B. Tech CSE (IoT)

SEMESTER –VII

Sl No.	Course Code	Course Title	Hours Per Week			Total Credits
			Lecture	Tutorial	Practical	
1.	100708	Biology for Engineers	3	0	0	3
2.	155701	Deep Learning	3	0	0	3
3.	1557XX	Program Elective-IV	3	0	0	3
4.	1007XX	Open Elective-I	3	0	0	3
5.	155701P	Deep Learning Lab	0	0	2	1
6.	100707P	Summer Entrepreneurship – III	-	-	-	8
7.	100709P	Project-I	-	-	-	6
TOTAL						27

List of Program Elective Courses - IV

sr.no.	Code	Course Title	L	T	P	Credit
1.	155702	Privacy and Security in IoT	3	0	0	3
2.	155703	Application of IoT in Robotics	3	0	0	3
3.	155704	Programming for IoT Boards	3	0	0	3
4.	155705	Pattern Recognition	3	0	0	3
5.	155706	Sensors and Actuator Devices for IoT	3	0	0	3

List of Open Elective Courses - I

Sr. No.	Code	Course Title	L	T	P	Credit
1.	100728	Soft Skills and Interpersonal Communication	3	0	0	3
2.	100729	Introduction to VLSI Design	3	0	0	3
3.	100734	Sales and Marketing	3	0	0	3
4.	100735	Digital Signal Processing	3	0	0	3
5.	100736	Control System	3	0	0	3

Semester-VII

Course Code- 100708 **Biology for Engineers** **3 0 0 3**

Unit- 1.0: Introduction Biology for Engineers **7 hrs**

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18 th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Unit- 2.0: Classification **7 hrs**

Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.

Unit- 3.0: Genetics and Biomolecules **7 hrs**

Genetics: Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences". Mendel's Concept of segregation and independent Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Biomolecules: Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Unit- 4.0: Enzymes and Information Transfer **7 hrs**

Enzymes: Purpose: To convey that without catalysis life would not have existed on earth. Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Information Transfer: Purpose: The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Unit- 5.0: Macromolecular Analysis and Metabolism **7 hrs**

Macromolecular Analysis: Purpose: To analyse biological processes at the reductionistic level. Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements. **Metabolism:** Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

Unit- 6.0: Microbiology **7 hrs**

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Plant Physiology covering, Transpiration; Mineral nutrition Ecology covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids.

Text/ Reference:-

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009.
3. D. L. Nelson and M. M. Cox, “Principles of Biochemistry”, W.H. Freeman and Company, 2012.
4. G. S. Stent and R. Calendar, “Molecular Genetics”, Freeman and company, 1978.
5. L. M. Prescott, J. P. Harley and C. A. Klein, “Microbiology”, McGraw Hill Higher Education, 2005.

B.Tech CSE (IoT) **Session – 2022 onwards**

Course Code- 155701 **Deep Learning** **3 0 0 3**

Unit-1.0: Introduction **6 hrs**

Definition of AI, Machine Learning, Deep Learning, Human Brain vs Artificial Neuron, Biological neuron and artificial neuron analogy; Neuron Models: McCulloch–Pitts neuron, Activation functions (Sigmoid, Tanh, ReLU, Leaky ReLU, Softmax); Perceptron, Multilayer Perceptrons, Back-Propagation Algorithm, XOR Problem, Difficulty of training deep neural networks, Discussion on deep learning frameworks.

Unit-2.0: Optimization & Hyperparameter Tuning: **8 hrs**

Gradient Descent, stochastic gradient, momentum, RMSProp, ADAM, Regularization for Deep Learning: Parameter Norm Penalties - L2 Parameter Regularization, Dataset Augmentation, Semi-Supervised Learning. Optimization for Training Deep Models.

Unit-3.0: Convolutional Neural Networks (CNN): **8 hrs**

Convolution operation, Filters, Padding, Stride, Pooling, Normalization, Modern CNN architectures: LeNet, AlexNet, VGG, GoogLeNet, ResNet, Inception, EfficientNet, Transfer Learning & Fine-tuning, Image Augmentation.

Unit-4.0: Sequence Modeling: **7 hrs**

RNN, Vanishing Gradient in RNN, LSTM & GRU networks, Bidirectional RNNs, Applications: Text generation, Sentiment analysis, Time-series forecasting.

Unit-5.0: Attention and Transformers: **7 hrs**

Attention mechanism (Self-attention, Multi-head), Positional Autoencoders, Encoder–Decoder architecture, Sparse Autoencoders, Denoising Autoencoders, Variational Autoencoders (VAE), Transformer architecture, BERT, GPT

Unit-6.0: Generative Models: **6 hrs**

basics, GANs (Generative Adversarial Networks)- Generator & Discriminator, DCGAN, CycleGAN, StyleGAN, Applications of GANs.

Text/Reference:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning,” MIT Press, 2016.
2. Christopher Bishop, “Pattern Recognition and Machine Learning,” Springer, 2006.
3. Aston Zhang, Zachary C. Lipton, Mu Li, Alex J. Smola, “Dive into Deep Learning (D2L),” 2020 (Free online book).
4. François Chollet, “Deep Learning with Python,” Manning Publications, 2018.
5. Christoph Molnar, “Interpretable Machine Learning,” 2020 (For Explainable AI).

Program Elective-IV

Course Code- 155702 **Privacy and Security in IoT** **3 0 0 3**

Unit-1.0: Security in IoT: **4 hrs**

IoT security: Vulnerabilities, Attacks and Countermeasures; Security Engineering for IoT development; IoT security lifecycle.

Unit-2.0: Network Robustness and Malware Propagation Control in IoT: **7 hrs**

Network Robustness; Fusion Based Defense Scheme; Sequential Defense Scheme; Location Certificate Based Scheme; Sybil node detection scheme; Formal Modeling and Verification; Sybil Attack Detection in Vehicular Networks; Performance evaluation of various Malware Dynamics Models; Analysis of Attack Vectors on Smart Home Systems.

Unit-3.0: Crypto Foundations: **8 hrs**

Block ciphers, message integrity, authenticated encryption, hash functions, Merkle trees, elliptic curves, public-key crypto (PKI), signature algorithms

Unit-4.0: Privacy Preservation in IoT: **7 hrs**

Privacy Preservation Data Dissemination: Network Model, Threat Model – Problem formulation and definition - Baseline data dissemination - Spatial Privacy Graph based data dissemination - Experiment Validation - Smart building concept-Privacy Threats in Smart Building - Privacy Preserving Approaches in Smart Building - Smart Meter Privacy Preserving Approaches.

Unit-5.0: Trust Models for IoT: **8 hrs**

Trust Model Concepts - Public Key Infrastructures Architecture Components - Public Key Certificate Formats - Design Considerations for Digital Certificates - Public Key Reference Infrastructure for the IoT - Authentication in IoT - Computational Security for IoT.

Unit-6.0: Security Protocols for IoT Access Networks: **8 hrs**

Time Based Secure Key Generation -Security Access Algorithm: Unidirectional, Bidirectional Transmission - Cognitive Security - IoT Security Framework - Secure IoT Layers – Secure Communication Links in IoT - Secure Resource Management, Secure IoT Databases.

Text/Reference:

1. William Stallings, “Cryptography and Network Security”, Pearson Education/PHI, 2006.
2. V.K. Jain, “Cryptography and Network Security”, Khanna Publishing House.
3. Gupta Sarika, “Information and Cyber Security”, Khanna Publishing House, Delhi.
4. Russell, Brian and Drew Van Duren. Practical Internet of Things Security, 2016,1st edition, PACKT Publishing Ltd, UK
5. Kim, S., Deka, G. C., & Zhang, P. (2019). Role of blockchain technology in IoT applications. Academic Press.
6. Whitehouse O Security of things: An Implementers’ guide to cyber security for internet of things devices and beyond, 2014, 1st edition, NCC Group, UK.
7. Hu, Fei. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, 2016, 1st edition, CRC Press, USA.

Course Code- 155703 **Application of IoT in Robotics** **3 0 0 3**

Unit-1.0: Introduction To Robotics and IoT: **6 hrs**

Introduction of Robotics: Definition, history, and application of robotics; Types of robots: mobile robots, autonomous robots, industrial robots; Introduction to IoT: Definition, components, and architecture; Evolution of IoT & enabling technologies (RFID, WSN, Cloud, Big Data).

Unit-2.0: IoT Sensors and Actuators: **8 hrs**

Types of IoT Sensors: Temperature, humidity, pressure, proximity; Actuators in IoT: DC motors, servo motors, stepper motors, solenoids; Selection criteria of sensors and actuators into robotic systems; Robotic perception enhancement using IoT sensors; Integration of cameras, LiDAR, ultrasonic sensors with IoT; Real-time control of robotic actuators using IoT data; Interfacing sensors/actuators with microcontrollers (Arduino/RPi/NodeMCU).

Unit-3.0: Design Principles for Connected Devices: **8 hrs**

IoT/M2M System Layers and Design Standardization; Communication technologies: Wi-Fi, BLE, ZigBee, LoRa, RFID; Data Enrichment, Data Consolidation and Device Management at Gateway; Web communication protocols (HTTP, MQTT, CoAP, WebSockets); Message Communication Protocols; Internet Connectivity; Internet connectivity and IP addressing in IoT devices.

Unit-4.0: IoT Platforms and Middleware: **7 hrs**

Overview of IoT platforms: AWS IoT, Azure IoT, Google Cloud IoT; Middleware for integrating IoT devices and robotics; Hands-on experience with setting up and using loT platforms for robotics applications; Introduction to edge computing and its relevance in robotics.

Unit-5.0: Data Acquisition and Processing: **7 hrs**

Data acquisition from IoT sensors and actuators in robotic systems; Data logging formats: JSON, CSV, MQTT payloads; Data processing techniques: Filtering, aggregation, normalization; Real-time data analysis in robotics applications.

Unit-6.0: IoT-Enabled Robotic Applications & Case Studies:
6 hrs

Robotic Applications: Smart robotic systems using IoT; IoT-based mobile robots; Industrial IoT (IIoT) robotics applications; Healthcare & service robots with IoT; Autonomous delivery robots.
Case studies: Drones, warehouse robots, smart agriculture robots; Mini-project discussion: IoT-controlled robot.

Text/Reference:

1. Raj Kamal, “Internet of Things: Architecture and Design Principles”, McGraw Hill, Latest Edition.
2. K. S. Fu, R. C. Gonzalez, “Robotics: Control, Sensing, Vision, and Intelligence”, McGraw-Hill.
3. Claire Rowland, “Designing Connected Products for IoT”, O’Reilly, Latest Edition.
4. Hanes, Salgueiro, Grossetete, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases”, Cisco Press, Latest Edition.

Course Code- 155704 **Programming for IoT Boards** **3 0 0 3**

Unit-1.0: IoT Ecosystem and Enabling Technologies: **6 hrs**
IoT Ecosystem, Challenges and Levels of Implementation, Enabling Technologies, Overview of Processing Elements and Peripherals

Unit-2.0: Programming for Prototyping Boards: **7 hrs**
Environment: Board, IDE, shields; Programming: syntax, variables, types, operators, constructs and functions; Sketch: skeleton, compile and upload, accessing pins; Debugging: UART communication protocol and serial library.

Unit-3.0: Interfacing with Prototyping Boards: **7 hrs**
Circuits: design, wiring, passive components; Sensors and Actuators: Interfacing, Read/Write; Software libraries; Shields - interfacing and libraries.

Unit-4.0: Single Board Computers: Programming & Interfacing: **7 hrs**
SBC Architecture & Schematic Board schematic; Setup, Configure & Use , OS implications: Linux - basics, file system and processes, Shell CLI & GUI; Programming API's - RPi. GPIO - PWM library to access pins -Tkinter GUI.

Unit-5.0: IoT Networking, Protocols & Cloud Integration: **7 hrs**
Networking & Internet Connectivity, Standard Internet Protocols – MQTT & CoAP, Networking Socket Interface - Cloud - Public APIs and SDK's for accessing cloud services; Social Network APIs - Interfacing - sensors and actuators - Pi Camera, Servo - APIs for data conversion.

Unit-6.0: Embedded Programming and RTOS: **8 hrs**
Embedded Programming: MCU, GPIO, WDT, timers/counters - I/O - A/D - D/A, PWM, Interrupts, Memory; serial communication UART - I2C – SPI, Peripheral Interfacing OS – basics – types – tasks – process - threads (POSIX Threads), thread preemption - Preemptive Task Scheduling Policies - Priority Inversion - Task communication - Task Synchronization issues - racing and deadlock - binary and counting semaphores (Mutex example) - choosing RTOS
Real World Projects: IoT Integrated Primary Health Care, Face Detection by AI, Cloud IoT Systems for Smart Agriculture, Smart Home Gadgets, Autonomous Car Features, Speed and horn intensity control.

Text/Reference:

1. Yamanoor, Sai, and Srihari Yamanoor. Python Programming with Raspberry Pi, 2017, 1st edition, Packt Publishing Ltd,. UK
2. Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black, 2015, 1st edition, McGraw Hill Education, India
3. Marco Schwartz, Home Automation with Arduino, 3rd edition, Open Home Automation 2014. Schwartz, Marco. Internet of things with arduino cookbook, 2016, 1st edition, Packt Publishing Ltd., UK
4. Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 2015, 1st edition, Packt Publishing Ltd., UK

Course Code- 155705 **Pattern Recognition** **3 0 0 3**

Unit-1.0: Introduction: **6 hrs**

Introduction fundamentals and definitions, Feature vectors, Classifiers, Supervised and Unsupervised learning, Bayesian decision theory.

Unit-2.0: Features: **8 hrs**

Types and traits, scaling ordering, measurements, normalization, invariance, feature properties, dimensionality reduction of feature space, dimensionality reduction by feature selection, PCA, KPCA, ICA.

Unit-3.0: Parameter estimation: **7 hrs**

Maximum likelihood estimation (MLE), least squares estimation (LSE), Method of minimum variance & unbiased Estimation (MVUE); parameter free methods: KNN, Clustering; Special classifiers: linear regression, LDA, SVM, CNN.

Unit-4.0: Classifiers and learning: **7 hrs**

Fundamentals of classifiers, Linear Classifiers, Nonlinear Classifiers. Unsupervised and semi supervised learning: Learning from unclassified data, Characteristics analysis of different classifiers

Unit-5.0: Clustering: **7 hrs**

Basic Concepts of clustering, Hierarchical agglomerative clustering, K-means partitional clustering, semi supervised learning with expectation maximization using labelled and unlabelled data;

Unit-6.0: Classification and Ensemble Learning Techniques: **7 hrs**

Classification with nominal features : decision tree, random forest; classifier independent concepts, Combinations of classifiers: boosting, voting , stacking

Text/Reference:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2nd printing edition, 2011.
2. Richard O. Duda, Peter E. Hart, David G. Stork, Pattern Classification, John Wiley, 2nd edition, 2002.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, The MIT Press; Illustrated edition, 2012.
4. S. Theodoridis, K. Koutroumbas, “Pattern Recognition”, Academic Press, 4th edition, 2008

Course Code- 155706 **Sensors and Actuator Devices for IoT** **3 0 0 3**

Unit-1.0: Introduction to Sensors: **8 hrs**

Principles of sensing, classification and characteristics, Static and dynamic parameters, Environmental Parameters (EP), Sensor Characterization; Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges; Inductive Sensors: Sensitivity and Linearity of the Sensor, Types; Capacitive Sensors: Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators, Ultrasonic Sensors.

Unit-2.0: Thermal and Magnetic Sensors: **9 hrs**

Thermal Sensors: Gas Thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index Thermosensors, Helium Low Temperature Thermometer, Nuclear and Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Junction Semiconductor Types; **Magnetic Sensors:** Working Principles, Types and Characteristics, Force & displacement Sensors.

Unit-3.0: Radiation Sensors: **6 hrs**

Radiation Sensors: Introduction, Basic Characteristics, Types of Photoresistors /Photodetectors, X-ray and Nuclear Radiation Sensors, Fiber Optic Sensors.

Unit-4.0: Smart Sensors & Interfacing: **7 hrs**

Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters (ADC/DAC), Compensation, Information Coding and Processing, Data Communication, Standards for Smart Sensor Interface, Sensor Nodes & Automation Interfaces.

Unit-5.0: Sensors Applications: **6 hrs**

On-board Automobile Sensors, Home Appliance Sensors, Medical Diagnostic Sensors, Sensors for Manufacturing, Environmental Monitoring Sensors.

Unit-6.0: Actuators: **6 hrs**

Pneumatic and Hydraulic Actuation Systems, Valves and Rotary actuators, Mechanical Actuation Systems, Electrical Actuation Systems (Solenoids, Motors, Relays).

Text/Reference:

1. D. Patranabis-Sensors and Transducers, PHI Learning Private Limited.
2. W. Bolton-Mechatronics, Pearson Education Limited. Reference Books.
3. Patranabis-Sensors and Actuators- 2nd Ed., PHI, 2013.
4. Robert H. Bishop-The Mechatronics Handbook, 2nd Ed., Mechatronic Systems, Sensors and Actuators, fundamentals and modelling e- Resources & other digital material.

Open Elective-I

Course Code: 100728 Soft Skill and Interpersonal Communication 3 0 0 3

Unit-1.0 Self-Discovery and Analysis 7 hrs

Self-Analysis: SWOT Analysis, Who am I, Attributes, Importance of Self-Confidence, Self-Esteem.

Unit- 2.0 Creative and Innovative Thinking 3 hrs

Creativity: Out of Box Thinking, Lateral Thinking.

Unit- 3.0 Attitude and Motivation 8 hrs

Attitude: Factors Influencing Attitude, Challenges and Lessons from Attitude, Etiquette; Motivation: Factors of Motivation, Self-Talk, Intrinsic & Extrinsic Motivators.

Unit- 4.0 Strategic Goal Setting 7 hrs

Goal Setting: Wish List, SMART Goals, Blue Print for Success, Short Term, Long Term, Life Time Goals.

Unit- 5.0 Effective Time Management 8 hrs

Time Management: Value of Time, Diagnosing Time Management, Weekly Planner, To Do List, Prioritizing Work.

Unit- 6.0 Interpersonal Skills and Teamwork 9 hrs

Interpersonal Skills: Gratitude - Understanding the relationship between Leadership Networking & Team work. Assessing Interpersonal Skills Situation description of Interpersonal Skill. Team Work - Necessity of Team Work Personally, Socially and Educationally.

Text/References:

1. Soft Skills, 2015, Career Development Centre, Green Pearl Publications.
2. Covey Sean, Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.
3. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.

Course Code- 100729 **Introduction to VLSI Design** **3 0 0 3**

Unit-1.0: **9 hrs**

Introduction MOSFET, threshold voltage, current, Channel length modulation, body bias effect and short channel effects, MOS switch, MOSFET capacitances, MOSFET models for calculation- Transistors and Layout, CMOS layout elements, parasitics, wires and vias-design rules-layout design SPICE simulation of MOSFET I-V characteristics and parameter extraction.

Unit-2.0: **9 hrs**

CMOS inverter, static characteristics, noise margin, effect of process variation, supply scaling, dynamic characteristics, inverter design for a given VTC and speed, effect of input rise time and fall time, static and dynamic power dissipation, energy & power delay product, sizing chain of inverters, latch up effect-Simulation of static and dynamic characteristics, layout, post layout simulation.

Unit-3.0: **8 hrs**

Static CMOS design, Complementary CMOS, static properties, propagation delay, Elmore delay model, power consumption, low power design techniques, logical effort for transistor sizing, ratioed logic.

Unit-4.0: **7 hrs**

Pseudo NMOS inverter, DCVSL, PTL, DPTL & Transmission gate logic, dynamic CMOS design, speed and power considerations, Domino logic and its derivatives, C2MOS, TSPC registers, NORA CMOS – Course project.

Unit-5.0: **5 hrs**

Circuit design considerations of Arithmetic circuits, shifter, CMOS memory design - SRAM and DRAM.

Unit-6.0: **4 hrs**

BiCMOS logic - static and dynamic behaviour -Delay and power consumption in BiCMOS Logic.

Text/ Reference:

1. Principles of CMOS VLSI design: a system perspective by Neil H.E. Weste and Kamran Eshraghian; Addision Wesley pub.
2. Digital integrated circuits by Demassa & Ciccone. Wiley pub.
3. Modern VLSI Design system on silicon by Wayne Wolf: Addision Wesley Longman Publisher.
4. Basic VLSI Design by Douglas A Pucknell & Kamran Eshranghian; PHI.
5. Digital Integrated Circuits: A Design Perspective by Jan M Rabaey; PHI

Course Code- 100734 Sales and Marketing 3 0 0 3

Unit-1.0: Introduction to Sales and Marketing: 6 hrs

Marketing: Definition, importance, and evolution of marketing concepts.; **Sales:** Definition, role of sales in a business, and the relationship between sales and marketing; **Marketing Mix (4Ps):** Product, Price, Place (Distribution), and Promotion; **Consumer Behavior:** Understanding consumer motivations, buying decisions, and factors influencing purchasing.

Unit-2.0: Market Analysis and Strategy: 8 hrs

Market Segmentation, Targeting, and Positioning (STP): Identifying target markets, developing positioning strategies; **Market Research:** Understanding the purpose of market research, types of research methods, and data analysis; **Competitive Analysis:** Identifying competitors, analyzing their strengths and weaknesses, and developing competitive strategies; **Strategic Marketing Planning:** Developing marketing plans, setting objectives, and measuring performance.

Unit-3.0: Sales Management and Techniques: 7 hrs

Sales Processes and Strategies: Understanding different sales strategies, lead generation, and sales techniques; **Sales Force Management:** Recruiting, training, motivating, and managing sales personnel; **Customer Relationship Management (CRM):** Understanding the importance of CRM, managing customer interactions, and building strong relationships; **Sales Communication and Negotiation:** Developing effective communication skills, negotiation techniques, and closing sales.

Unit-4.0: Marketing Communication and Promotion: 8 hrs

Advertising: Understanding different advertising media, campaign planning, and media buying;
Sales Promotion: Understanding different types of sales promotions, couponing, and loyalty programs; **Public Relations (PR):** Building positive relationships with the public, media relations, and crisis communication; **Digital Marketing:** Understanding online marketing channels, social media marketing, SEO, and email marketing.

Unit-5.0: Product, Branding, and Pricing Strategies: 7 hrs

Product and Brand Management: Developing and managing product lines, branding strategies, and brand equity; **Pricing Strategies:** Understanding different pricing methods, pricing objectives, and pricing policies.

Unit-6.0: Distribution Channels and Ethics in Sales & Marketing: 6 hrs

Distribution Channels: Understanding different distribution channels, logistics, and supply chain management; **Ethics in Sales and Marketing:** Understanding ethical issues in sales and marketing, and responsible marketing practices.

Text/Reference:

1. K.S. Chandrasekar, Marketing Management Text And Cases, Tata Mcgraw-Hill Publication, New Delhi.2010
2. Govindarajan, Marketing Management Concepts, Cases, Chhallenges And Trends, Prentice Hall Of India, New Delhi. 2009
3. Philip Kotler, Marketing Management- Analysis Planning And Control, Prentice Hall Of India, New Delhi,

4. Ramaswamy. V S & Namakumari. S, Marketing Management-Planning Implementation And Control, Macmillan Business Books, New Delihi, 2002,
5. Balaram Dogra & Karminder Ghuman, Rural Marketing: Concept & Cases, Tata Mcgraw-Hill Publishing Company, New Delhi, 2008
6. Ravi Shanker, Services Marketing: The Indian Perspective, Excel Books, New Delhi, 2008

Course Code- 100735 Digital Signal Processing 3 0 0 3

Unit-1.0: 6 hrs

Discrete-time signals and systems: Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Unit-2.0: 6 hrs

Z-transform: Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

Unit-3.0: 9 hrs

Discrete Fourier Transform: Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Connvolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Unit-4.0: 9 hrs

Design of Digital filters: Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and Highpass filters.

Unit-5.0: 6 hrs

Effect of finite register length in FIR filter design, Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Unit-6.0: 6 hrs

Applications of Digital Signal Processing: Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Text/ Reference:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

Course Code- 100736 **Control System** **3 0 0 3**

Unit-1.0: Discrete Representation of Continuous Systems: **6 hrs**

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

Unit-2.0: Discrete System Analysis: **6 hrs**

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Unit-3.0: Stability of Discrete Time System: **4 hrs**

Stability analysis using Jury test, Stability analysis using bilinear transformation, Design of digital control system with dead beat response, Practical issues with dead beat response design.

Unit-4.0: State Space Approach for discrete time systems: **10 hrs**

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Re-constructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Unit-5.0: Design of Digital Control System: **8 hrs**

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Unit-6.0: Discrete output feedback control: **8 hrs**

Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Text/Reference:

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.

B.Tech CSE (IoT) **Session – 2022 onwards**

Course Code- 155701P **Deep Learning Lab** **0 0 2 1**

Perform all Experiments

List of Experiments:

1. Write a program to implement a single-layer perceptron for binary classification.
2. Build an MLP classifier using a custom forward pass and backpropagation.
3. Implement Backword propagation neural network.
4. Implement Gradient Descent, SGD, and Momentum on a simple function and plot convergence.
5. Write a program to perform manual convolution on an image using a custom filter (edge detection / blur).
6. Build a CNN on MNIST / CIFAR-10 using PyTorch or TensorFlow.
7. Train, test, and report accuracy.
8. Use a pretrained model (VGG16 / ResNet50) and fine-tune it on a small dataset.
9. RNN / LSTM for Text Generation, sentiment analysis.
10. Implement LSTM-based text generation on a small text corpus (e.g., nursery rhymes).
11. Build a Denoising Autoencoder to remove noise from images (MNIST/CIFAR-10).