B. TECH (COMPUTER SCIENCE & ENGINEERING (IoT)

sr.no.	Code	Course Title	L	T	P	Credit
1.	155601	Machine Learning	3	1	0	4
2.	155602	Computer Networks	3	0	0	3
3.	155603	Ad hoc & Sensor Networks	3	0	0	3
4.	155604	AI and Ethics	1	0	0	1
5.	155605	Constitution of India	3	0	0	0
6.	1556XX	Program Elective Course-II	3	0	0	3
7.	1556XX	Program Elective Course-III	3	0	0	3
8.	155601P	Machine Learning Lab	0	0	4	2
9.	155603P	Ad hoc & Sensor Networks Lab	0	0	4	2
10.	155605P	NPTEL Course	0	0	4	2
			TOTAL			23

List of Program Elective Courses - II

sr.no.	Code	Course Title	L	T	P	Credit
1.	155607	Mobile and Wireless Computing for IoT	3	0	0	3
2.	155608	Natural Language Processing	3	0	0	3
3.	155609	Introduction to Industry 4.0	3	0	0	3
4.	155610	Data Science	3	0	0	3
5.	155611	Blockchain Technology	3	0	0	3

List of Program Elective Courses - III

Sr. No.	Code	Course Title	L	T	P	Credit
1.	155612	Python Programming	3	0	0	3
2.	155613	Graph Theory	3	0	0	3
3.	155614	Augmented Reality and Virtual Reality	3	0	0	3
4.	155615	Computer Vision and Robotics	3	0	0	3
5.	155616	Microprocessors and Microcontrollers	3	0	0	3

Course Code- 155601 Machine Learning **3 1 0 4**

Unit-1.0 **8 hrs**

Introduction: Basic definitions, Linear Algebra, Statistical learning theory, types of learning, hypothesis space and Inductive bias, evaluation and cross validation, Optimization.

Unit-2.0 **8 hrs**

Statistical Decision Theory, Bayesian Learning (ML, MAP, Bayes estimates, Conjugate priors), Linear Regression, Ridge Regression, Lasso, Principal Component Analysis, Partial Least Squares

Unit-3.0 **9 hrs**

Linear Classification, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Perceptron, Support Vector Machines + Kernels, Artificial Neural Networks + Back Propagation, Decision Trees, Bayes Optimal Classifier, Naive Bayes.

Unit-4.0 **5 hrs**

Hypothesis testing, Ensemble Methods, Bagging Adaboost Gradient Boosting.

Unit-5.0 **5 hrs**

Clustering, K-means, K-medoids, Density-based Hierarchical, Spectral.

Unit-6.0 **7 hrs**

Expectation Maximization, GMMs, Learning theory Intro to Reinforcement Learning, Bayesian Networks.

Text/Reference:

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin.
3. J. Shavlik and T. Dietterich (Ed), Readings in Machine Learning, Morgan Kaufmann, 1990.
4. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017. [SS-2017]
6. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009. [TH-2009]

Course Code- 155602 Computer Networks 3 0 0 3

Unit-1.0: Data communication Components 6 hrs

Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN.

Unit-2.0: Techniques for Bandwidth utilization 6 hrs

Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit-3.0: Data Link Layer and Medium Access Sub Layer 8 hrs

Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Unit-4.0: Network Layer 7 hrs

Switching, Logical addressing – IPV4, IPV6; Address mapping - ARP, RARP, BOOTP and DHCP– Delivery, Forwarding and Unicast Routing protocols.

Unit-5.0: Transport Layer 8 hrs

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit-6.0: Application Layer 7 hrs

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Text/Reference:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
4. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course Code- 155603 Ad hoc & Network Sensors 3 0 0 3

Unit-1.0: Introduction to Ad Hoc and Sensor Networks 7 hrs
Characteristics of ad hoc wireless networks, Applications of ad hoc networks, Challenges in ad hoc networks, Wireless sensor networks (WSN) – Characteristics and applications, Design issues in WSN, Sensor network architecture – Layered architecture, Cross-layer design.

Unit-2.0: MAC Protocols for Ad Hoc and Sensor Networks 7 hrs
Fundamentals of MAC design, Issues in designing MAC protocols, MAC protocols for ad hoc networks – Contention-based protocols (Aloha, CSMA, MACA, MACAW), Scheduling-based MAC protocols, MAC protocols for WSN – S-MAC, T-MAC, B-MAC, X-MAC, Energy-efficient MAC protocols.

Unit-3.0: Routing Protocols in Ad Hoc and Sensor Networks 7 hrs
Challenges in routing, Proactive vs. Reactive routing, Ad hoc routing protocols – AODV, DSR, DSDV, OLSR, Hybrid routing (ZRP), Hierarchical routing, Geographic routing, Routing protocols for WSN – Flooding, SPIN, LEACH, TEEN, Directed diffusion, Geographic and Energy-Aware Routing (GEAR).

Unit-4.0: Transport and Energy Management in Wireless Sensor Networks 7 hrs
Issues in transport protocols, TCP over ad hoc networks, Transport protocols for WSN – CODA, RMST, PSFQ, ESRT, Energy-efficient routing in WSN, Data aggregation, Clustering techniques for WSN, Energy harvesting in sensor networks, Sleep-wake scheduling algorithms.

Unit-5.0: Localization, Synchronization, and Data Dissemination in WSN 7 hrs
Localization techniques – GPS-based localization, Range-based localization (RSSI, TOA, TDOA, AOA), Range-free localization (Centroid, DV-Hop, APIT), Time synchronization in WSN – RBS, TPSN, Data dissemination and query processing in WSN, Mobile sink-based data collection.

Unit-6.0: Security and Emerging Trends in Ad Hoc and Sensor Networks 7 hrs
Security issues in ad hoc and sensor networks, Attack models – Eavesdropping, Sybil attack, Blackhole, Wormhole, Intrusion detection in WSN, Secure routing in ad hoc networks, Privacy-preserving techniques, Emerging trends – Mobile ad hoc networks (MANETs), Vehicular ad hoc networks (VANETs), Cognitive radio sensor networks (CRSN), AI/ML applications in WSN.

Text/Reference:

1. C. Siva Ram Murthy, B.S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Pearson, 2004.
2. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, Elsevier, 2004.
3. Holger Karl, Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley, 2005.
4. C. K. Toh, Ad Hoc Mobile Wireless Networks: Protocols and Systems, Pearson, 2002.
5. Edgar H. Callaway, Wireless Sensor Networks: Architectures and Protocols, CRC Press, 2003.
6. Thomas Haenselmann, Wireless Sensor Networks: Design Principles for Scalable Distributed Systems, Springer, 2007.
7. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley, 2007.

Course Code- 155604 AI and Ethics **1 0 0 1**

Unit-1.0: **2 hrs**

Introduction: Definition of morality and ethics in AI, AI, and society.

Unit-2.0: **2 hrs**

Impact of AI: Impact on society, Impact on human psychology, Impact on the legal system, Impact on the environment and the planet, and Impact on trust.

Unit-3.0: **2 hrs**

Ethical Initiatives in AI: International ethical initiatives, Ethical harms, and concerns, Case study: healthcare robots, Autonomous Vehicles, Warfare, and weaponization.

Unit-4.0: **4 hrs**

AI Standards And Regulation: Model Process for Addressing Ethical Concerns During System Design, Transparency of Autonomous Systems, Data Privacy Process, Algorithmic Bias Considerations, Ontological Standard for Ethically Driven Robotics and Automation Systems.

Unit-5.0:

Rob ethics: Social and Ethical Implication of Robotics: **2 hrs**

Robotics- Ethics and Morality, Moral Theories-Ethics in Science and Technology, Ethical Issues in an ICT Society, Harmonization of Principles, Ethics and Professional Responsibility, Robotics Taxonomy.

Unit-6.0: **2 hrs**

Challenges and Opportunities: Ethical issues in artificial intelligence, Societal Issues Concerning the Application of Artificial Intelligence in Medicine, decision-making role in industries, and National and International Strategies on AI.

Text/Reference:

1. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield," The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452– March 2020.
2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.
3. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017.
4. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020.

Course Code- 155605 Constitution of India 3 0 0 0

Unit-1.0: **7 hrs**

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India.

Unit-2.0: **7 hrs**

Scheme of the fundamental rights, The scheme of the Fundamental Duties and its legal status, The Directive Principles of State Policy – Its importance and implementation.

Unit-3.0: 7 **hrs**

Federal structure and distribution of legislative and financial powers between the Union and the States, Parliamentary Form of Government in India – The constitution powers and status of the President of India.

Unit-4.0: **7 hrs**

Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India.

Unit-5.0: **7 hrs**

Emergency Provisions: National Emergency, President Rule, Financial Emergency, Local Self Government – Constitutional Scheme in India.

Unit-6.0: **7 hrs**

Scheme of the Fundamental Right to Equality, Scheme of the Fundamental Right to certain Freedom under Article 19, Scope of the Right to Life and Personal Liberty under Article 21.

Text/Reference:

1. "Constitution of India" (for Competitive Exams) - Published by Naidhruva Edutech Learning Solutions, Bengaluru. – 2022.
2. "Introduction to the Constitution of India", (Students Edition.) by Durga Das Basu (DD Basu): Prentice –Hall, 2008.
3. "Constitution of India, Professional Ethics and Human Rights" by Shubham Singles, Charles E. Haries, and et al: published by Cengage Learning India, Latest Edition – 2019.
4. "The Constitution of India" by Merunandan K B: published by Merugu Publication, Second Edition, Bengaluru.
5. "Samvidhana Odu" - for Students & Youths by Justice HN Nagamohan Dhas, Sahayana, kerekon.
6. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice –Hall, 2004.

Program Elective-II

Course Code- 155607 Mobile and Wireless Computing for IoT 3 0 0 3

Unit- 1.0: **7 hrs**

Introduction to Wireless Networks:

Fundamentals of Wireless Communication: Applications, History, Transmission, Frequencies, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Cellular Systems.

Unit- 2.0: **7 hrs**

Medium Access Control & Telecommunication Systems:

MAC Protocols: SDMA, FDMA, TDMA, CDMA; Telecommunication Systems: GSM, DECT, TETRA, UMTS, IMT-2000, Introduction to LTE (4G).

Unit- 3.0: **7 hrs**

Wireless LANs and PANs:

Wireless LAN and PAN: IEEE 802.11 standards, Infrared vs. Radio, Infrastructure vs. Ad hoc Networks, HIPERLAN, Bluetooth, ZigBee, IoT Wireless Standards, Overview of 5G.

Unit- 4.0: **7 hrs**

Mobile Network Layer:

Mobile Network Layer: Mobile IP, DHCP, Routing in Adhoc Networks (DSDV, DSR, AODV), Mobile TCP variants, Fast Retransmit, Time-out Freezing, Selective Retransmission.

Unit- 5.0: **7 hrs**

Mobility Management and Applications:

Mobility Management and Applications: Handoffs, File Systems, Wireless Application Protocol (WAP), Mobile OS (Android/iOS), Case Studies – Mobile Banking, M-commerce, Location-Based Services.

Unit- 6.0: **7 hrs**

Emerging Trends in Wireless & Mobile Computing:

Emerging Trends: 5G and Beyond, Network Slicing, Massive MIMO, IoT and Wireless Sensor Networks (WSN), LoRa, NB-IoT, Sigfox, Edge Computing, 6G Concepts.

Text/Reference:

1. Mobile Communications Jochen Schiller Pearson / Addison-Wesley, 2nd Ed., 2003. ISBN: 978-0321123817.
2. Wireless Communications & Networks, William Stallings, Pearson, 2nd Ed., 2014 (Int'l Adaptation). Print ISBN: 978-1292027388.
3. Mobile Computing: Technology, Applications, and Service Creation, Asoke K. Talukder, Hasan Ahmed, Roopa Yavagal, McGraw-Hill Education India, Reprint 2011 (orig. 2006). Print ISBN: 978-0070144576.

Course Code- 155608 Natural Language Processing 3 0 0 3

Unit-1.0: **7 hrs**

Sound: Biology of Speech Processing; Place and Manner of Articulation; Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.

Unit-2.0: **7 hrs**

Words and Word Forms: Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

Unit-3.0: **7 hrs**

Structures: Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents.

Unit-4.0: **7 hrs**

Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution.

Unit-5.0: **7 hrs**

Meaning: Lexical Knowledge Networks, Wordnet Theory; Indian Language Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors; Coreferences.

Unit-6.0: **7 hrs**

Web 2.0 Applications: Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).

Text/Reference:

1. Jurafsky, Dan and Martin, James, "Speech and Language Processing", 2nd Edition, Prentice Hall, 2008
2. Manning, Christopher and Heinrich, Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
3. Allen James, "Natural Language Understanding", 2nd edition, Benjamin Cumming, 1995.
4. Charniack, Eugene, "Statistical Language Learning", MIT Press, 1993.

Course Code- 155609 Introduction to Industry 4.0 3 0 0 3

Unit- 1.0: 7 hrs

Introduction to Industry 4.0: Sensing & Actuation, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected business perspective.

Unit- 2.0: 7 hrs

Cyber Physical Systems & Emerging Technologies: Cyber Physical Systems, Next Generation Sensors, Collaborative Platform, Product Lifecycle Management, Artificial Intelligence, Big Data, Blockchain and its role in secure transactions.

Unit- 3.0: 7 hrs

Cloud Computing for Industry 4.0: Introduction to Cloud Technologies, Top Cloud Services Providers platforms and their real-life use cases exploration (AWS, Azure, GCP).

Unit- 4.0: 7 hrs

The Role of Augmented Reality in the Age of Industry 4.0: Introduction to AR/VR, AR Hardware & Software, Industrial Applications of AR

Unit- 5.0: 7 hrs

Industrial Internet of Things (IIoT) & Security: Introduction to IIoT, Industrial Internet System, Industrial Process, Key Enablers of IIoT, Blockchain for IoT Security and Data Integrity, Cybersecurity Challenges in Industry 4.0.

Unit- 6.0: 7 hrs

Case Studies: Real time use cases from different Industries like Oil, chemical, manufacturing, and pharmaceutical industry, and Applications of UAVs in Industries.

Text/Reference:

1. The Concept Industry 4.0, An Empirical Analysis of Technologies and Applications in Production Logistics, Christoph Jan Bartodziej, Springer Fachmedien Wiesbaden, November 2016, ISBN: 9783658165024.
2. Industry 4.0, Entrepreneurship and Structural Change in the New Digital Landscape, Tessaleno Devezas, João Leitão, Askar Sarygulov, Springer, 1st Edition, 2017, ISBN: 9783319496047.
3. Blockchain for Industry 4.0: Secure IoT Solutions, Seung Ho Hong, Springer, ISBN: 9789811552721.

Course Code- 155610 Data Science 3 0 0 3

Unit- 1.0: 4 hrs

Introduction to Data Science: Concept of Data Science, Traits of Big data, Web Scraping, Analysis vs Reporting.

Unit- 2.0: 7 hrs

Programming Tools for Data Science: Python Toolkits: Matplotlib, NumPy, Scikit-learn, NLTK, Data Visualization: Bar Charts, Line Charts, Scatterplots; Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction.

Unit- 3.0: 9 hrs

Mathematical Foundations: Linear Algebra: Vectors, Matrices; Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation; Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem; Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, Phacking, Bayesian Inference.

Unit- 4.0: 10 hrs

Basic concept of Machine Learning: Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks Learning And Generalization, Overview of Deep Learning.

Unit- 5.0: 5 hrs

Case Studies & Applications: Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.

Unit- 6.0: 7 hrs

Practical Implementation & Mini Project: Hands-on Python programs: Flower classification, Loan approval prediction, Traffic prediction, Hate speech detection, Actor age prediction, Mini project for time prediction.

Text/Reference:

1. Data Science From Scratch: First Principles with Python, Joel Grus, O'Reilly, First Edition, 2015, ISBN: 9789352130962.
2. Machine Learning, Tom M. Mitchell McGraw Hill Education, First Edition, 2017, ISBN: 978-1259096952.
3. Hands-On Machine Learning with Scikit-Learn, Keras & Tensor Flow, Aurélien Géron, O'Reilly, 3rd Edition, 2022, ISBN: 978-9355421982.
4. Python for Data Analysis, Wes McKinney, O'Reilly Media, 2nd Edition, 2017, ISBN: 978-1491957660.
5. Practical Statistics for Data ScientistsPeter Bruce, O′Reilly; 2nd edition, 2020, ISBN: 978-1492072942.

Course Code- 155611 Block Chain Technology 3 0 0 3

Unit-1.0: 8 hrs

Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Block chain Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

Unit-2.0: 8 hrs

Understanding Block chain with Crypto currency: Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

Unit-3.0: 6 hrs

Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Unit-4.0: 6 hrs

Understanding Block chain for Enterprises: Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

Unit-5.0: 8 hrs

Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain.

Unit-6.0: 6 hrs

Block chain application development: Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

Text/Reference:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015.
2. Josh Thompsons, “Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming”.
3. Daniel Drescher, “Block Chain Basics”, Apress; 1st edition, 2017.
4. Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.
5. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing.
6. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing.
7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O’Dowd, Venkatraman Ramakrishna, “Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer”, Import, 2018

Program Elective-III

Course Code- 155612 Python Programming **3 0 0 3**

Unit-1.0: Input and Output **7 hrs.**

Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language.

Unit-2.0: Control Flow statements, Function, Loops and Strings **9 hrs.**

Control Flow Statements, The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elseif…else Decision Control Statement, Nested if Statement, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, The while Loop, The for Loop, The continue and break Statements. Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Unit-3.0: Lists **4 hrs.**

Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement.

Unit-4.0: Dictionaries, Tuples and Sets **8 hrs.**

Creating Dictionary, Accessing and Modifying key value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, Tuples and Sets, Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozen set.

Unit-5.0: Files **7 hrs.**

Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Unit-6.0: Object Oriented Design and Python Modules **7 hrs.**

Programming types, Object Oriented Programming, Object Oriented Design, Inheritance and Polymorphism. Introduction to modules, statistics module, numpy, introduction to popular machine learning libraries Tensor Flow & Keras.

Text/Reference:

1. Introduction to Python Programming, Gowrishankar S, Veena A ,1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372
2. Python Data Science Handbook: Essential Tools for Working with Data, Jake VanderPlas, 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058
3. Core Python Applications Programming, Wesley J Chun, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
4. Python Programming A Modular Approach, SheetalTaneja, Pearson Publications
5. Programming and Problem Solving with Python, Ashok NamdevKamathane and Amit Ashok Kamathane Tata McGraw Hill Education (India) Private Limited

6. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.
7. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.
8. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.

Course Code-155613 Graph Theory 3 0 0 3

Unit-1.0: 8 hrs

Introduction: What is graph, Application of graphs, Finite and infinite graphs, incidence and degree, isolated Vertex pendant Vertex, and Null graph, paths and circuits, isomorphism, sub graphs, a puzzle with multicolored cubes, walks, paths, and circuits, Connected graphs, disconnected graphs and components, Euler graphs, Operations on graphs, More on Euler graphs, Hamiltonian paths and circuits, The Traveling Salesman problem.

Unit-2.0: 7 hrs

Trees and Fundamental circuits: Trees, some properties of trees, pendant vertices in a tree, Distance and centers in a tree, Rooted and binary trees, On counting trees, Spanning trees, fundamental circuits, Finding all spanning trees of a Graph, Spanning trees in a Weighted graph.

Unit-3.0: 9 hrs

Cut set, and cut vertices: Properties of a cut set, all cut sets in a graph, Fundamental circuits and cut sets, connectivity and separability, Network flows, 1-Isomorphism, 2-Isomorphism.

Planar and Dual Graphs: Combinatorial vs. Geometric Graphs, Planar graph, kuratowski's Two Graphs, Difference Representations of a planar graph, Detection of planarity, Geometric Dual, Combinatorial, Duel, More on criteria of planarity, Thickness and crossings.

Unit-4.0: 6 hrs

Matrix Representation of Graphs: Incidence Matrix Sub matrices of A(G), Circuits Matrix, Fundamental Circuit Matrix and Rank of B, An application to a switching Network, Cut-set Matrix, Relationships among Af , Bf and Cf . path Matrix, Adjacency Matrix.

Unit-5.0: 5 hrs

Coloring, Covering and partitioning: Chromatic number, Chromatic partitioning, Chromatics polynomial, Coverings, Four color problem.

Unit-6.0: 7 hrs

Directed Graphs: What's a directed Graphs, Some types of Digraphs, Digraphs and binary Relations, Directed paths and connectedness, Euler Digraphs, Trees with Directed Edges, Fundamental Circuits in Digraphs, Matrices A, B and C of Digraphs, Adjacency Matrix of a Digraph, Paired Comparisons and Tournaments, Acyclic Digraphs and Decyelization.

Text/Reference:

1. Douglas B. West, "Introduction to Graph Theory", Prentice Hall of India.
2. Deo, N: Graph theory, PHI.
3. Bondy and Murthy: Graph theory and application. Addison Wesley.
4. R. Diestel, "Graph Theory", Springer-Verlag, 2nd edition, 2000.
5. John M. Aldous and Robin J. Wilson: Graphs and Applications-An Introductory Approach, Springer.
6. Robin J, Wilson: Introduction to Graph Theory, Addison Wesley.
7. Frank Harary, "Graph Theory", Narosa.
8. R. Ahuja, T. Magnanti, and J. Orlin, "Network Flows: Theory, Algorithms, and Applications", Prentice-Hall.

Course Code-155614 Augmented Reality & Virtual Reality 3 0 0 3

Unit-1.0: 8 hrs

Introduction to Augmented Reality:

What Is Augmented Reality: Defining Augmented Reality, History of Augmented Reality; The Relationship Between AR and Other Technologies: Media, Technologies, Spectrum Between Real and Virtual Worlds; Applications of Augmented Reality.

Unit- 2.0: 7 hrs

Augmented Reality Concepts & Working:

How Does Augmented Reality Work? Concepts Related to AR, Ingredients of an Augmented Reality Experience; AR Components – Scene Generator, Tracking System, Monitoring System, Display, Game Scene.

Unit- 3.0: 6 hrs

AR Devices & Interfaces:

AR Devices: Optical See-Through HMD, Virtual Retinal Systems, Monitor-Based Systems, Projection Displays, Video See-Through Systems.

Unit- 4.0: 8 hrs

Introduction to Virtual Reality:

Defining Virtual Reality, History of VR; Human Physiology and Perception; Key Elements of Virtual Reality Experience; Virtual Reality Systems. Interface to the Virtual World: Input & Output – Visual, Aural & Haptic Displays; Applications of Virtual Reality.

Unit- 5.0: 7 hrs

Representing the Virtual World:

Representation of the Virtual World; Visual Representation in VR; Aural Representation in VR; Haptic Representation in VR.

Case Study: GHOST (General Haptics Open Software Toolkit) software development toolkit.

Unit- 6.0: 6 hrs

Visual Perception & Rendering:

Visual Perception: Perception of Depth, Motion, and Color; Combining Sources of Information; Visual Rendering: Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates.

Text/Reference:

1. Augmented Reality: Principles and Practice Dieter Schmalstieg, Tobias Höllerer Addison, Wesley Professional, 1st ed., 2016. Print ISBN: 9780321883575.
2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Steve Aukstakalnis, Addison-Wesley Professional PTG, 1st ed., 2017. Print ISBN: 9780134094236
3. Virtual RealitySteven M. LaValle, Cambridge University Press, 1st ed., 2023 (print). Print ISBN: 9781107198937.

Course Code- 155615 Computer Vision and Robotics 3 0 0 3

Unit- 1.0: 8 hrs

Introduction to Computer Vision:

What is Computer Vision? Applications in IoT (e.g., smart cameras, face recognition); Basics of Image Formation: Pinhole camera concept, digital images, pixels, and resolution; Light and Color: Color models (RGB, Grayscale), simple shading concepts; Image Representation: How images are stored and displayed.

Unit- 2.0: 7 hrs

Image Processing Fundamentals:

Basic Image Operations: Brightness, contrast adjustment, negative images, histogram; Filters and Convolution: Smoothing (blur) and sharpening filters with real examples; Edge Detection: Introduction to edges, Canny, and Sobel operators; Introduction to Noise and Noise Removal.

Unit- 3.0: 7 hrs

Features and Segmentation:

Detecting Features: Corners and simple shape detection; Image Segmentation: Splitting an image into regions or objects (e.g., background vs. foreground); Thresholding and Contour Detection; Applications: Object detection basics (e.g., QR code detection).

Unit- 4.0: 7 hrs

Introduction to Robotics:

What is a Robot? Types of robots (industrial, service, mobile, and autonomous); Components of Robots: Sensors, actuators, controllers, and power systems; Basics of Robot Movements: Wheels, motors, and simple path following; IoT and Robotics: Smart home robots and warehouse robots.

Unit- 5.0: 7 hrs

Robot Sensors and Planning:

Sensors in Robotics: Distance sensors, cameras, IR sensors, ultrasonic sensors; Sensor Fusion: How robots combine data from multiple sensors; Basics of Path Planning: Grid-based pathfinding and obstacle avoidance (intro to potential fields); Applications: Line-following robot, delivery robots.

Unit- 6.0: 6 hrs

Emerging Trends and Hands-on Applications:

Introduction to OpenCV: Simple programs (e.g., converting to grayscale, edge detection); Introduction to Arduino/Raspberry Pi for Robotics; Emerging Applications: Self-driving cars, drones, smart surveillance.

Mini Project Discussion: Face detection app or simple line-following robot.

Text/Reference:

1. Learning OpenCV 4: Computer Vision with Python Adrian Kaehler, Gary Bradski, O'Reilly, 2019, ISBN: 978-1491937990
2. Robotics: Modelling, Planning and Control Bruno Siciliano, Lorenzo Sciavicco, Springer, 2nd Edition, ISBN: 978-1849966344
3. Introduction to Autonomous Robots, Nikolaus Correll, Bradley Hayes, Amazon KDP, 2022, ISBN: 979-8714113980.

Course Code-155616 Microprocessors and Microcontrollers 3 0 0 3

Unit- 1.0 **7 hrs**

Fundamentals of 8085 Architecture and Programming:

Introduction to Microprocessor Systems: Architecture and Pin diagram of 8085, Timing Diagram, Memory organization, Addressing modes, Interrupts. Assembly Language Programming, 8085 interrupts, Additional I/O concepts and processes.

Unit- 2.0 **7 hrs**

8085 Interfacing and Peripheral Devices:

Interfacing of 8085 with 8255, 8254/ 8253, 8251, 8259: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI).

Unit- 3.0 **7 hrs**

Keyboard, Display and Data Converters:

Intel 8255, Sample-and- Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor.

Unit- 4.0 **7 hrs**

8086 Architecture and Memory Interfacing:

Introduction to 8086, 80286, 80386 and 80486 Microprocessor: 8086 Architecture, Generation of physical address, Pin diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives.

Unit- 5.0 **7 hrs**

8086 Instruction Set and Interrupts:

Instruction set of 8086, Assembly Language Programming, Hardware, and Software Interrupts. Introduction of 80286, 80386, and 80486 microprocessors.

Unit- 6.0 **7 hrs**

8051 Microcontroller and Applications:

Overview of Microcontroller 8051: Introduction to 8051 Microcontroller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer and Counter Programming, Interrupt Programming.

Course Code- 155601 **Machine Learning Lab** **0 0 4 2**

Perform all Experiments

List of Experiments:

1.
   a) Implementation of Python Basic Libraries such as Statistics, Math, Numpy and Scipy
   b) Implementation of Python Libraries for ML application such as Pandas and Matplotlib.

2.
   a) Creation and Loading different datasets in Python
   b) Write a python program to compute Mean, Median, Mode, Variance, Standard Deviation using Datasets

3.
   a) Write a python program to compute reshaping the data, Filtering the data , merging the data and handling the missing values in datasets

4.
   a) Write a Python program to implement Simple Linear Regression and plot the graph.
   b) Implementation of Multiple Linear Regression for House Price Prediction using sklearn

5. Implementation of Logistic Regression for iris using sklearn

1. Implementation of random forest algorithm

2. Implementation of navie bayes classifier algorithm and plot the graph.

3. Implementation of SVM classification and plot the graph.

9.
   a) Implementation of PCA
   b) Implementation of LDA.

10.
   a) Implementation of k-means clustering.
   b) Implementation of hierarchical clustering

Course Code- 155603 Ad hoc & Network Sensors Lab **0 0 4 2**

Perform all the Experiments

1. Experiment 1: Introduction to Wireless Network Simulation
    - Overview of NS2/NS3, MATLAB, and OMNeT++ for ad hoc and sensor networks.
    - Understanding network topology setup and performance analysis metrics.
2. Experiment 2: Simulation of Ad Hoc Routing Protocols
    - Implement and analyze AODV, DSR, and DSDV routing protocols.
    - Compare throughput, end-to-end delay, and packet delivery ratio.
3. Experiment 3: MAC Protocol Implementation for Ad Hoc Networks
    - Implement and analyze contention-based MAC protocols (CSMA, MACA, MACAW).
    - Study the impact of collision avoidance techniques in wireless communication.
4. Experiment 4: Energy-Efficient Routing in Wireless Sensor Networks (WSN)
    - Implement LEACH (Low-Energy Adaptive Clustering Hierarchy) protocol.
    - Compare energy consumption and network lifetime.
5. Experiment 5: Localization Techniques in WSN
    - Implement range-based (RSSI, TOA, TDOA) and range-free (DV-Hop, Centroid) localization algorithms.
    - Evaluate accuracy and error rates in node positioning.
6. Experiment 6: Time Synchronization in WSN
    - Implement RBS (Reference Broadcast Synchronization) and TPSN (Timing-sync Protocol for Sensor Networks).
    - Analyze clock drift and synchronization accuracy.
7. Experiment 7: Data Aggregation in WSN
    - Implement data aggregation techniques using clustering methods.
    - Compare efficiency in terms of energy saving and data redundancy.
8. Experiment 8: Security Attacks in Ad Hoc and Sensor Networks
    - Simulate wormhole, blackhole, and Sybil attacks in NS2/NS3.
    - Implement countermeasures for secure routing.
9. Experiment 9: QoS-Based Routing in Ad Hoc Networks
    - Implement QoS-aware routing using bandwidth and delay constraints.
    - Analyze performance trade-offs between QoS metrics.
10. Experiment 10: Performance Evaluation of Sleep-Wake Scheduling Algorithms
    - Implement duty-cycle-based sleep-wake scheduling algorithms.
    - Compare energy efficiency and network lifetime improvement.