3:1:0:0**	**ESE Marks**	**60**
Credits	**4**	**Exam Hours**	**2 Hrs. 30 Mins**
Prerequisites (if any)	**Nil**	**Course Type**	**Theory**

Preamble:

To make students familiar with automation and control technologies in modern manufacturing To provide knowledge on the elements of modern manufacturing systems. Examine the mechanisms of CMM and FMS. To determine the modern application of automation systems in manufacturing industry

Course Outcomes - At the end of the course students will be able to

	Course Outcomes	**Bloom's Knowledge Level (KL)**
CO 1	Explain the basic structure, facilities, and automation needs of production systems.	**K2**
CO 2	Describe the elements, principles, and levels of automation including computer control, PLC, and robotics.	**K2**
CO 3	Classify manufacturing systems and understand automation strategies with suitable examples.	**K2**
CO 4	Discuss group technology, flexible manufacturing, and modern systems such as lean and agile manufacturing.	**K2**

Mapping of course outcomes with program outcomes (Minimum requirements)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
CO 1	2	1	-	-	-	2	-	-	-		1
CO 2	2	-	-	-	1	2	-	-	-	-	1
CO 3	2	-	-	-	1	2	-	-	-	-	1
CO 4	2	1	-	-	1	2	-	-	-	-	1

MODULE – 1 (10 Hours)

Production system facilities – basic idea and examples of manufacturing facilities and equipment – role of manufacturing support systems. Automation in production systems – meaning, need, and advantages – role of manual labor in automated production systems. Automation principles and strategies – simple explanation of the USA principle (Understand, Simplify, Automate) – ten basic strategies of automation and production systems explained in brief. Automation migration strategy – basic concept and need for gradual automation. Manufacturing industries and products – simple classification and examples.

MODULE – II (12 Hours)

Elements of an automated system – basic components: power source, program of instructions, and control system – simple functions and examples. Advanced automation functions – basic idea of safety monitoring, maintenance, and error detection and recovery – importance in automatic systems. Levels of automation – meaning and simple examples from low to high automation. Automation in industries – basic variables and parameters in process industries (continuous systems) and discrete manufacturing (batch or piece production). Types of control systems – basic idea of continuous and discrete control – simple examples from real industries. Computer process control – basic concept, control requirements, and capabilities of computer-based control systems – levels of industrial process control explained in simple terms. Applications of computer control – process monitoring, direct digital control (DDC), and introduction to numerical control (NC), robotics, and programmable logic controllers (PLC).

MODULE – III (9 Hours)

Components of a manufacturing system – basic elements: production machines, material handling system, computer control system, and human resources – simple functions and examples of each. Classification of manufacturing systems – based on type of operation, number of workstations, level of automation, and part/product variety – simple explanation with examples. Types of manufacturing systems – basic idea of Type I, Type II, and Type III systems – meaning and simple differences**.**

MODULE – IV (13 Hours)

Part families – basic idea and need for grouping similar parts – simple part classification and coding – examples – concept of cellular manufacturing – advantages and applications of group technology. Inspection and metrology – basic idea of measuring and inspection – contact and non-contact inspection methods – introduction to coordinate measuring machines (CMM) – main parts and working – simple uses and benefits – basic idea of machine vision – image capture and processing in simple terms – common applications of machine vision. Flexible manufacturing systems (FMS) – meaning and need – simple types of FMS – main components: workstations, material handling, computer control – role of operators – advantages and applications – basic ideas of planning and implementation. Modern manufacturing systems – basic comparison between lean and agile manufacturing – importance of automation in modern industries.

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

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Text Books

1. Groover, Mikell P. *Automation, Production Systems, and Computer-Integrated Manufacturing.* 3rd ed., Pearson Education, 2008

Reference

1. Groover, Mikell P. *Automation, Production Systems, and Computer-Integrated Manufacturing.* 2nd ed., Prentice Hall of India, 2001
2. Radhakrishnan, P., and S. Subramanian. *CAD/CAM and Computer-Integrated Manufacturing (CIM).* Wiley Eastern Ltd., 1994.
3. HMT Ltd. *Mechatronics.* Tata McGraw-Hill, 2002.