DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

MASTER OF TECHNOLOGY (M.Tech.)

IN

ELECTRONICS & COMMUNICATION ENGINEERING

(With Specialization in Internet of Things (IoT))

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

Waknaghat, Solan – 173234

DETAILED SYLLABUS

(Effective from Academic Session – 2026–2027)

Proposed Course Structure

SEMESTER – I								
S.No.	**Course Code**	**Name of the Subjects**		**Course Hours**			**Total**	**Credits**
			C/ E/ A	**L**	**T**	**P**		
1	26M**EC***	Advanced Digital Signal Processing	C	3	0	0	3	3
2	26M**EC***	Introduction to Internet of Things	C	3	0	0	3	3
3		**Prog.Specific Elective-1**	**E**	**3**	**0**	**0**	**3**	**3**
PSE-1	**	*Embedded Systems and Applications*						
	**	*Sensor and Smart Instrumentation*						
	**	*Wireless Technologies for IoT*						
4		**Prog.Specific Elective-2**	**E**	**3**	**0**	**0**	**3**	**3**
PSE-2	**	*Network Security Protocols*						
	**	*Industrial Automation and IIoT*						
5	26M**EC***	Research Methodology and Intellectual Property Rights	C	2	0	0	2	2
6	26M**EC***	Advanced Digital Signal Processing Lab	C			4	4	2
7	26M**EC***	Introduction to Internet of Things Lab	C			4	4	2
8	26M**EC***	Audit Course-1/Swayam Certification-1	A	2	0	0	2	0
Total							**24**	**18**
SEMESTER – II								
S.No.	**Course Code**	**Name of the Subjects**		**Course Hours**			**Total**	**Credits**
			C/ E/ A	**L**	**T**	**P**		
1	26M**EC***	Modern Microelectronic Devices & Sensors	C	3	0	0	3	3
2	26M**EC***	Wireless Networking	C	3	0	0	3	3
3		**Prog.Specific Elective-3**	**E**	**3**	**0**	**0**	**3**	**3**
PSE-3	**	*Signal Processing for IoT*						
	**	*RF technology for 5G and IoT*						
4		**Prog.Specific Elective-4**	**E**	**3**	**0**	**0**	**3**	**3**
PSE-4	**	Applied Machine Learning for IoT						
	**	Image Sensing and Realtime Processing						
5	**26M**EC***	**Mini Project**	**C**	**0**	**0**	**4**	**4**	**2**
6		Modern Microelectronic Devices & Sensors Lab	C			4	4	2
7		Wireless Networking Lab	C			4	4	2

8	Aud-2	Audit Course-2/Swayam Certification-2	A	2			0	0
Total							**22**	**18**
SEMESTER – III								
S.No.	**Course Code**	**Name of the Subjects**		**Course Hours**			**Total**	**Credits**
			C/ E	**L**	**T**	**P**		
1		**Prog.Specific Elective-5**	**E**	**3**	**0**	**0**	**3**	**3**
PSE-5	**	Cognitive Radio						
	**	RF and Microwave Circuit Design						
2		**Open Elective-1**	**E**	**3**	**0**	**0**	**3**	**3**
OE-1	**	Business Analytics						
	**	Operations Research						
	**	Waste to Energy						
3	26M**EC***	Dessertation-1	C	0	0	20	20	10
Total							**26**	**16**
SEMESTER – IV								
S.No.	**Course Code**	**Name of the Subjects**		**Course Hours**			**Total**	**Credits**
			C/ E	**L**	**T**	**P**		
1	26M**EC***	Dessertation-2	C	0	0	32	32	16
Total							**32**	**16**
Overall Credits in 1st(18), 2nd(18), 3rd(16) and 4th(16) Semestrs								**68**

List of Audit courses 1 & 2

- English for Research Paper Writing
- Disaster Management
- Sanskrit for Technical Knowledge
- Value Education
- Constitution of India
- Pedagogy Studies
- Stress Management by Yoga
- Personality Development through Life Enlightenment Skills.

DETAILED SYLLABUS

(Semester-1)

Advanced Digital Signal Processing

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: CORE
L-T-P: 3-0-0

Course Outcomes:

At the end of this course, students will be able to

1. To understand theory of different filters and algorithms
2. To understand theory of multirate DSP, solve numerical problems and write algorithms
3. To understand theory of prediction and solution of normal equations
4. To know applications of DSP at block level.

Course Contents:

Unit	Contents
1	Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR
2	Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.
3	Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.
4	Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm
5	Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.
6	Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

References:

1. J. G. Proakis and D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, *Multirate Digital Signal Processing: Multirate Systems – Filter Banks – Wavelets*, John Wiley & Sons, 1999.
3. Bruce W. Suter, *Multirate and Wavelet Signal Processing*, Academic Press, 1997.
4. M. H. Hayes, *Statistical Digital Signal Processing and Modeling*, Wiley, 2002.
5. S. Haykin, *Adaptive Filter Theory*, 4th Edition, Prentice Hall, 2001.
6. D. G. Manolakis, V. K. Ingle, and S. M. Kogon, *Statistical and Adaptive Signal Processing*, McGraw Hill, 2000.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Introduction to Internet of Things (IoT)

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: CORE
L-T-P: 3-0-0

Course Outcomes:

At the end of this course, students will be able to

1. Understand IoT architecture, components, and enabling technologies.
2. Analyze IoT communication protocols and networking standards.
3. Design basic IoT systems using sensors, actuators, and embedded platforms.
4. Apply cloud computing and data analytics concepts in IoT applications.
5. Evaluate security, privacy, and ethical issues in IoT systems.

Course Contents:

Unit	Contents
1	**Introduction to IoT:** Definition, characteristics, and evolution of IoT, IoT vs M2M communication, IoT architecture: layered and functional models, Key enabling technologies.
2	**Sensors, Actuators, and Embedded Platforms:** Types of sensors and actuators, Sensor interfacing and data acquisition, Microcontrollers and embedded platforms (Arduino, Raspberry Pi), Edge devices and gateways.
3	**IoT Communication Technologies:** Wired and wireless communication technologies, Short-range: Bluetooth, Zigbee, RFID, Long-range: LoRaWAN, NB-IoT, Protocols: MQTT, CoAP, HTTP, AMQP
4	**IoT Data Processing and Cloud Integration:** IoT data lifecycle, Cloud platforms for IoT (AWS IoT, Azure IoT, Google Cloud IoT), Edge vs Cloud computing, Basics of data analytics and visualization.
5	**Security and Applications:** Security challenges in IoT, Authentication, encryption, and privacy, IoT applications: Smart cities, healthcare, agriculture, industry (IIoT), Case studies.

References:

1. A. Bahga and V. Madisetti, *Internet of Things: A Hands-on Approach*. Hyderabad, India: Universities Press, 2015.
2. R. Kamal, *Internet of Things: Architecture and Design Principles*. New Delhi, India: McGraw Hill Education, 2017.
3. S. Greengard, *The Internet of Things*. Cambridge, MA, USA: MIT Press, 2015.
4. O. Hersent, D. Boswarthick, and O. Elloumi, *The Internet of Things: Key Applications and Protocols*, 2nd ed. Hoboken, NJ, USA: Wiley, 2012.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Embedded Systems and Applications

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

Course Outcomes:
At the end of this course, students will be able to

1. Understand various components of embedded system, design challenges.
2. Comprehend RISC architecture, programming of ARM and PIC microcontrollers.
3. Know about embedded system design and development methodology, tools and languages used for embedded system design.
4. Learn about Devices and Communication interface used in embedded system.
5. Learn about Real Time Operating System used for embedded system application.

Course Contents:

Unit	Contents
1	Introduction: Characteristics of Embedded System Computing, Concept of Real time Systems, Classification, Application areas, Design challenges – real-time execution, physical size, power consumption, multirate operation.
2	Embedded system processors: ARM Processor Fundamentals and Architectures, ARM Instruction Set, PIC Microcontroller and its Architecture, Instruction Set.
3	Embedded hardware units and devices in a System, Embedded software in a system, Embedded system-on-chip (SOC), Embedded system-on-module (SOM).
4	Devices and Communication interface: Serial communication devices, Parallel communication, Wireless Devices, Timer and Counting Devices, Watchdog timer, Real time clock, Parallel communication network using ISA, PCI, Serial bus communication protocols, SCI, CAN, I2C, USB.
5	Real Time Operating System: Real-time Kernels, Polled Loops System, Coroutines, Interrupt-driven System, Multi-rate System, Processes and Thread Context Switching, Scheduling, Inter-process Communication, Real-time Memory Management, I/O, VxWorks, RT-Linux.
6	Case Study: ARM Cortex-A5 Processor-based SOM, ATSAMA5D27-SOM1, Use of SAMA5D2 GPIO under Linux.

References:

1. Frank Vahid and Tony Givargis, "Embedded system design: A unified Hardware/Software introduction,"3rd Ed., Wiley 2014.
2. Shibu K. V, "Introduction to Embedded Systems," 2nd Ed., McGraw Hill 2017.
3. Embedded System: Architecture, Programming and Design by Rajkamal,2nd Ed., 2010, Tata McGraw Hill gle, and S. M. Kogon, *Statistical and Adaptive Signal Processing*, McGraw Hill, 2000.
4. Steve Furber, "ARM System-on-Chip Architecture," 2nd Ed., Pearson, 2012
5. Tim Wilmshurst, "Designing Embedded Systems with PIC Microcontrollers: Principles and Applications," 2nd Ed., Newnes, 2009.
6. Steven F Barrett and Daniel J Pack, "Embedded Systems Design and Applications with the 68HC12 and HCS12," 1st Ed., Pearson 2012.
7. Kenneth Ayala, "The 8051 microcontroller," 3rd Ed., Thomson, 2005.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Sensors and Smart Instrumentation

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

Course Outcomes:

At the end of this course, students will be able to

1. Knowledge of characteristics of sensors and measurement system, criteria for transducer selection.
2. Learn about data acquisition systems, signal conditioners and signal converters.
3. Knowledge about different basic sensors and transducers used for measurement of physical quantities.
4. Knowledge about different measurement systems used in industry.
5. Learn about characteristics and working of smart sensors and instruments.

Course Contents:

Unit	Contents
1	Introduction: Basics of measurement systems, sensors and transducers, General transducers characteristics, static and dynamic characteristics, Criteria for transducer selection, Calibration techniques, Classification of errors.
2	Data acquisition system and its uses in intelligent Instrumentation systems, Signal conditioners, signal converters, sample and hold. Instrumentation amplifiers, Interference, grounding and shielding.
3	Resistive Transducers: Potentiometers, strain gauges, Resistance Thermometer, Thermistors. Inductive Transducers, Capacitive Transducers: Principles of operation, construction, Piezoelectric transducer, fibre optic transducers for the measurement of force, temperature, flow and pressure, Elastic Transducers: Spring bellows, diaphragm, bourdon tube.
4	Pressure sensor, temperature measurement, flow measurement, level measurement, displacement, force, velocity, acceleration and torque measurement. Telemetry, multiplexing, modulation of data, transmission channels.
5	Smart instruments - comparison with conventional transducers - self diagnosis and remote calibration features - smart transmitter with HART communicator - Micro Electro Mechanical Systems - sensors, actuators - principles and applications, nonlinearity compensation. Cogent sensors, Soft sensors, self-validating sensors, temperature-compensating sensors, ANN-based sensors, ANN techniques for fault detection, linearization, and calibration.

References:

1. Doebelin EO, “Measurement Systems: Application and Design,” Tata McGraw Hill, 7th Ed., 2019.
2. Patranabis D, “Sensors and Transducers,” Prentice Hall of India, 2nd Ed., 2003.
3. Manabendra Bhuyan, “Intelligent Instrumentation: Principles and Applications”, CRC Press, 2017.
4. Subhas Chandra Mukhopadhyay, “Intelligent Sensing, Instrumentation and Measurements (Smart Sensors, Measurement and Instrumentation Book 5),” Springer, 2013.
5. Bela G. Liptak, “Instrument Engineers' Handbook, Volume One: Process Measurement and Analysis,” 4th Ed., CRC Press, 2003.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Wireless Technologies for IoT

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

Course Outcomes:
At the end of this course, students will be able to

1. To understand the fundamentals of wireless networks.
2. Analyze the standards of IoT which employed for wireless networks.
3. Explain the use of various wireless technologies in IoT.
4. Design and develop various applications of IoT.

Course Contents:

Unit	Contents
1	**Cellular Standards:** Cellular carriers and Frequencies, Channel allocation, Cell coverage, Cell Splitting, Microcells, Picocells, Handoff, 1st, 2nd, 3rd and 4th Generation Cellular Systems (GSM, CDMA, GPRS, EDGE,UMTS), Mobile IP, WCDMA.
2	**RF Basics: Radio Frequency (RF) Fundamentals:** Introduction to RF & Wireless Communications Systems, RF and Microwave Spectral Analysis, Communication Standards, Understanding RF & Microwave Specifications. Spectrum Analysis of RF Environment, Protocol Analysis of RF Environment, Units of RF measurements, Factors affecting network range and speed, Environment, Line-of-sight, Interference, Defining differences between physical layers- OFDM.

3	**WLAN: Wi-Fi Organizations and Standards:** IEEE, Wi-Fi Alliance, WLAN Connectivity, WLAN QoS & Power-Save, IEEE 802.11 Standards,802.11-2007,802.11a/b/g, 802.11e/h/I,802.11n.
4	**Wi-Fi Hardware & Software:** Access Points, WLAN Routers, WLAN Bridges, WLAN Repeaters, Direct-connect Aps, Distributed connect Aps, PoE Infrastructure, Endpoint, Client hardware and software, Wi-Fi Applications.
5	**WSN & WPN:** Wireless Personal Area Networks, Bluetooth, Bluetooth Standards, BlueTooth Protocol Architecture, UWB, IEEE 802.15 standards, ZigBee, Sub1GHz, Sensor Networks, coexistence strategies in Sensor Networks, Routing protocols in Wireless Sensor Networks.

References:

1. Wireless Communications – Principles and Practice; by Theodore S Rappaport, Pearson Education Pte. Ltd., Delhi.
2. Wireless Communications and Networking; By: Stallings, William; Pearson Education Pte. Ltd., Delhi.
3. Bluetooth Revealed; By: Miller, Brent A, Bisdikian, Chatschik; Addison Wesley Longman Pte Ltd., Delhi.
4. Wilson , "Sensor Technology hand book," Elsevier publications 2005.
5. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005.
6. Mobile and Personal Communications Services and Systems; 1st Edition; By: Raj Pandya; PHI, New Delhi.
7. Fundamentals of Wireless Communication by Tse David and Viswanath Pramod, Cambridge University press, Cambridge.
8. Mobile Communications; By: Schiller, Jochen H; Addison Wesley Longman Pte Ltd., Delhi.
9. 3G Networks: Architecture, protocols and procedures based on 3GPP specifications for UMTS WCDMA networks, By Kasera, Sumit, Narang, and Nishit, TATA MGH, New Delhi.
10. Wireless Sensor Networks: information processing by approach, ZHAO, FENG, GUIBAS and LEONIDAS J, ELSEVIER, New Delhi.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Network Security Protocols

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

Course Outcomes:
At the end of this course, students will be able to

1. Understand the threats posed to network security and the more common attacks associated with those threats.
2. Understand the threats present in computer networks and counter measures for the same
3. Analyzing the security protocols at different layers of the OSI model.
4. Gain knowledge of authentication processes and security in the wireless networks.

Course Contents:

Unit	Contents
1	Introduction: Computer security concepts; OSI security architecture Security attacks, Security mechanisms, A model for network security, Standards.
2	Understanding network security: Network security: Physical security, Pseudo security, Hardware security, Software security; Security services: Access control, Authentication, Confidentiality, Integrity, Non-repudiation; Security standards, Elements of security. DoS Attacks, Firewall and Intrusion prevention systems.
3	Security threats to Computer Networks: Introduction; Sources of security threats; Security threat motives; Security threat management; Security threat correlation; Security threat awareness.
4	Security protocols in network layer: Security at different layers: pros and cons; Internet protocol security (IPSec): IPSec security associations, IPSec protocols: AH and ESP, Tunnel versus transport mode, Incompatibility with NAT, Internet key exchange protocol.
5	Security protocols in transport layer: Secure socket layer (SSL) handshake protocol: Steps in handshake, Key design ideas; SSL record layer protocol, OpenSSL, Transport layer security (TLS).
6	Security protocols in application layer: Pretty good privacy (PGP), Secure/multipurpose internet mail extension (S/MIME), Secure-HTTP (SHTTP), Hypertext transfer protocol over secure socket layer (HTTPS), Secure electronic transactions (SET), Kerberos.

7	Security in wireless networks and devices: GSM (2G) security, Security in UMTS (3G), Wireless LAN security: authentication, confidentiality and integrity.

References:

1. Cryptography and Network Security: principle and practices Wiliam Stallings.
2. Computer Network Security, Joseph Migga Kizza.
3. Cryptography, Network Security, and Cyber Laws / Bernard L. Menezes.

Evaluation Scheme:

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1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Industrial Automation and IIoT

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

Course Outcomes:
At the end of this course, students will be able to

1. Learn about history, architecture and advantages of Industrial automation.
2. Knowledge about various components used for Industrial automation.
3. Learn about PLC, SCADA and DCS used for automation.
4. Study about Industrial Communication and Human Machine Interface.
5. Learn about Industrial IoT reference architecture, layers and application domains.

Course Contents:

Unit	Contents
1	Introduction: History of automation, Automation systems, Types of automation, Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Advantages and limitations of Automation, Industrial revolutions.
2	Automation components: Sensors and actuators, Electric, Hydraulic, Pneumatic, actuators, process control valves, Introduction of DC and AC servo drives for motion control. Controllers, Transmitters and Signal Conditioning: Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Analog and Digital signal conditioning for sensors, Smart and Intelligent transmitters.

3	Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.
4	SCADA & Distributed control system: Elements of SCADA, Features of SCADA, MTU, RTU Functions, Applications of SCADA, Communications in SCADA, Introduction to DCS, Architecture, Input and output modules, Specifications of DCS.
5	Industrial Communication and Human Machine Interface (HMI): Device network: CAN, PROFIBUS-PA, Control network: ControlNet, PROFIBUS-DP, Ethernet, Interfaces: RFID, Barcode, HMI: Block Diagram, Types, Advantages and industrial applications.
6	Industrial IoT: Business Model and Reference Architecture, Layers: IIoT Sensing, IIoT Processing, IIoT Communication , IIoT Networking. Industrial IoTApplication Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security, Oil, chemical and pharmaceutical industry.

References:

1. K. S. Singh, “Industrial Instrumentation and Control”, 3rd Ed., The McGraw Hill, 2010.
2. C.D. Johnson, “Process Control Instrumentation Technology”, 8th Ed., PHI, 2015.
3. Madhuchhanda Mitra, SamarjitSen Gupta, “Programmable Logic controllers and Industrial Automation”, Penram International, 2008.
4. Gregory K. McMillan, P. Hunter Vegas, “Process / Industrial Instruments and Controls Handbook,” 6th Ed., McGraw Hill, 2019.
5. Bela G. Liptak, Kriszta Venczel, “Instrument and Automation Engineers' Handbook: Process Measurement and Analysis,” 5th Ed., CRC Press, 2016.
6. A.Suresh et. al., “Industrial IoT Application Architectures and Use Cases”, 1st Ed., CRC Press, 2018.
7. Giacomo Veneri Antonio Capasso, “Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0”, Ingram short title, 2018.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Research Methodology and IPR

COURSE CODE:
COURSE CREDITS: 2
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 2-0-0

Course Outcomes:
At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Contents:

Unit	Contents
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations
2	Effective literature studies approaches, analysis Plagiarism , Research ethics.
3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
6	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners".
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Evaluation Scheme:

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3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Advanced Digital Signal Processing Lab

COURSE CODE:
COURSE CREDITS: 2
CORE/ELECTIVE/AUDIT/MOOCs: CORE
L-T-P: 0-0-4

Course Outcomes:
At the end of this course, students will be able to

1. Design different digital filters in software.
2. Apply various transforms in time and frequency.
3. Perform decimation and interpolation.

List of Assignments:

1. Basic Signal Representation
2. Correlation Auto And Cross
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT Of Input Sequence
5. Butterworth Low pass And High pass Filter Design
6. Chebychev Type I,II Filter
7. State Space Matrix from Differential Equation
8. Normal Equation Using Levinson Durbin
9. Decimation And Interpolation Using Rationale Factors
10. Maximally Decimated Analysis DFT Filter
11. Cascade Digital IIR Filter Realization
12. Convolution And M Fold Decimation &PSD Estimator
13. Estimation Of PSD
14. Inverse Z Transform
15. Group Delay Calculation
16. Separation Of T/F
17. Parallel Realization of IIR filter

Suggested Books / Resources:

[1] J. G. Proakis and D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms, and Applications*, 4th ed. Upper Saddle River, NJ, USA: Pearson Education, 2007.

[2] A. V. Oppenheim and R. W. Schafer, *Discrete-Time Signal Processing*, 3rd ed. Upper Saddle River, NJ, USA: Pearson Education, 2010.

[3] V. K. Ingle and J. G. Proakis, *Digital Signal Processing Using MATLAB*, 3rd ed. Stamford, CT, USA: Cengage Learning, 2012.

Evaluation Scheme:

1.	Mid Sem. Evaluation	20 Marks
2.	End Sem. Evaluation	20 Marks
3.	Attendance	15 Marks
4.	Lab Assessment	45 Marks
	Total	100 Marks

Introduction to Internet of Things Lab

COURSE CODE:
COURSE CREDITS: 2
CORE/ELECTIVE/AUDIT/MOOCs: CORE
L-T-P: 0-0-4

Course Outcomes:

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

1. Understand the architecture, characteristics, protocols, and enabling technologies of Internet of Things (IoT) systems.
2. Interface and program various sensors, actuators, and embedded platforms such as Arduino, ESP32, and Raspberry Pi.
3. Acquire, process, monitor, and analyze real-time sensor data using IoT communication technologies and cloud platforms.
4. Design and develop IoT-based smart automation, monitoring, and security applications for real-world scenarios.

List of Assignments

1. Study of Internet of Things (IoT) Architecture, Characteristics, and Applications
2. Installation and Configuration of Arduino IDE, ESP32 Development Environment, and Raspberry Pi
3. Introduction to Arduino/ESP32 Programming and Serial Communication Interface
4. Interfacing and Blinking of Light Emitting Diode (LED) using Arduino/ESP32
5. PWM-Based Control of LED Brightness and LED Fading using Arduino
6. Interfacing Push Button Switch and Counting Button Press Events using Interrupts
7. Interfacing RGB LED and Generating Multiple Color Patterns using PWM
8. Analog Input Acquisition using Potentiometer and Displaying Sensor Values on Serial Monitor
9. Interfacing and Calibration of LM35 Temperature Sensor with Arduino
10. Measurement of Temperature and Humidity using DHT11/DHT22 Sensor
11. Ambient Light Detection and Monitoring using LDR/Photoresistor Sensor
12. Object Detection using Infrared (IR) Obstacle Detection Sensor
13. Distance Measurement using Ultrasonic Sensor and LCD Display Interface
14. Motion Detection and Monitoring using Passive Infrared (PIR) Sensor
15. Detection of Gas Leakage using MQ-Series Gas Sensor and Alarm Generation
16. Smoke Detection and Safety Alarm System using Smoke Sensor
17. Interfacing Relay Module for Electrical Appliance Control using Arduino/ESP32
18. Servo Motor Interfacing and Position Control using Joystick Module
19. Speed and Directional Control of DC Motor using Arduino/ESP32
20. Interfacing and Control of Stepper Motor using Raspberry Pi
21. Wireless Sensor Data Acquisition and Wi-Fi Communication using ESP32
22. Implementation of MQTT-Based IoT Communication between Devices
23. Uploading and Monitoring Sensor Data on ThingSpeak Cloud Platform

24. Development of IoT Dashboard and Remote Device Control using Blynk Mobile Application
25. Smart Street Light Automation using PIR and LDR Sensors
26. Design of IoT-Based Smart Intrusion Detection and Alarm System
27. Real-Time Environmental Monitoring System using Cloud Connectivity
28. Design and Implementation of IoT-Based Smart Monitoring and Home Automation Mini Project

Suggested Books / Resources

1. A. Bahga and V. Madisetti, *Internet of Things: A Hands-on Approach*. Hyderabad, India: Universities Press, 2015.
2. M. Banzi and M. Shiloh, *Getting Started with Arduino*, 3rd ed. Sebastopol, CA, USA: Maker Media, 2014.
3. A. McEwen and H. Cassimally, *Designing the Internet of Things*. Chichester, U.K.: Wiley, 2014.

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1.	Mid Sem. Evaluation	20 Marks
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