ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

SCHOOL OF ELECTRONIC SCIENCES

B. Tech in Electronics and Instrumentation Engineering (Honors)

Curriculum and Syllabus

(**2023-24 admitted students**)

School/ Department: SCHOOL OF ELECTRONIC SCIENCES

Course: B. Tech **Programme: Electronics and Instrumentation Engineering**

Abbreviation used:

AC	Audit course	LC	Laboratory Course	PA	Practical Assessment
PC	Professional Core	PR	Project/ Practical/ Internship	L	Lecture
PE	Professional Elective	SE	Seminar/ Expert Lecture/ Etc.	T	Tutorial
OE	Open Elective	IA*	Internal Assessment	P	Practical
MC/BS/HS	Mandatory/ Common Course	EA	End-Semester Assessment		
ACC	Advanced Competency Course				
*Internal Assessment Mark (40 marks) consists of (i) Mid Semester (20 marks) (ii) Quiz/ Assignment/Attendance (20 marks)					

Honors Degree in "Electronics and Instrumentation Engineering"

Sl. No.	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
1	EI3171	Soft Computing	3	0	0	3	40	60	-	100
2	EI3172	Artificial Intelligence: Foundations and Applications	3	0	0	3	40	60	-	100
3	EI3582	Data Acquisition & Automation Lab	0	0	3	1.5	-	-	100	100
4	EI4171/ EI4173/ EI4175	Robotic Intelligence and Automation / Mechatronics and Intelligent Instrumentation System / Nanotechnology	3	0	0	3	40	60	-	100
5	EI4177/ EI4179/ EI4181	Industrial Automation / Networking of Embedded Systems / Analog Instrumentation	3	0	0	3	40	60	-	100
6	EI4581	Advanced Control System Lab	0	0	3	1.5	-	-	100	100
7	EI4182/ EI4184	Digital Control System / Biomedical Instrumentation & Signal Processing	3	0	0	3	40	60	-	100
		Total	**15**	**0**	**6**	**18**	**200**	**300**	**200**	**700**

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
SOFT COMPUTING	EI3171	3-0-0	3

Prerequisite: Set Theory, linear and complex algebra, Anatomy of human brain.

Course Outcomes:

At the end of the course, a student will be able to:

- **CO1:** Acquire the foundational concepts of fuzzy sets, fuzzy inference systems, and their real-life applications.
- **CO2:** Illustrate the structure and functioning of various neural network models and their uses.
- **CO3:** Analyze the application of genetic algorithms to solve engineering optimization problems.
- **CO4:** Evaluate and compare different soft computing techniques for intelligent problem-solving.

Module I: Fuzzy Logic Systems **04 Hours**

Introduction to soft computing and fuzzy logic covering fuzzy sets, fuzzy vs. crisp sets, fuzzy relations, linguistic variables, membership functions, fuzzy operations, fuzzy rules, fuzzy inference, and a fuzzy logic-based case study for air conditioning control.

Module II: Artificial Neural Networks (ANNs) **08 Hours**

Fundamentals of neural networks including artificial neuron models, feedforward networks, recurrent networks, CNN, RBM, and the general architecture and characteristics of neural networks

Module III: Machine Learning Using Neural Networks **08 Hours**

Learning algorithms in neural networks such as backpropagation, MLP, ART, RBFN, Hopfield networks, comparison of MLP and RBFN, hybrid neuro-fuzzy systems, and practical applications of neural networks.

Module IV: Genetic Algorithms and Hybrid Soft Computing Systems **10 Hours**

Basics and principles of genetic algorithms including encoding, fitness function, reproduction, crossover, mutation, inheritance operators, generational cycle, and GA-based optimization techniques.

Total lecture hours: **30 Hours**

Text Book:

1. S. Rajasekaran and G. A. V. Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, New Delhi, India: PHI.
2. S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing, New Delhi, India: Wiley.
3. D. E. Goldberg, Genetic Algorithms in Search Optimization and Machine Learning, 3rd ed., Boston, MA, USA: Addison Wesley.
4. S. Haykin, Neural Networks: A Comprehensive Foundation, New Delhi, India: PHI.

Reference Book:

1. J. S. R. Jang, C. T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing, New Delhi, India: PHI.
2. N. K. Kasabov, Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, Cambridge, MA, USA: MIT Press, 1996.
3. B. Yegnanarayana, Artificial Neural Networks, New Delhi, India: PHI Learning, 2004.
4. S. Haykin, Neural Networks and Learning Machines, 3rd ed., Upper Saddle River, NJ, USA: Pearson Education, 2008.

CO-PO-PSO MAPPING

SOFT COMPUTING															
Course outcome	**Program Outcomes**											**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	3	3	2	2	1	0	2	3	3	2	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	2	3	2	3	2	3
CO3	3	3	3	3	3	1	1	1	1	1	1	1	3	3	3
CO4	3	3	3	3	3	2	2	2	2	2	2	2	3	3	3
Average	3	3	3.0	2.75	2.75	2.5	1.25	2.0	.2.5	2.0	2.0	2.0	3	2.75	3
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
ARTIFICIAL INTELLIGENCE: FOUNDATIONS ANDAPPLICATIONS	**EI3172**	**3-0-0**	**3**

Prerequisite: Control System Engineering, Hydraulics and Fluid Machines, Thermodynamics

Course Outcomes:

At the end of the course, a student will be able to:

- **CO1:** Identify the historical evolution, architecture, and application domains of Artificial Intelligence systems.
- **CO2:** Apply various knowledge representation techniques.
- **CO3:** Implement fundamental AI methods
- **CO4:** Analyze AI problem-solving under real-world constraints

Module I: **7 Hours**

Introduction to AI: Historical Evolution and AI today, Architecture of AI Systems, Domains and Scope of AI Applications

Module II: **7 Hours**

Knowledge Representation Methods: State Space Representation, Logical Representations, Knowledge Graphs,

Module III: **8 Hours**

Basic Artificial Intelligence Methods: Decision-tree learning, Supervised and Unsupervised learning, Classification and Regression, Support Vector Machines, Neural Networks (Basics), Reinforcement Learning, Tools: Tensor Flow, ML Flow etc.

Module IV: **8 Hours**

Real-World Considerations: Contract search, anytime search, Memory-bounded search, Search with Real-time adjustments, Observability (full / partial), Information (known / unknown), State (deterministic / stochastic), Periodicity (discrete / continuous).

Total lecture hours: **30 Hours**

Text Book:

1. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, 3rd Edition, Prentice Hall, 2009.
2. Principles of Artificial Intelligence, Nils J. Nilsson, Morgan Kaufmann, 1982

Reference Book:

1. Artificial Intelligence: A New Synthesis, Nils J. Nilsson, 1st Edition, Morgan Kaufmann, 1998
2. Heuristic Search: Theory and Applications, Stefan Edelkamp and Stefan Schroedl, 1st Edition, Morgan Kaufmann, 2011
3. Logic in Computer Science: Modelling and Reasoning about Systems, Michael Huth and Mark Ryan, 2nd Edition, Cambridge University Press, 2004.
4. The Cambridge Handbook of Artificial Intelligence, Keith Frankish and William M. Ramsey (ediitors), Cambridge University Press, 2014.

CO-PO-PSO MAPPING

ARTIFICIAL INTELLIGENCE: FOUNDATIONS ANDAPPLICATIONS															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	-	-	-	1	-	-	-	-	2	-	2	3	2	2
CO2	3	2	2	1	2	-	-	-	-	1	-	2	3	2	2
CO3	3	3	2	2	3	-	-	-	-	1	1	3	3	2	2
CO4	3	3	2	3	2	-	-	-	-	2	1	3	3	2	2
Average	3	2	1.5	1.5	2	0	0	0	0	1.5	0.5	2.5	3	2	2
Level of Correlation: 3 - High 2 - Medium 1 - Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
ROBOTIC INTELLIGENCE & AUTOMATION	**EI4171**	**3-0-0**	**3**

Prerequisite: Mathematics (basic algebra, geometry), Physics (mechanics, basic electronics)

Course Outcomes:

At the end of the course, a student will be able to:

CO1: Select suitable sensors and actuators for humanoid robots based on component specifications.
CO2: Analyze swarm robotics and basic AI for coordinating group robotic tasks.
CO3: Develop a conceptual model of a collaborative robot using HRI technologies.
CO4: Design an intelligent automation system using IoRT, control systems, and NLP.

Module I: Introduction to Robotics 07 Hours

Introduction to Robotics: Definition, brief history, types of robots (industrial, mobile, humanoid), classification by geometrical configuration (serial vs. parallel manipulators). Robot Components and Specifications: Basic components and specifications (accuracy, repeatability, load capacity, and speed of response). Humanoid Robots and Sensors: Introduction to humanoid robots, types of sensors, and actuators. Applications of Humanoid Robots.

Module II: Swarm Robotics and AI Basics 08 Hours

Introduction to Swarm Robotics: Definition, key features (decentralized control, group behavior, scalability), and comparison with single-robot systems. Tasks in Swarm Robotics: Simple tasks (e.g., moving together, collecting objects, exploring areas) and AI Basics for Robotics: Introduction to AI for simple decision-making. Applications of Swarm Robotics.

Module III: Human-Robot Interaction and Collaborative Robots 08 Hours

Introduction to Human-Robot Interaction (HRI): Definition, importance, and examples. Sensors for HRI: Basic sensor technologies for interaction (e.g., vision for detecting humans, speech recognition for commands). Collaborative Robots (Cobots): Introduction to Cobots, types, and applications. Ethics in HRI: Basic ethical concerns.

Module IV: Intelligent Automation Technologies 07 Hours

Internet of Robotic Things (IoRT): Definition and How Robots Connect with Smart Systems. Basic Control Systems. Natural Language Processing (NLP) Basics: How robots understand simple human speech. Case Studies in Automation.

Total lecture hours: 30 Hours

Text Book:

1. Siciliano, B., & Khatib, O. (Eds.), Springer Handbook of Robotics. Springer, 2016.
2. Murphy, R. R., Introduction to AI Robotics. MIT Press, 2019.
3. Spong, M. W., Hutchinson, S., & Vidyasagar, M., Robot Modeling and Control. Wiley, 2020.
4. Saha, S. K., Introduction to Robotics. McGraw Hill Education, 2014.

Reference Book:

1. Craig, J. J., Introduction to Robotics: Mechanics and Control. Pearson, 2005.
2. Niku, S. B., Introduction to Robotics: Analysis, Control, Applications. Wiley, 2020.
3. Matarić, M. J., The Robotics Primer. MIT Press, 2007.
4. Russell, S. J., & Norvig, P., Artificial Intelligence: A Modern Approach. Pearson, 2020.

CO-PO-PSO MAPPING

ROBOTIC INTELLIGENCE & AUTOMATION															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	2	-	3	-	-	-	2	2	-	2	3	3	2
CO2	3	3	2	2	3	-	-	-	2	2	-	2	3	3	2
CO3	2	2	3	2	3	-	-	2	3	3	2	2	3	3	2
CO4	2	2	3	2	3	-	2	2	2	3	2	3	3	3	3
Average	2.5	2.25	2.5	2	3	-	0.5	1	2.25	2.5	1.5	2.25	3	3	2.25
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
MECHATRONICS AND INTELLIGENT INSTRUMENTATION SYSTEM	**EI4173**	**3-0-0**	**3**

Prerequisite: Basic Electronics, Programming Fundamentals, Mechanics

Course Outcomes:

At the end of the course, a student will be able to:

CO1: Choose appropriate sensors and actuators for robotic applications using mechatronic principles.
CO2: Evaluate AI and embedded systems enabled intelligent behavior in mechatronics.
CO3: Develop a conceptual model of a collaborative mechatronic system with HRI integration.
CO4: Design a smart automation system.

Module I: Mechatronics and Intelligent Instrumentation Systems — 07 Hours

Introduction to mechatronics and its interdisciplinary scope. Overview of sensors and actuators with emphasis on specifications. Component selection strategies for robotic applications. Case studies demonstrating sensor-actuator integration in industrial robots.

Module II: Intelligent Systems in Mechatronics — 08 Hours

Basics of embedded systems (Arduino, PIC): programming and real-time operations; AI in mechatronics: perception, rule-based logic, and decision-making; Interfacing sensors with embedded platforms, applications: AI-based mobile robots and warehouse navigation.

Module III: Human-Robot Interaction and Collaborative Systems — 08 Hours

Fundamentals of human-robot interaction (HRI): modalities and safety, Sensors for HRI: vision, speech, and tactile systems, Collaborative robots (Cobots): design, ethics, and shared tasks, Conceptual modeling of HRI systems.

Module IV: Intelligent Automation Systems — 07 Hours

IoT applications in mechatronics: architecture and protocols (MQTT, Wi-Fi), Feedback and PID control systems, Industrial data communication: Modbus, CAN protocols, System design and case studies: smart factories and robotic assistants.

Total lecture hours: 30 Hours

Text Book:

1. Bolton. W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering. Pearson, 2015.
2. Alciatore. D. G., & Histand. M. B., Introduction to Mechatronics and Measurement Systems. McGraw-Hill, 2019.
3. Siciliano. B., & Khatib. O., Springer Handbook of Robotics. Springer, 2020.
4. Russell. S. J., & Norvig. P., Artificial Intelligence: A Modern Approach. Pearson, 2020.

Reference Book:

1. Craig, J. J., Introduction to Robotics: Mechanics and Control. Pearson, 2005.
2. Necsulescu, D., Mechatronics. Prentice Hall, 2009.
3. Kamen, E. W., & Heck, B. S., Fundamentals of Signals and Systems. Pearson, 2014.
4. Matarić, M. J. (2007). The Robotics Primer. MIT Press.

CO-PO-PSO MAPPING

MECHATRONICS AND INTELLIGENT INSTRUMENTATION SYSTEM															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	3	2	3	-	-	-	-	-	-	2	3	3	2
CO2	3	3	2	2	3	-	-	-	-	-	-	2	3	3	2
CO3	2	3	3	2	3	1	-	2	3	2	2	2	3	2	2
CO4	3	3	3	3	3	-	2	-	2	2	2	3	3	3	3
Average	2.75	2.75	2.75	2.25	3.00	0.25	1.00	1.00	1.25	1.50	1.50	2.25	3.00	2.75	2.25
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
NANOTECHNOLOGY	**EI4175**	**3-0-0**	**3**

Prerequisite: Basic Electronics, Mathematics, Fundamentals of Physics

Course Outcomes:

At the end of the course, a student will be able to:

CO1: Apply nanoelectronics principles to design nanosensor circuits for instrumentation applications.

CO2: Analyse the performance of nanoelectronic devices in sensing and signal processing contexts.

CO3: Evaluate the suitability of nanomaterials for specific instrumentation applications.

CO4: Design simple nanoelectronic systems for measurement and control.

Module I: Fundamentals of Nanoelectronics & Nanomaterials — 07 Hours

Introduction, significance in instrumentation, Types and properties of nanomaterials (e.g., CNTs, QDs, graphene), Quantum effects, Moore's Law, scaling limits, Application in sensors and signal processing

Module II: Devices & Fabrication — 08 Hours

Nanoelectronic Devices: Introduction to quantum dots, single electron transistors (SETs), tunnel diodes, CNT- and graphene-based transistors, **Device Operation**: Tunnelling, Coulomb blockade, low-power ops, **Fabrication Essentials**: Top-down & bottom-up fabrication methods, MEMS/NEMS intro; device reliability

Module III: Characterization Techniques — 08 Hours

Need for nanoscale measurements, **Microscopy Techniques**: Optical microscopy, Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM); basic principles and applications, **Spectroscopic Methods**: UV-Visible spectroscopy, Raman spectroscopy, and X-ray diffraction (XRD) for nanomaterial analysis, Electrical measurements: I-V characterization, resistance, and capacitance measurements

Module IV: Applications in Instrumentation — 07 Hours

Nano sensors: Principles of nano sensors (e.g., gas, chemical, biosensors); use of nanomaterials for improved sensitivity and selectivity. **Signal Processing**: Nanoelectronic circuits for low-power amplification and processing in instrumentation systems.

Total lecture hours: 30 Hours

Text Book:

1. Murty, B. S., Shankar, P., Raj, B., Rath, B. B., & Murday, J. Textbook of Nanoscience and Nanotechnology. Springer Science & Business Media, 2013.
2. Pradeep, T. A Textbook of Nanoscience and Nanotechnology. Tata McGraw-Hill Education, 2012.
3. Bhushan, B. (Ed.). Springer Handbook of Nanotechnology, 5th Edition. Springer, 2020.
4. Giri, P. K., Goswami, D. K., & Perumal, A., Advanced Nanomaterials and Nanotechnology. Springer, 2021.

Reference Book:

1. Kelsall, R., Hamley, I., & Geoghegan, M. Nanoscale Science and Technology. John Wiley & Sons, 2005.
2. Hussain, C. M., & Kailasa, S. K. (Eds.*)*. Handbook of Nanomaterials for Sensing Applications, Elsevier, 2021.
3. Zhang, J., & Zhang, Y. (Eds.). Nanomaterials for Energy and Sensor Applications, CRC Press, 2020.
4. Wolf, E. L. Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience. Wiley-VCH, 2006.

CO-PO-PSO MAPPING

NANO-ELECTRONICS															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	3	2	3	2	2	1	2	2	1	2	3	3	2
CO2	3	3	2	3	3	2	2	1	2	2	1	2	3	3	2
CO3	3	3	2	3	2	2	2	1	1	2	1	2	3	3	3
CO4	3	2	3	2	3	1	1	1	2	3	2	3	3	3	3
Average	3.0	2.5	2.5	2.5	2.75	1.75	1.75	1.0	1.75	2.25	1.25	2.25	3.0	3.0	2.5
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
INDUSTRIAL AUTOMATION	**EI4177**	**3-0-0**	**3**

Prerequisite: Communication Systems (Basic), Computer Fundamentals, Control Systems

Course Outcomes:

At the end of the course, a student will be able to:

- **CO1:** List the fundamentals of industrial automation
- **CO2:** Demonstrate knowledge of industrial communication protocols and network standards
- **CO3:** Analyze the architecture, functionality, and software aspects of Distributed Control Systems
- **CO4:** Apply safety principles and protection techniques in industrial environments

Module I: **7 Hours**

Introduction to Automation: Evolution of instrumentation and Control, types of industries, Benefits of automation, Computer based- Plant Automation, Evolution of Hierarchical system structure, Continuous versus Discrete Process Control

Module II: **8 Hours**

Instrumentation Standard Protocols: Introduction to wired and wireless network sensors, overall fieldbus trends, Instrumentation Network Design, Fieldbus advantages and disadvantages, HART Network, Foundation Fieldbus Network, Modbus TCP/IP, Ethernet and TCP/IP based system

Module III: **8 Hours**

Distributed Control System: Introduction to Distributed Control System, Functional level, data base organization, Operator interface, Introduction to Object Linking and Embedding (OLE) for Process Control, application software, and Knowledge-based software

Module IV: **7 Hours**

Hazard and Safety: Initial consideration, Enclosures, Intrinsic Safety, Prevention of Ignition, Methods of Production, Analysis Evaluation and Construction

Total lecture hours: **30 Hours**

Text Book:

1. Dobrivoje Popovic, "Distributed Computer Control for Industrial Automation", Marcel Dekker, 1990
2. PC-Based Instrumentation: Concepts and Practice, N. Mathivanan, Prentice-Hall of India, New Delhi, 2016
3. Computer-Based Industrial Control, Krishna Kant, PHI, 2009.

Reference Book:

1. B. G. Liptak , "Process Control, Instrument Engineering Hand book", Chilton Book Company, Third Edition, 1995
2. Electronic Instrumentation, PH.S. Kalsi, Tata-McGraw Hill Education, 2017.

CO-PO-PSO MAPPING

INDUSTRIAL AUTOMATION															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	2	2	2	1	1	1	1	2	2	2	3	2	2
CO2	3	2	2	2	3	1	1	1	1	2	2	2	3	2	2
CO3	3	2	2	2	3	1	1	1	2	2	2	2	3	2	2
CO4	3	2	2	2	2	3	3	1	2	2	2	2	3	2	2
Average	3	2	2	2	2.5	1.5	1.5	1	1.5	2	2	2	3	2	2
Level of Correlation: 3 – High 2 – Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
NETWORKING OF EMBEDDED SYSTEMS	EI4179	3-0-0	3

Prerequisite: Microprocessor and Microcontroller

Course Outcomes:

At the end of the course, a student will be able to:

CO1: Identify the types of Embedded networking.
CO2: Differentiate the various Bus protocols.
CO3: Apply the knowledge of networking protocols.
CO4: Examine knowledge of Network Topology.

Module I: **08 Hours**

Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols –Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming - ISA/PCI Bus protocols – Firewire.

Module II: **08 Hours**

Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components –Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet protocol.

Module III: **08 Hours**

Exchanging messages using UDP and TCP – Serving web pages with Dynamic Data –Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP –Keeping Devices and Network secure.

Module IV: **06 Hours**

Wireless sensor networks – Introduction – Applications – Network Topology – Localization–Time Synchronization - Energy efficient MAC protocols –SMAC – Energy efficient and robust routing – Data Centric routing.

Total lecture hours: **30 Hours**

Text Book:

1. Embedded Systems Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John & Wiley Publications, 2002.
2. Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port - Jan Axelson, Penram Publications, 1996.
3. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications.
4. Bhaskar Krishnamachari, 'Networking wireless sensors', Cambridge press 2005.

Reference Book:

1. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series - Dogan Ibrahim, Elsevier 2008.
2. Embedded Ethernet and Internet Complete - Jan Axelson, Penram publications, 2003.
3. Networking Wireless Sensors – Bhaskar Krishnamachari, Cambridge press 2005.
4. Arnold S Burger, "Embedded System Design", CMP.

CO-PO-PSO MAPPING

NETWORKING OF EMBEDDED SYSTEMS															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	2	2	2	1	2	-	-	-	3	2	1	-	3	2	1
CO2	2	-	2	1	2	-	-	-	2	2	1	-	3	2	-
CO3	2	2	-	2	-	-	-	-	1	-	-	1	3	2	2
CO4	2	2	-	2	-	-	-	-	1	-	-	1	3	1	1
Average	2	1.5	1	1.5	1	-	-	-	1.75	1	0.5	0.5	3	1.75	1
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
ANALOG INSTRUMENTATION	**EI4181**	**3-0-0**	**3**

Prerequisite: Analog Electronics

Course Outcomes:

At the end of the course, a student will be able to:

CO1: Define analog Instrumentation and Measurement systems.
CO2: Design various analog circuits used for Instrumentation System.
CO3: Apply the concept of noise and signal generator circuits.
CO4: Test various signal conditioning circuits like noise reduction circuits filter circuits.

Module I: **04 Hours**

Introduction to Analog Instrumentation: Basic concepts of analog instrumentation using OPAMP, Importance and applications of analog instrumentation, Overview of measurement systems using differential amplifiers and Measurement Circuits.

Module II: **08 Hours**

Analog Instrumentation Circuits: Voltage and current measurement techniques, Instrumentation amplifiers, Bridges and their applications, Signal generators and waveform synthesis. Analog Multiplier, Divisor, Summer, and squaring Circuits

Noise and Interference: Sources of noise and interference in analog instrumentation, Noise analysis and characterization, Noise reduction techniques, Grounding, and shielding strategies.

Module III: **08 Hours**

Analog Filters: Introduction to filtering and filter design, components for filter implementation, active low-pass, high-pass, band-pass, band-reject and all-pass filters – design and realization, Frequency Response of different types of filters, Switch capacitance filter.

Module IV: **10 Hours**

Instrumentation System Design: Design considerations for analog instrumentation systems, Performance specifications and requirements, Selection and evaluation of components, Design of measurement systems.

Analog oscilloscopes: advantages and limitations, Arbitrary waveform generators (AWG): Fundamentals, AWGs as sampled data systems, Different kinds of AWG, Waveform editing features in AWGs, Performance factors of AWGs

Total lecture hours: **30 Hours**

Text Book:

1. W. D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, New York, NY, USA: Prentice Hall.
2. V. F. Leonard, Analogue Instrumentation Fundamentals, The Blacksburg Continuing Education Series, Financial Times Prentice Hall.
3. A. Neamen, Electronic Circuit Analysis and Design, 2nd ed., Boston, MA, USA: McGraw-Hill, 2001.
4. Sedra and K. C. Smith, Microelectronic Circuits, 7th ed., New York, NY, USA: Oxford Univ. Press, 2014.

Reference Book:

1. N. Kularatna, Digital and Analogue Instrumentation: Testing and Measurement, London, UK: The IET.
2. R. A. DeCarlo and P. M. Lin, Linear Circuit Analysis, 2nd ed., New York, NY, USA: Oxford Univ. Press, 2001.
3. O. Doebelin and D. N. Manik, Measurement Systems: Application and Design, 5th ed., New Delhi, India: Tata McGraw-Hill, 2007.
4. S. Kalsi, Electronic Instrumentation, 3rd ed., New Delhi, India: Tata McGraw-Hill, 2010.

CO-PO-PSO MAPPING

ANALOG INSTRUMENTATION															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	3	2	2	1	1	2	3	3	2	3	3	3	3
CO2	3	3	3	3	3	0	2	3	0	2	3	2	3	2	2
CO3	2	3	1	3	3	1	1	1	1	1	1	1	3	3	3
CO4	3	3	3	3	3	2	2	2	2	2	2	2	2	3	2
Average	2.75	2.75	2.5	2.75	2.75	1.0	1.5	2.0	1.5	2.0	2.0	2.0	2.75	2.75	2.5
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
DIGITAL CONTROL SYSTEM	EI4182	3-0-0	3

Prerequisite: Signals and Systems, Control Systems, Basic Linear Algebra and Differential Equations

Course Outcomes:

At the end of the course, a student will be able to:

CO1: Analyze the behavior and stability of discrete-time control systems using Z-domain methods.
CO2: Apply Z-transforms and inverse techniques to solve difference equations in control systems.
CO3: Implement compensators and controllers in discrete domain.
CO4: Design digital filters and discrete-time controllers using classical and state-space approaches.

Module I: **08 Hours**

Principle features of discrete time control system, Signal sampling, quantizing and coding, Data acquisition, conversion and distribution system, Reconstruction of original signal from sampled signal

Module II: **08 Hours**

Fundamentals of Z-transform, Properties and theorems of Z-transform, Z-transform from the convolution integral, Inverse Z-transform: direct division, partial fractions, inversion integral, Z-transform method for solving difference equations

Module III: **07 Hours**

S-plane to Z-plane mapping and vice-versa, Stability analysis of closed-loop systems in the Z-plane, Discrete-time equivalents of continuous-time systems and analog controllers, Transient and steady state response analysis

Module IV: **07 Hours**

Digital filters: structure, implementation, frequency response, applications, Control system controllers: structure, software/hardware features, response types, Phase lead and lag compensator design, PID controller design and parameter tuning in a discrete domain, Introduction to discrete-time state equations, discretization, pulse transfer matrix, and stability assessment.

Total lecture hours: **30 Hours**

Text Book:

1. K. Ogata, Digital Control Engineering, Prentice Hall, Englewood Cliffs, 1995.
2. M. Gopal, Digital Control Engineering, Wiley Eastern, 1988.
3. G. F. Franklin, J. D. Powell, and M. L. Workman, Digital Control of Dynamic Systems, Addison-Wesley, 1998.
4. B.C. Kuo, Digital Control System, Holt, Rinehart and Winston, 1980.

Reference Book:

1. Ioan Doré Landau, Digital Control Systems: Design, Identification and Implementation, Springer.
2. Charles L. Phillips and Troy Nagle, Digital Control System Analysis and Design, Pearson.
3. Kavita Singh, Rashmi Vashisth, "Digital Control System", Galgotia Publications
4. V. I. George, C.P. Kurian, " Digital Control Systems", Cengage Learning

CO-PO-PSO MAPPING

DIGITAL CONTROL SYSTEM															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	3	-	2	2	-	-	-	-	-	-	2	3	2	-
CO2	3	2	-	2	2	-	-	-	-	-	-	2	3	2	-
CO3	3	2	3	2	3	1	1	1	2	2	2	2	3	3	2
CO4	3	3	3	3	3	1	1	1	2	2	2	2	3	3	2
Average	3.0	2.5	3.0	2.3	2.5	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	2.5	2.0
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
BIOMEDICAL INSTRUMENTATION & SIGNAL PROCESSING	EI4184	3-0-0	3

Prerequisite: Analog Electronics, signal system

Course Outcomes:

At the end of the course, a student will be able to:

CO1: Evaluate physiological systems and biomedical signals like ECG, EEG, and EMG.
CO2: Analyze transducers and electrodes for biomedical measurements.
CO3: Apply signal processing techniques to analyze biomedical signals.
CO4: Implement noise reduction in biomedical systems.

Module I: **04 Hours**

Introduction: Physiological systems of the body, Basic medical instrumentation system, Sources of biomedical signals, Origin of bioelectric potentials, Examples of biomedical signals: ECG, EEG, EMG, PCG, EMG, VMG, VAG, ENG, EGG, Block diagram description of electrocardiograph (ECG) and electroencephalograph (EEG).

Module II: **08 Hours**

Physiological Transducers: Introduction, performance characteristics of transducers, displacement, position and motion transducers, transducers for body temperature measurement, blood flow and pressure measurement, biosensors, smart sensors, General principle of electrode and its applications.

Module III: **08 Hours**

General considerations for signal conditioners, Preamplifiers, Sources of noise in low level measurements, biomedical signal analysis and processing techniques: FT, FFT, STFT, Laplace transform, Wavelet transform,

Module IV: **10 Hours**

Noise fundamental: Noise description, Types of analog noises, Low and high frequency noise, Noise Bandwidth, noise calculation, Noise in biomedical circuits and components.

Filtering for removal of artifacts: Random noise, structured noise and physiological interference, stationary versus nonstationary processes, Illustration of the Problem with Case-studies, Time-domain Filters, and Frequency-domain Filters.

Total lecture hours: **30 Hours**

Text Book:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, 3rd ed., New Delhi, India: TMH, 2003.
2. R. M. Rangayyan, Biomedical Signal Analysis: A Case-Study Approach, Hoboken, NJ, USA: John Wiley, 2014.
3. R. Pallas-Areny and J. G. Webster, Analog Signal Processing, New York, NY, USA: Wiley.
4. D. R. Neuman, Biomedical Engineering: Principles and Design, 2nd ed., New York, NY, USA: McGraw-Hill, 2009.

Reference Book:

1. W. J. Tompkins, Biomedical Digital Signal Processing, New Delhi, India: PHI.
2. M. Akay, Time-Frequency and Wavelets in Biomedical Signal Processing, Hoboken, NJ, USA: IEEE Press, 1998.
3. L. Cromwell, Biomedical Instrumentation and Measurements, 2nd ed., Pearson Education.
4. E. N. Bruce, Biomedical Signal Processing and Signal Modelling, Hoboken, NJ, USA: John Wiley, 2001.

CO-PO-PSO MAPPING

BIOMEDICAL INSTRUMENTATION & SIGNAL PROCESSING															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	1	2	2	1	0	2	0	3	2	3	3	3	3
CO2	3	3	3	3	3	0	2	3	0	2	3	2	3	2	3
CO3	2	3	1	3	3	1	1	1	1	1	1	1	3	3	3
CO4	3	3	3	3	3	2	2	2	2	2	2	2	2	3	2
Average	2.75	2.75	2.0	2.75	2.75	1.0	1.25	2.0	.75	2.0	2.0	2.0	2.75	2.75	2.75
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
DATA ACQUISITION & AUTOMATION LABORATORY	EI3582	0-0-3	1.5

Prerequisite: Basic knowledge of sensors, embedded systems, and control systems.

Course Outcomes:

At the end of the course, a student will be able to:

CO1: Analyze sensor signals and data acquisition system fundamentals.
CO2: Apply DAQ tools to interface sensors and implement control methods.
CO3: Create automated systems for real-time monitoring and fault detection.
CO4: Design intelligent automation solutions using advanced control techniques.

LIST OF EXPERIMENTS

EXP 1 : Introduction to DAQ Systems using NI LabVIEW / Arduino / Raspberry Pi
EXP 2 : Analog-to-Digital and Digital-to-Analog Conversion
EXP 3 : Signal Conditioning: Amplification and Filtering of Sensor Signals
EXP 4 : Sampling Theorem and Aliasing Demonstration
EXP 5 : Temperature Measurement using RTD/Thermocouple and DAQ
EXP 6 : ON/OFF and PID Control using DAQ Hardware
EXP 7 : Automated Bottle Filling System using Proximity Sensor and Actuator
EXP 8 : Level Control System using Ultrasonic Sensor and Relay Control
EXP 9 : Noise Reduction Techniques in Sensor Data (Hardware/Software Filters)
EXP 10 : Data Scaling, Offset, and Calibration using LabVIEW/Python
EXP 11 : Fuzzy Logic-based Process Control (e.g., Fan Speed based on Temperature)
EXP 12 : Real-Time PID Control of Level or Flow System
EXP 13 : Servo Motor Position Control with DAQ Feedback System
EXP 14: Real-Time Fault Detection in Motors using Vibration and Temperature Sensors
EXP 15 : Accelerometer-Based Vibration Monitoring
EXP 16 : Lighting Control System using LDR and PWM Output
EXP 17 : Smart Conveyor System using Sensor Array and Actuator Logic

Text Book:

1. Gary Johnson & Richard Jennings, LabVIEW Graphical Programming, 4th Edition, McGraw-Hill, 2006.
2. John Park & Steve Mackay, Practical Data Acquisition for Instrumentation and Control Systems, 1st Edition, Newnes, 2003.
3. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, 19th Revised Edition, Dhanpat Rai & Co., 2014.
4. Dale Patrick & Stephen W. Fardo, Industrial Process Control Systems, 2nd Edition, Delmar Cengage Learning, 2009.

Reference Book:

1. Clarence W. de Silva, Sensors and Actuators: Engineering System Instrumentation, 2nd Edition, CRC Press, 2015.
2. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson, 2005.
3. John G. Webster, Measurement, Instrumentation, and Sensors Handbook, 2nd Edition, CRC Press, 2014.
4. Ernest O. Doebelin, Measurement Systems: Application and Design, 5th Edition, McGraw-Hill, 2004.

CO-PO-PSO MAPPING

DATA ACQUISITION & AUTOMATION LABORATORY															
Course outcome	**Program Outcomes**											**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	3	1	1	1	1	2	1	2	3	3	1
CO2	3	3	2	2	3	1	1	1	1	2	1	2	3	3	1
CO3	3	2	3	2	3	1	2	2	2	3	1	2	3	3	1
CO4	3	3	3	2	3	1	2	2	2	3	2	3	3	3	2
Average	3	2.5	2.5	1.75	3	1	1.5	1.5	1.5	2.5	1.25	2.25	3	3	1.25
Level of Correlation: 3 - High 2 - Medium 1 - Low															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH
Techno Campus, MahalaxmiVihar, Ghatikia, Bhubaneswar-751029.
Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
ADVANCED CONTROL SYSTEM LAB	EI4581	0-0-3	1.5

Prerequisite: Control Systems, MATLAB
Course Outcomes:
At the end of the course, a student will be able to:

CO1: Analyze the linear and non-linear systems using Lyapunov method.
CO2: Determine P, PI, PID responses of closed loop systems.
CO3: Design lead, lag and lead-lag compensators using frequency domain methods.
CO4: Test controllability and observability of continuous and discrete control systems.

LIST OF EXPERIMENTS

EXP 1 : Design and analyze PID control system using 2nd and 3rd order systems.
EXP 2 : Stabilize PID control system using Ziegler-Nichols method.
EXP 3 : Design of level controller using PI Controller.
EXP 4 : Design lead compensator network using MATLAB and analyze the network using MATLAB/Simulink.
EXP 5 : Design lag compensator network using MATLAB and analyze the network using MATLAB/Simulink.
EXP 6 : Design of lead–lag compensator to stabilize an unstable system.
EXP 7 : Controllability and Observability test of a continuous control system using MATLAB/Simulink.
EXP 8 : Controllability and Observability test of a discrete control system usingMATLAB/Simulink.
EXP 9 : Study and analyze stepper motor using PLC.
EXP 10 : Study of synchro transmitter and receiver.
EXP 11 : Design Boost converter using Fuzzy logic controller.
EXP 12 : Stability test of state space analysis by Lyapunov's theorem.
EXP 13 : Design Digital Kalman filter using MATLAB.
EXP 14 : Study and analyze 2nd order transfer function using control system simulator.

Text Book:

1. Ogata K., Modern Control Engineering, Pearson Education.
2. Nagrath I.J. and Gopal M., Control Systems Engineering, New Age International.
3. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall.

Reference Book:

1. Dorf R.C. and Bishop R.H., Modern Control Systems, Pearson.
2. M. Gopal, Digital Control and State Variable Methods, Tata McGraw-Hill.
3. Franklin G. F., Powell J. D., Emami-Naeini A., Feedback Control of Dynamic Systems, Pearson Education

CO-PO-PSO MAPPING

ADVANCED CONTROL SYSTEM LAB															
Course outcome	**Program Outcomes**											**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	3	2	2	-	-	-	-	-	-	-	1	3	2	-
CO2	3	3	3	2	2	-	-	-	-	-	-	1	3	3	-
CO3	3	2	3	2	3	-	-	-	-	-	-	1	3	2	-
CO4	3	3	2	3	3	-	-	-	-	1	-	2	3	3	-
Average															
Level of Correlation: 3 - High 2 - Medium 1 - Low															