SCHEME & SYLLABUS OF UNDERGRADUATE DEGREE COURSE

Internet of Things

V & VI Semester

Effective for the students admitted in year 2020-21 and onwards.

B.Tech.: Artificial Intelligence & Data Science
3rd Year - V Semester

S.No.	Category	Course Code	Course Title	Contact hrs./week L	T	P	Marks Exam Hrs.	IA	ETE	Total	Cr
THEORY											
1	ESC	5IO3-01	Information Theory & Coding	2	0	0	2	20	80	100	**2**
2	PCC/PEC	5IO4-02	RFID and Wireless Sensor Networks	3	0	0	3	30	120	150	**3**
3		5IO3-03	Operating Systems	3	0	0	3	30	120	150	**3**
4		5IO4-04	Fundamentals of IoT and Applications	3	0	0	3	30	120	150	**3**
5		5IO4-05	Analysis of Algorithms	3	0	0	3	30	120	150	**3**
6		Professional Elective 1(anyone)		2	0	0	2	20	80	100	**2**
		5IO5-11	Embedded System Design								
		5IO5-12	Human-Computer Interaction								
		5IO5-13	Information Security System								
		5IO5-14	Smart Systems								
			Sub Total	**16**	**0**	**0**		**160**	**640**	**800**	**16**
PRACTICAL & SESSIONAL											
7	PCC	5IO4-21	Arduino Lab	0	0	2	2	30	20	50	**1**
8		5IO4-22	Network Simulator Lab-3	0	0	2	2	30	20	50	**1**
9		5IO4-23	Analysis of Algorithms Lab	0	0	2	2	30	20	50	**1**
10		5IO4-24	Embedded Systems Lab	0	0	2	2	30	20	50	**1**
11	PSIT	5IO7-30	Industrial Training	0	0	1		75	50	125	**2.5**
12	Anandam	5IO8-00	ANANDAM						100	100	**2**
			Sub- Total	**0**	**0**	**9**		**195**	**230**	**425**	**8.5**
		TOTAL OF V SEMESTER		**16**	**0**	**9**		**355**	**870**	**1225**	**24.5**

L: Lecture, **T**: Tutorial, **P**: Practical, **Cr**: Credits **ETE:** End Term Exam, **IA:** Internal Assessment

B.Tech.: Artificial Intelligence & Data Science
3rd Year - VI Semester

THEORY												
S.No.	Category	Course		Contact hrs./week			Marks					Cr
		Code	Title	L	T	P	Exam Hrs.	IA	ETE	Total		
1	ESC	6IO3-01	Digital Image Processing	2	0	0	2	20	80	100		**2**
2	PCC/PEC	6IO4-02	Sensor-Concepts and Techniques	3	0	0	3	30	120	150		**3**
3		6IO3-03	Sensor Networks & IoT	3	0	0	3	30	120	150		**3**
4		6IO4-04	Cloud Computing	3	0	0	3	30	120	150		**3**
5		6IO4-05	Introduction to Machine Learning	3	0	0	3	30	120	150		**3**
6		Professional Elective 1(anyone)		3	0	0	3	30	120	150		**3**
		6IO5-11	Embedded IoT									
		6IO5-12	Distributed System									
		6IO5-13	Data Mining & Predicting Modeling									
		6IO5-14	Artificial Intelligence and Expert Systems									
			Sub Total	**17**	**0**	**0**		**170**	**680**	**850**		**17**
PRACTICAL & SESSIONAL												
7	PCC	6IO4-21	Machine Learning Lab	0	0	3	2	45	30	75		**1.5**
8		6IO4-22	Raspberry Pi Lab	0	0	3	2	45	30	75		**1.5**
9		6IO4-23	IoT Enabled Embedded Devices Lab	0	0	3	2	45	30	75		**1.5**
10		6IO4-24	Mobile Application Development Lab	0	0	3	2	45	30	75		**1.5**
11	Anandam	6IO8-00	ANANDAM						100	100		**2**
			Sub- Total	**0**	**0**	**12**		**180**	**220**	**400**		**8**
		TOTAL OF III SEMESTER		**17**	**0**	**12**		**350**	**900**	**1250**		**25**

L: Lecture, **T**: Tutorial, **P**: Practical, **Cr**: Credits **ETE:** End Term Exam, **IA:** Internal Assessment

SYLLABUS OF
UNDERGRADUATE DEGREE COURSE

Internet of Things

V & VI Semester

Effective for the students admitted in year 2020-21 and onwards.

5IO3-01: Information Theory & Coding

Credit: 2	Max Marks: 100 (IA :20, ETE:80)
2L+ 0T+ 0P	End Term Exams: 2hr

S.No.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course	01
2	**Introduction to information theory** Uncertainty, Information and Entropy, Information measures for continuous random variables, source coding theorem. Discrete Memory less channels, Mutual information, Conditional entropy.	05
3	**Source coding schemes for data compaction** Prefix code, Huffman code, Shanon-Fane code &Hempel-Ziv coding channel capacity. Channel coding theorem. Shannon limit	05
4	**Linear Block Code** Introduction to error connecting codes, coding & decoding of linear block code, minimum distance consideration, conversion of non-systematic form of matrices into systematic form.	05
5	**Cyclic Code** Code Algebra, Basic properties of Galois fields (GF) polynomial operations over Galois fields, generating cyclic code by generating polynomial, parity check polynomial. Encoder & decoder for cyclic codes.	06
6	**Convolutional Code** Convolutional encoders of different rates. Code Tree, Trllis and state diagram. Maximum likelihood decoding of convolutional code: The viterbi Algorithm fee distance of a convolutional code	06
	Total	28

Suggested Books

- J. A. Thomas and T. M. Cover: Elements of information theory, Wiley, 2006.
- J. H. van Lint: Introduction to Coding Theory, Third Edition, Springer, 1998.
- F. J. MacWilliams and N.J. Sloane: Theory of Error Correcting Codes, Parts I and II, North-Holland, Amsterdam, 1977.
- D. Stinson: Combinatorial Designs: Constructions and Analysis, Springer, 2003
- P. J. Cameron and J. H. van Lint: Designs, Graphs, Codes and their Links, Cambridge Univ.Press, 2010.
- C. Fragouli and E. Soljanin: Network Coding Fundamentals, Now Publisher, 2007.
- M. Medard and A. Sprintson, (editors): Network Coding – Fundamentals and Applications, Acadamic Press, 2012.
- C. Fragouli, J. Le Boudec, J. Widmer: Network coding: An instant primer

5IO4-02: RFID and Wireless Sensor Networks

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	Introduction of RFID, Automatic Identification Systems, A Comparison of Different ID Systems, Components of an RFID System, Differentiation Features of RFID Systems, Transponder Construction Formats, Frequency, Range and Coupling , Active and Passive Transponders, Information Processing in the Transponder , Selection Criteria for RFID Systems, Fundamental Operating Principles	08
2	Frequency Ranges and Radio Licensing Regulations, Coding and Modulation, Data Integrity, Multi-Access Procedures – Anticollision, Security of RFID Systems, Attacks on RFID Systems	08
3	Wireless Sensor Networks- Introduction, Challenges and Constraints, Applications, Node Architecture, Operating Systems, Physical Layer	07
4	Medium Access Control: Characteristics of MAC Protocols in Sensor Networks, Contention Free MAC Protocols, Contention-Based MAC Protocols, Network Layer: Various Routing Protocols.	09
5	Security in WSN: Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and ZigBee Security	08
	Total	40

Suggested Books

- RFID Handbook, Klaus Finkenzeller, WILEY & SONS
- Fundamentals of Wireless Sensor Networks: theory and practice by Waltenegus Dargie,Christian Poellabauer
- RFID and Sensor Networks Architecture, Protocols, Security and integration by Yan Zhang, Laurence T. Yang, Jining.
- Ian F. Akyildiz, and Mehmet Can Vuran, Wireless Sensor Networks, 2010, Wiley, USA.
- 3IBM Bluemix: The Cloud Platform for Creating and Delivering Applications, http://www.redbooks.ibm.com/redpapers/pdfs/redp5242.pdf
- Wireless Sensor Networks Technology, protocols and applications by KAZEM SOHRABY, DANIEL MINOLI TAIEB ZNATI, JOHN WILEY & SONS, INC Publication.

5IO4-03: Operating Systems

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction and History of Operating systems:** Structure and operations; processes and files Processor management: inter-process communication, mutual exclusion, semaphores, wait and signal procedures, process scheduling, and algorithms, critical sections, threads, multithreading	08
3	**Memory management:** contiguous memory allocation, virtual memory, paging, page table structure, demand paging, page replacement policies, thrashing, segmentation, case study	08
4	**Deadlock: Shared resources**, resource allocation, and scheduling, resource graph models, deadlock detection, deadlock avoidance, deadlock prevention algorithms Device management: devices and their characteristics, device drivers, device handling, disk scheduling algorithms, and policies.	10
5	**File management:** file concept, types and structures, directory structure, cases studies, access methods and matrices, file security, user authentication	07
6	**UNIX and Linux operating systems as case studies;** Time OS and case studies of Mobile OS	06
	Total	40

Suggested Books

- Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts (9 ed.), John Wiley, 2012. ISBN 978-1118063330.
- Tanenbaum, Modern Operating Systems (3 ed.), Prentice Hall India Learning Private Limited, 2019. ISBN 978-8120339040.
- W. Stallings, Operating Systems Internals and Design Principles (7 ed.), Prentice-Hall, 2013. ISBN 978-9332518803
- Operating Systems – William Stallings, Pearson Education Asia (2002)
- Operating Systems - Nutt, Pearson Education Asia (2003)

5IO4-04: Fundamentals of IoT and Applications

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Fundamentals of IoT** Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.	08
2	**Sensors Networks** Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.	08
3	**Wireless Technologies for IoT:** WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. **IP Based Protocols for IoT:** IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols	08
4	**Data Handling& Analytics** Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications	08
5	**Applications of IoT** Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	08
	Total	40

Suggested Books

- Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications
- Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.
- J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
- Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
- Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications
- Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
- Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
- https://onlinecourses.nptel.ac.in/noc17_cs22/course
- http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

5IO4-05: Analysis of Algorithms

Credit: 3		Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P		End Term Exams: 3hr
S.No.	**Contents**	**Hours**
1	**Introduction:** Objective, scope, and outcome of the course.	**01**
2	**Background**: Review of Algorithm, Complexity Order Notations: definitions and calculating complexity. **Divide And Conquer Method**: Binary Search, Merge Sort, Quick sort, and Strassen's matrix multiplication algorithms.	**06**
3	**Greedy Method**: Knapsack Problem, Job Sequencing, Optimal Merge Patterns, and Minimal Spanning Trees. **Dynamic Programming**: Matrix Chain Multiplication. Longest Common Subsequence and 0/1 Knapsack Problem.	**09**
4	**Branch And Bound**: Traveling Salesman Problem and Lower Bound Theory. Backtracking Algorithms and queens' problem. **Pattern Matching Algorithms**: Naïve and Rabin Karp string matching algorithms, KMP Matcher and Boyer Moore Algorithms.	**08**
5	**Assignment Problems:** Formulation of Assignment and Quadratic Assignment Problem. Randomized **Algorithms-** Las Vegas algorithms, Monte Carlo algorithms, a randomized algorithm for Min-Cut, randomized algorithm for 2- SAT. Problem definition of Multicommodity flow, Flow shop scheduling, and Network capacity assignment problems.	**08**
6	**Problem Classes Np, Np-Hard, And Np-Complete:** Definitions of P, NP-Hard and NP-Complete Problems. Decision Problems. Cook's Theorem. Proving NP-Complete Problems - Satisfiability problem and Vertex Cover Problem. Approximation Algorithms for Vertex Cover and Set Cover Problem.	**08**
	Total	**40**

Suggested Books

- T .H . Cormen, C .E .Leiserson, R .L .Rivest "Introduction to Algorithms", PHI.
- Sedgewich, Algorithms in C, Galgotia
- Berman. Paul, "Algorithms, Cengage Learning".
- Richard Neopolitan, Kumar SS Naimipour, "Foundations of Algorithms"
- Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006
- E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galotia Publication

5IO4-11: Embedded System Design

Credit: 2		Max Marks: 100 (IA :20, ETE:80)
2L+ 0T+ 0P		End Term Exams: 2hr
S.No.	**Contents**	**Hours**
1	**Introduction To Embedded Concepts** Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software.	**08**
2	**Overview Of ARM and Cortex-M3** Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture. Cortex-M3 Basics: Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. CortexM3Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions.Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus. Interfaces on Cortex-M3, I-Code Bus, D Code Bus, System Bus, External PPB and DAP Bus	**08**
3	**Cortex Exception Handling and Interrupt** Exceptions: Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency	**08**
4	**Cortex-M3/M4 Programming** Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. Exception Programming: Using nterrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection Unit and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.	**08**
5	**Cortex-M3/M4 Development and Debugging Tools** STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development and Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzeretc.	**08**
	Total	**40**

Suggested Books

- A Joseph Yiu," The Definitive Guide to the ARM Cortex-M3", Second Edition, Elsevier Inc. 2010.
- Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer'sGuide Designing and Optimizing System Software", Elsevier Publications,2006
- Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education, India ISBN: 9788131708408, 8131708403 , 2015
- STM32L152xx ARM Cortex M3 Microcontroller Reference Manual 5/97
- ARM Company Ltd. "ARM Architecture Reference Manual– ARM DDI 0100E"

5IO5-12: Human-Computer Interaction

Credit: 2	Max Marks: 100 (IA :20, ETE:80)
2L+ 0T+ 0P	End Term Exams: 2hr

S.No.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	Historical evolution of the field, Interactive system design, Concept of usability - definition and elaboration, HCI and software Engineering, GUI design and Aesthetics, Prototyping techniques.	02
2	**Model-based Design and evaluation:** Basic idea, introduction to different types of models, GOMS family of models (KLM and CMN- GOMS), Fitts' law and Hick-Hyman's law, Model-based design case studies.	04
3	**Guidelines in HCI:** Schneiderman's eight, golden rules, Norman's seven principles, Norman's model of interaction, Nielsen's ten heuristics with examples of its use Heuristic evaluation, Contextual inquiry, Cognitive walkthrough.	05
4	**Empirical research methods in HCI:** Introduction (motivation, issues, research question formulation techniques), Experiment design, and data analysis (with an explanation of one-way ANOVA).	06
5	**Task modeling and analysis:** Hierarchical task analysis (HTA), Engineering task models and Concur Task Tree (CTT), Introduction to formalism in dialog design, design using FSM (finite state machines) Statecharts and (classical) Petri Nets in dialog design.	07
6	**Introduction to CA**, CA types, the relevance of CA in IS design Model Human Processor (MHP), OOP- Introduction OOM- Object-Oriented Modeling of User Interface Design.	05
	Total	30

Suggested Books

- Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ―Human-Computer Interaction, 3rd Edition, Pearson Education, 2004Brian Fling, ―Mobile Design and Development, First Edition, O'Reilly Media Inc., 2009)
- Bill Scott and Theresa Neil, ―Designing Web Interfaces, First Edition, O'Reilly, 2009. (

5IO5-13: Information Security System

Credit: 2	Max Marks: 100 (IA :20, ETE:80)
2L+ 0T+ 0P	End Term Exams: 2hr

S.No.	Contents	Hours
1	**Introduction:** Objective, scope, and outcome of the course.	01
2	**Introduction to security attacks:** services and mechanism, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stream and block ciphers.	05
3	**Modern block ciphers**: Block Cipher structure, Data Encryption Standard (DES) with an example, the strength of DES, Design principles of block cipher, AES with structure, its transformation functions, key expansion, example, and implementation. Multiple encryption and triple DES, Electronic Code Book, Cipher Block Chaining Mode, Cipher Feedback mode, Output Feedback mode, Counter mode.	06
4.	**Public Key Cryptosystems with Applications:** Requirements and Cryptanalysis, RSA cryptosystem, Rabin cryptosystem, Elgamal cryptosystem, Elliptic curve cryptosystem.	05
5	**Cryptographic Hash Functions, their applications:** Simple hash functions, its requirements and security, Hash functions based on Cipher Block Chaining, Secure Hash Algorithm (SHA). Message Authentication Codes, its requirements and security, MACs based on Hash Functions, Macs based on Block Ciphers. Digital Signature, its properties, requirements and security, various digital signature schemes (Elgamal and Schnorr), NIST digital Signature algorithm.	07
6	**Key management and distribution:** symmetric key distribution using symmetric and asymmetric encryptions, distribution of public keys, X.509 certificates, public key infrastructure. Remote user authentication with symmetric and asymmetric encryption, Kerberos Web Security threats and approaches, SSL architecture and protocol, Transport layer security, HTTPS, and SSH.	06
	Total	30

Suggested Books

- Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
- Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
- Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
- Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

5IO5-14: Smart Systems

Credit: 2	Max Marks: 100 (IA :20, ETE:80)
2L+ 0T+ 0P	End Term Exams: 2hr

S. No.	Contents	Hours
1	**Introduction to Sensor Devices** Piezoresistive pressure sensor, Piezoresistive Accelerometer, Capacitive Sensing, Accelerometer and Microphone, Resonant Sensor and Vibratory Gyroscope, Low-Power, Low Voltage Sensors- Micro Electro Mechanical Systems Analysis and Design of MEMS Devices- Nano Sensors.	06
2	**Interfacing Sensor Information and MCU** Amplification and Signal Conditioning, Integrated Signal Conditioning, Digital conversion, MCU Control MCUs for Sensor Interface, Techniques and System Consideration, Sensor Integration.	06
3	**Control Techniques and Standards** Control of Sensors using - State Machines, Fuzzy Logic, Neural Networks, Adaptive Control. Control Application using - CISC, RISC, DSP Control and IEEE 1451 Standards.	06
4	**Communication For Smart Sensors** Wireless Data Communications- RF Sensing, Telemetry, Automotive Protocols, Industrial Networks Home Automation, MCU Protocols.	06
5	**Packaging, Testing and Reliability Implications of Smart Sensors** Semiconductor Packaging- Hybrid Packaging- Packaging for Monolithic Sensors- Reliability Implications Testing Smart Sensors- HVAC Sensor Chip	06
	Total	30

Suggested Books

- Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill.
- Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Pearson Education.
- Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice Hall.

5IO3-21: Arduino Lab

Credit: 1	Max Marks: 50 (IA :30, ETE:20)
0L+ 0T+ 2P	End Term Exams: 2hr

S. No.	Content
1	Understanding Arduino UNO Board and Components
2	Installing and work with Arduino IDE
3	Blinking LED sketch with Arduino
4	Simulation of 4-Way Traffic Light with Arduino
5	Using Pulse Width Modulation
6	LED Fade Sketch and Button Sketch
7	Using a Potentiometer to Change the Resistance Values of an LED
8	Digital Read Serial Sketch (Working with DHT/IR/Gas or Any other Sensor)
9	Working with Adafruit Libraries in Arduino
10	Spinning a DC Motor and Motor Speed Control Sketch
11	Working with Shields
12	Interfacing Arduino with Cloud (Thingspeak API)

Suggested Books

- Simon Monk "Programming Arduino: Getting Started with Sketches" 2nd Edition, Kindle Edition, McGraw Hill; 2nd edition
- John Boxall " Arduino Workshop: A Hands-On Introduction with 65 Projects", No Starch Press
- Michael Margolis "Arduino Cookbook, 2e", O′Reilly; 2nd edition
- Blum Richard "Arduino Programming in 24 Hours, Sams Teach Yourself", Sams Publishing; 1st edition

5IO4-22: Network Simulator Lab-3

Credit: 1	Max Marks: 50 (IA :30, ETE:20)
0L+ 0T+ 2P	End Term Exams: 2hr

S.No.	List of Experiments
1	Introduction to network simulators used for wireless Ad Hoc and Sensor Networks.
2	Introduction to TCL scripting: demonstration of one small network simulation script.
3	To study various trace file formats of network simulators.
4	To implement and compare various MAC layer protocols.
5	To implement and compare AODV and DSR routing algorithms in MANET
6	To implement DSDV routing algorithms in MANET
7	To implement signal strength based link management routing protocols.
8	To calculate and compare average throughput for various TCP variant
9	To implement and compare various routing protocols for wireless sensor networks

Suggested Books

- ns-3-manual, https://www.nsnam.org/docs/ns-3-manual.pdf
- Documentation - NS-3, https://www.nsnam.org/documentation/

5IO4-23: Analysis of Algorithms Lab

Credit: 1	Max Marks: 50 (IA :30, ETE:20)
0L+ 0T+ 2P	End Term Exams: 2hr

S. No.	List of Experiments
1	Sort a given set of elements using the Quicksort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
2	Implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
3	a. Obtain the Topological ordering of vertices in a given digraph. b. Compute the transitive closure of a given directed graph using Warshall's algorithm.
4	Implement 0/1 Knapsack problem using Dynamic Programming.
5	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
6	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
7	a. Print all the nodes reachable from a given starting node in a digraph using the BFS method. b. Check whether a given graph is connected or not using the DFS method.
8.	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
9.	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.
10	Implement N Queen's problem using Backtracking.

Suggested Books

- T .H . Cormen, C .E .Leiserson, R .L .Rivest "Introduction to Algorithms", PHI.
- Sedgewich, Algorithms in C, Galgotia
- Berman. Paul, "Algorithms, Cengage Learning".
- Richard Neopolitan, Kumar SS Naimipour, "Foundations of Algorithms"
- Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006
- E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galotia Publication

5IO4-24: Embedded Systems Lab

Credit: 1	Max Marks: 50 (IA :30, ETE:20)
0L+ 0T+ 2P	End Term Exams: 2hr

S. No.	List of Experiments
1	Programming practice on assembler and simulator tools.
2	Basic experiments with Atmega: - Blink, Digital Read Serial, Fade, and Read Analog Voltage.
3	Experiments with Atmega -Digital: - Button, Digital Input Pullup, Blink Without Delay.
4	Experiments with Atmega -Analog: - Analog In Out Serial, Sensors: - LM35, Display: - LCD, LED and Communication:-Bluetooth, Zigbee and Wi Fi.
5	Intel Atom Processor:- Linux Shell commands
6	Experiments with Intel Atom Processor:- temperature sensor Interface ,Capacitive touch pad and Accelerometer using analog boar
7.	Experiments with Intel Atom Processor:- Blinking LED and Controlling the motor using GPIO board
8.	Introduction to ARM7- Cortex processor Instruction set.
9.	Programming in Integrated Development Environment
10.	Experiments with ARM7- Cortex (STM 32F4 Discovery):-Interfacing with Audio card, MEMS Sensor and Accelerometer.
11.	Experiments with ARM7- Cortex (ST Nucleo-F401RE):- Interfacing with MEMS and Bluetooth, Working with SPI and I2C sensors including accelerometers

Suggested Books

- Vijay Madisetti, Arshdeep Bahga, ―Internet of Things (A Hands-on Approach), Universities Press, 2015
- Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication
- Hanes David, Salgueiro Gonzalo, Grossetete Patrick), Barton Rob "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things", Pearson publication

6IO3-01: Digital Image Processing

Credit: 2	Max Marks: 100 (IA :20, ETE:80)
2L+ 0T+ 0P	End Term Exams: 2hr

S. No.	Contents	Hours
1	**Introduction:** Objective, scope, and outcome of the course.	01
2	**Introduction to Image Processing:** Digital Image representation, Sampling & Quantization, Steps in image Processing, Image acquisition, color image representation.	04
3	**Image Transformation & Filtering:** Intensity transform functions, histogram processing, Spatial filtering, Fourier transforms, and its properties, frequency domain filters, color models, Pseudo coloring, color transforms, Basics of Wavelet Transforms.	06
4	**Image Restoration:** Image degradation and restoration process, Noise Models, Noise Filters, degradation function, Inverse Filtering, Homomorphism Filtering.	07
5	**Image Compression:** Coding redundancy, Interpixel redundancy, Psychovisual redundancy, Huffman Coding, Arithmetic coding, Lossy compression techniques, JPEG Compression.	05
6	**Image Segmentation & Representation:** Point, Line, and Edge Detection, Thresholding, Edge and Boundary linking, Hough transforms, Region-Based Segmentation, Boundary representation, Boundary Descriptors.	05
Total		28

Suggested Books

- Rafael C Gonzalez, Richard E Woods, "Digital Image Processing," 4th Edition, Pearson, 2018.
- Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
- Anil K.Jain, "Fundamentals of Digital Image Processing," Person Education, 2003.

6IO4-02: Sensor-Concepts and Techniques

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S. No.	Contents	Hours
1	**Sensors / Transducers** Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization. Inductive Sensors: Sensitivity and Linearity of the Sensor Types Capacitive Sensors: Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators, Ultrasonic Sensors.	**08**
2	**Thermal and Magnetic Sensors** Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index thermosensors, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Sensors and the Principles Behind - Magneto, resistive Sensors, Anisotropic Magneto resistive Sensing, Semiconductor Magnetoresistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros, Synchroresolvers, Eddy Current Sensors, Electromagnetic Flowmeter, Switching Magnetic Sensors SQUID Sensors	**08**
3	**Radiation and Electro Analytical Sensors** Introduction , Basic Characteristics, Types of Photosensistors/Photo detectors, Xray and Nuclear Radiation Sensors, Fiber Optic Sensors, the Electrochemical Cell, The Cell Potential, Standard Hydrogen Electrode (SHE), Liquid Junction and Other Potentials, Polarization, Concentration Polarization, Reference Electrodes, Sensor Electrodes, Electro ceramics in Gas Media.	**08**
4	**Smart Sensors** Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, The Automation.	**08**
5	**Actuators** Pneumatic and Hydraulic Actuation Systems, Actuation systems, Pneumatic and hydraulic systems Directional Control valves, Presure control valves, Cylinders, Servo and proportional control valves Process control valves, Rotary actuators.	**08**
	Total	**40**

Suggested Books

- D. Patranabis – "Sensors and Transducers" –PHI Learning Private Limited.
- W. Bolton – "Mechatronics" –Pearson Education Limited.
- Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.

6IO4-03: Sensor Networks & IoT

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S. No.	Contents	Hours
1	**Introduction** Introduction to Sensor networks in smart transportation, smart cities, smart living, smart energy, smart health, and smart learning.	**08**
2	**Sensor Network Systems** Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints, hardware, Data representation and visualization, Interaction and remote control.	**08**
3	**IoT Physical Devices and Endpoints** Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device. Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases	**08**
4	**Industrial Automation and IoT** Industrial Automation-Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation	**08**
5	**IoT Implementations Case Study** Case study: Smart Grid &IoT, Commercial building automation using IoT, Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT.	**08**
	Total	**40**

Suggested Books

- Vijay Madisetti, Arshdeep Bahga, ―Internet of Things (A Hands-on Approach), Universities Press, 2015
- Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication
- Hanes David, Salgueiro Gonzalo, Grossetete Patrick), Barton Rob "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things", Pearson publication

6IO4-04: Cloud Computing

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction:** Objective, scope and outcome of the course. Introduction Cloud Computing: Nutshell of cloud computing, Enabling Technology, Historical development, Vision, feature Characteristics and components of Cloud Computing. Challenges, Risks and Approaches of Migration into Cloud. Ethical Issue in Cloud Computing, Evaluating the Cloud's Business Impact and economics, Future of the cloud. Networking Support for Cloud Computing. Ubiquitous Cloud and the Internet of Things	06
3	**Cloud Computing Architecture:** Cloud Reference Model, Layer and Types of Clouds, Services models, Data centre Design and interconnection Network, Architectural design of Compute and Storage Clouds. Cloud Programming and Software: Fractures of cloud programming, Parallel and distributed programming paradigms-Map Reduce, Hadoop, High-level Language for Cloud. Programming of Google App Engine.	10
4	**Virtualization Technology:** Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor VMware, KVM, Xen. Virtualization: of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of data-Centre.	09
5	**Securing the Cloud:** Cloud Information security fundamentals, Cloud security services, Design principles, Policy Implementation, Cloud Computing Security Challenges, Cloud Computing Security Architecture. Legal issues in Cloud Computing. Data Security in Cloud: Business Continuity and Disaster Recovery, Risk Mitigation, Understanding and Identification of Threats in Cloud, SLA-Service Level Agreements, Trust Management	07
6	**Cloud Platforms in Industry:** Amazon web services, Google AppEngine, Microsoft Azure Design, Aneka: Cloud Application Platform -Integration of Private and Public Clouds Cloud applications: Protein structure prediction, Data Analysis, Satellite Image Processing, CRM	07
	Total	40

Suggested Books

- Dan C Marinescu, Cloud Computing, Theory and Practice, MK Elsevier
- Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley
- Barrie Sosinsky, Cloud Computing Bible, Wiley
- Jim Smith, Ravi Nair, Virtual Machines: Versatile Platforms for Systems and Processes, MK Elsevier

6IO4-05: Introduction to Machine Learning

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S. No.	Contents	Hours
1	**Introduction to Machine Learning** What is machine learning – Types of Machine learning Techniques-security with deep learning - -Reinforcement learning- Logistic Regression-hypothesis- Logistic regression models- Decision boundary- Cost function-Dimensionality Reduction- Principal Component	**08**
2	**Predictive Analytics** Linear regression-with one variable-with multiple variable--Multiple Linear regression-Non linear regression-Regression analysis- Predictive models - prediction using logistics regression.	**08**
3	**Classification and Clustering Techniques** Support vector Machine- Decision Tree-Naïve Bayes-Random Forest- Density-Based Clustering Methods-Hierarchical Based clustering methods-Partitioning methods- Grid based methods-K means clustering - pattern based with deep learning.	**08**
4	**Ensembling Models** Need of Ensembling- Applications of Ensembling - Types of Ensembling- Techniques of Ensembling- Bagging-Boosting – Stacking-Blending-AdaBoost -informatics with deep learning	**08**
5	**Model Evaluation, Model Selection, And Algorithm Selection** Statistical tests - validation Techniques-Cross validation -Nested Cross validation- Essential Model Evaluation Terms and Techniques - Bootstrapping and Uncertainties -Cross-validation and Hyperparameter Optimization - Algorithm Comparison - Testing the Difference of Proportions - Comparing Two Models with the McNemar Test - The F-test for Comparing Multiple Classifiers - Comparing Algorithms - optimizing deep learning hyper parameters by evolutionary algorithm.	**08**
	Total	**40**

Suggested Books

- Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Müller, Sarah Guido, Publisher(s): O'Reilly Media, Inc., ISBN: 9781449369415
- Ensemble Methods: Foundations and Algorithms by Zhi-Hua Zhou , CRC Press, 2012
- https://machinelearningmastery.com/stacking-ensemble-machine-learning-with-python

6IO5-11: Embedded IoT

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S. No.	Contents	Hours
1	**Fundamentals and Applications of IoT** Introduction to Internet of Things (IoT), Functional Characteristics, Recent Trends in the Adoption of IoT, Societal Benefits of IoT, Health Care, Machine to Machine (M2M), Smart Transportation, Smart Living, Smart Cities, Smart Grid	**08**
2	**IoT ARCHITECTURE** Functional Requirements - Components of IoT: Sensors, Actuators, Embedded Computation Units Communication Interfaces, Software Development	**08**
3	**Communication Principles** RFID, ZigBEE, Bluetooth, Internet Communication, IP Addresses, MAC Addresses, TCP and UDP, IEEE 802 Family of Protocols, Cellular, Introduction to EtherCAT.	**08**
4	**Communication Interface in IoT** IEEE 802.11 Wireless Networks Attacks: Basic Types, WEP Key Recovery Attacks, Keystream Recovery Attacks against WEP – RFID Security, Security Issues in ZigBEE: Eavesdropping Attacks, Encryption Attacks – Bluetooth Security: Threats to Bluetooth Devices and Networks.	**08**
5	**Cloud Security Concepts** Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PAAS, IAAS and SAAS. e.g. User authentication in the cloud; Cryptographic Systems Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.	**08**
	Total	**40**

Suggested Books

- P Adrian McEwen and Hakim Cassimally, ―Designing the Internet of Things‖, John Wiley and Sons Ltd, UK, 2014.
- Olivier Hersent, David Boswarthick and Omar Elloumi, ―The Internet of Things: Key Applications and Protocols, John Wiley and Sons Ltd., UK 2012.
- Dieter Uckelmann, Mark Harrison, Florian Michahelles, ―Architecting the Internet of Things, Springer, New York, 2011.
- Johnny Cache, Joshua Wright and Vincent Liu, ―Hacking Exposed Wireless: Wireless Security Secrets and Solutions, Tata McGraw Hill, New Delhi, 2010
- Himanshu Dwivedi, Chris Clark and David Thiel, ―Mobile Application Security‖, Tata McGraw Hill, New Delhi, 2010.
- Tim Mather, Subra Kumaraswamy, ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1 edition [ISBN: 0596802765], 2009.

6IO5-12: Distributed System

Credit: 3	Max Marks: 150 (IA :30, ETE:120)	
3L+ 0T+ 0P	End Term Exams: 3hr	
S.No.	**Contents**	**Hours**
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Distributed Systems:** Features of distributed systems, nodes of a distributed system, Distributed computation paradigms, Model of distributed systems, Types of Operating systems: Centralized Operating System, Network Operating Systems, Distributed Operating Systems & Cooperative Autonomous Systems, design issues in distributed operating systems. Systems Concepts and Architectures: Goals, Transparency, Services, Architecture Models, Distributed Computing Environment (DCE). Theoretical issues in distributed systems: Notions of time and state, states & events in a distributed system, time, clocks & event precedence, recording the state of distributed systems.	08
3	**Concurrent Processes and Programming:** Processes and Threads, Graph Models for Process Representation, Client/Server Model, Time Services, Language Mechanisms for Synchronization, Object Model Resource Servers, Characteristics of Concurrent Programming Languages (Language not included).Inter-process Communication and Coordination: Message Passing, Request/Reply and Transaction Communication, Name and Directory services, RPC, and RMI case studies.	08
4	**Distributed Process Scheduling:** A System Performance Model, Static Process Scheduling with Communication, Dynamic Load Sharing and Balancing, Distributed Process Implementation. Distributed File Systems: Transparencies and Characteristics of DFS, DFS Design and implementation, Transaction Service and Concurrency Control, Data and File Replication. Case studies: Sun network file systems, General Parallel file System and Window's file systems. Andrew and Coda File Systems	08
5	**Distributed Shared Memory:** Non-Uniform Memory Access Architectures, Memory Consistency Models, Multiprocessor Cache Systems, Distributed Shared Memory, Implementation of DSM systems. Models of Distributed Computation: Preliminaries, Causality, Distributed Snapshots, modelling a Distributed Computation, Failures in a Distributed System, Distributed Mutual Exclusion, Election, Distributed Deadlock handling, Distributed termination detection.	08
6	**Distributed Agreement**: Concept of Faults, failure and recovery, Byzantine Faults, Adversaries, Byzantine Agreement, Impossibility of Consensus and Randomized Distributed Agreement. Replicated Data Management: concepts and issues, Database Techniques, Atomic Multicast, and Update Propagation. CORBA case study: Introduction, Architecture, CORBA RMI, CORBA Services.	08
	Total	41

Suggested Books

- Andrew S. Tannenbaum & Maarten Van Steen, Distributed Systems: Principles and Paradigms, Pearson
- George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, Distributed Systems: Concepts and Design, Addison Wesley
- P. K. Sinha, Distributed Operating Systems: Concepts and Design, IEEE press
- M. Singhal and N. G. Shivaratri, Advanced Concepts in Operating Systems,, McGraw-Hill

6IO5-13: Data Mining & Predicting Modeling

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Data Warehousing And Online Analytical Processing** Basic of Data Warehouse - Data Warehouse Modeling: Data Cube and OLAP - Data Warehouse Implementation - Data Generalization by Attribute-Oriented Induction - Data Cube Computation - Data Cube Computation Methods - Processing Advanced Kinds of Queries by Exploring Cube Technology - Multidimensional Data Analysis in Cube Space.	**09**
2	**Introduction, Data Preprocessing And Mining Frequent Patterns And Association** Introduction to data mining – kinds of data – Kinds of patterns to be mined – Technologies – applications – issues in mining – Data objects and attribute types – statistical distribution of data – data visualization – Measuring Data similarity and dissimilarity – Need for preprocessing – Data cleaning – Data Integration – Data reduction - Data Transformation and Data Discretization - Frequent Itemset, Closed Itemset, and Association Rules - Frequent Itemset Mining Methods.	**08**
3	**Classification** Basics – Decision tree Induction – Baye's Classification - Rule-Based Classification - Model Evaluation and Selection - Techniques to Improve Classification Accuracy - Bayesian Belief Networks - Classification by Backpropagation - Support Vector Machines - Classification Using Frequent Patterns- Lazy Learners (or Learning from Your Neighbors) - Other Classification Methods.	**08**
4	**Clustering** Basics - Partitioning Methods - Hierarchical Method - Density-Based Methods - Grid-Based Methods- Evaluation of Clustering - Clustering with Constraints - Outliers and Outlier Analysis - Outlier Detection Methods - Statistical Approaches - Proximity-Based Approaches - Clustering-Based Approaches.	**09**
5	**Data Mining Trends And Research Frontiers** Mining Complex Data Types - Other Methodologies - Data Mining Applications - Data Mining and Society – Data Mining Trends – Real world applications – Data Mining Tool study.	**08**
	Total	**42**

Suggested Books

- Han, M.Kamber, "Data Mining: Concept and Techniques", Academic Press, Morgan Kaufmann.
- Alex Berson and Stephen J. Smith. "Data Warehousing, Data Mining & OLAP", Tata McGraw Hill,2016.
- Pieter Adrians, Dolf Zantinge. "Data Mining", Addison Wesley, 2000.

6IO5-14: Artificial Intelligence and Expert Systems

Credit: 3	Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction** Overview of Artificial Intelligence, History, Approaches, Search techniques, State-space representations Depth-first, breadth-first, and heuristic search Planning and game playing, Genetic algorithms.	08
2	**Knowledge Representation and Issues** Notational systems, Trees, graphs, hierarchies, propositional and predicate logics, frames, semantic networks, constraints, conceptual dependencies, database, knowledge discovery in databases (KDD).	08
3	**Logical Reasoning and Probabilistic Reasoning** Predicate Calculus resolution, completeness, and strategies Unification, Prolog, monotonic and non-monotonic reasoning, Probabilistic inference networks Fuzzy inference rules, Bayesian rules, Dempster-Shafer Calculus	08
4	**Learning** Knowledge acquisition, classification rules, self-directed systems. **Neural Networks** Principles, biological analogies Training (techniques and errors) Recognition.	08
5	**Expert Systems** Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN	08
	Total	40

Suggested Books

- Stuart Russel and Peter Norvig, 'Artificial Intelligence A Modern Approach', Second Edition, Pearson Education, 2003 / PHI.
- Bratko, I., Prolog, 2nd Ed., Addison-Wesley, 1990.
- George F.Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', Fourth Edition, Pearson Education, 2002.
- Giarratano, J., and Riley G., Expert Systems Principles and Programming, PWS-KENT, 1989.

6IO4-21: Machine Learning Lab

Credit: 1.5	Max Marks: 75 (IA :45, ETE:30)
0L+ 0T+ 3P	End Term Exams: 2hr

S.No.	List of Experiments
1	Analysis and implementation using Python /Jupiter Notebook i. Compute the distance travelled by the robot from current position after a sequence of movement and original point. ii. Creation of scatter plot using sepal length and petal width to separate the Species classes
2	Computation of Statistical details and Complexity i. Calculate the Five Number Summary(Quartiles, IQR) for the attribute(age) of each employee a Tea Factory. ii. Analyze the complexity of Heap sort, applied over different sized random lists.
3	Preprocessing and construction of a quality dataset i. Preprocess the given data to build good training sets (80%) and test sets (20%) by removing the missing values and imputing them with the mean value. ii. Examine the interrelations among the set of variables using Principal Component Analysis, display the PCA Components and generate Heat map.
4	Analysis and Interpretation of data i. Manipulate the Twitter Data Set by removing the Punctuation, Numbers, Special Characters and word length<=3. Tokenize the Words and Stem. ii. Generate a word cloud for the Twitter dataset and retrieve the top 15 positive and negative tags.
5	Build new models (Classification and Clustering) i. Find core samples of high density and expand clusters from them using DBSCAN Clustering. ii. Split the iris dataset into train and test data(80%-20%) and train or fit the data into the model using K Nearest Neighbor Algorithm.
6	Evaluate the Performance of Machine Learning algorithms i. Evaluate the performance of Machine Learning algorithms using Confusion Matrix, Accuracy, Sensitivity, Specificity, Precision and Recall. ii. Employ Linear Regression to check the linearity between the a) stock price and interest rate, b)stock price and unemployment rate.

Suggested Books

- Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Müller, Sarah Guido, Publisher(s): O'Reilly Media, Inc., ISBN: 9781449369415
- Ensemble Methods: Foundations and Algorithms by Zhi-Hua Zhou , CRC Press, 2012
- https://machinelearningmastery.com/stacking-ensemble-machine-learning-with-python

6IO4-22: Raspberry Pi Lab

Credit: 1.5	Max Marks: 75 (IA :45, ETE:30)
0L+ 0T+ 3P	End Term Exams: 2hr

S.No.	List of Experiments
1	Getting started with Raspberry Pi, Install Raspian on your SD card
2	Linux basic commands.
3	Coding simple programs in Python.
4	How to use Python-based IDE (integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device
5	How to have your Raspberry Pi interact with online services through the use of public APIs and SDKs
6	Understanding the connectivity of Raspberry-Pi with IR sensor. Write an application to detect obstacle and notify user using LEDs.
7	Design APP Using MIT App Inventor and Connect to Temperature Sensor

Suggested Books

- Ian H. Witten & Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques", 2005 Elsevier Inc.

6IO4-23: IoT Enabled Embedded Devices Lab

Credit: 1.5	Max Marks: 75 (IA :45, ETE:30)
0L+ 0T+ 3P	End Term Exams: 2hr

S.No.	List of Experiments
1	Deploy using Node MCU/ESP 32 - Temperature Sensor Interfacing (LM35)
2	Deploy using Node MCU/ESP 32 - Bluetooth Interfacing (HC05)
3	Deploy using Node MCU/ESP 32 - Motor driver Interfacing (L298)
4	Deploy using Node MCU/ESP 32 - LCD Interfacing (HD44780
5	IMPLEMENTATION OF IoT using Google Assistant – Arest server - Creating own server – Project
6	IMPLEMENTATION OF IoT using Raspberry Pi & Python Programming: - LCD Interfacing (HD44780
7	IMPLEMENTATION OF IoT using Raspberry Pi & Python Programming: - Motor driver Interfacing (L298)
8	IMPLEMENTATION OF IoT using Raspberry Pi & Python Programming: - Camera interface
9	IMPLEMENTATION OF IoT using BLYNK/CAYENNE - –Installation and Activation - Blinking an LED -Reading Analog Voltage - LCD Interfacing (HD44780)
10	**IoT mini Project – Create a scenario and provide end to end solution as mini project.**

Suggested Books

- Vijay Madisetti, Arshdeep Bahga, ―Internet of Things (A Hands-on Approach), Universities Press, 2015
- Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication
- Hanes David, Salgueiro Gonzalo, Grossetete Patrick), Barton Rob "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things", Pearson publication

6IO4-24: Mobile Application Development Lab

Credit: 1.5	Max Marks: 75 (IA :45, ETE:30)
0L+ 0T+ 3P	End Term Exams: 2hr

S.No.	List of Experiments
1	To study Android Studio and android studio installation. Create "Hello World" application.
2	To understand Activity, Intent, Create sample application with login module. (Check username and password).
3	Design simple GUI application with activity and intents e.g. calculator.
4	Develop an application that makes use of RSS Feed.
5	Write an application that draws basic graphical primitives on the screen
6	Create an android app for database creation using SQLite Database.
7	Develop a native application that uses GPS location information
8	Implement an application that writes data to the SD card.
9	Design a gaming application
10	Create an application to handle images and videos according to size.