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MASTER OF TECHNOLOGY

COMPUTER SCIENCE & ENGINEERING

Course Components of Academic Programme

M.Tech(Computer Science and Engineering)

Minimum Duration : 4 Semesters (2 Years)
Maximum Duration : 8 Semesters (4 Year)
Total Number of Credits: 84 credits

Course Components		Credits
1.	**Compulsory Courses**	
I.	Core Course(CC)	26
2.	**Elective Courses**	
I.	Programme Elective Courses (PEC)	12
II.	Open Elective Courses (OEC)	3
3.	**Discipline-Centric Additional Courses**	
I.	Seminar(SM)	4
II.	Dissertation(DS)	30
III.	Comprehensive Viva-Voce(CM)	2
4.	**General Courses**	
I.	Human Values and Professional Ethics(VE)	-
II.	Disaster Management (DM)	-
III.	General Proficiency(GP)	4

A. Requirement of Awards of Degree:- CGPA>= 4.5 Clearance of total no. of credits as 84 and any other condition as per regulation and ordinances.
B. Audit Courses (AC) up to 4 credits may be done by a student as Extra Course(s) over and above the requirement for award of this degree

M.Tech (Computer Science and Engineering)
CURRICULUM STRUCTURE AND EVALUATION SCHEME W.E.F. 2021-22

SEMESTER: I

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE:EVALUATION			
COURSE			Credits	L	T	P	CWA	MSE	ESE	Total
Code	Title	Component								
MCS-102	Mobile Computing	CC	3	3	-	-	25	25	50	100
MCS-103	Advanced Operating Systems	CC	3	3	-	-	25	25	50	100
MCS-104	Networking Protocols	CC	3	3	-	-	25	25	50	100
	Program Elective I	PEC	3	3	-	-	25	25	50	100
	Program Elective II	PEC	3	3	-	-	25	25	50	100
MCS-153	Networking Protocols and Mobile Computing Lab	CC	2	-	-	4	25	25	50	100
MCS-164	Computing Lab I	CC	2	-	-	4	25	25	50	100
MCS-111	Seminar	SM	1	-	-	-	-	-	-	100
GP-101	General Proficiency	GP	1	-	-	-	-	-	-	100
	Total		**21**	**15**		**8**	**175**	**175**	**350**	**900**

PROGRAM ELECTIVE COURSES:

ELECTIVE NO.	ELECTIVES (CODE WITH SUBJECT NAME)	
Program Elective-I	MCS-124	1. Data Ware Housing and Mining
	MCS-125	2. Cloud Computing
	MCS-134	3. Internet of Things
	MCS-129	4. Algorithms Design and Techniques
	MCS-141	5. Wireless Sensor Networks
Program Elective-II	MCS-131	1. Applied Data Science
	MCS-132	2. Applied Cyber Security
	MCS-133	3. Applied AI using Python
	MCS-128	4. Machine Learning

SEMESTER: II

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE : EVALUATION			
COURSE			Credits	L	T	P	CWA	MSE	ESE	Total
Code	Title	Component								
MCS-241	Computer Vision and its Applications	CC	3	3	-	-	25	25	50	100
MCS-202	Distributed Computing	CC	3	3	-	-	25	25	50	100
MCS-203	Artificial Intelligence & Expert Systems	CC	3	3	-	-	25	25	50	100
	Program Elective-III	PEC	3	3	-	-	25	25	50	100
	Open Elective-I	OEC	3	3	-	-	25	25	50	100
MCS-254	Computing Lab II	CC	2	-	-	4	25	25	50	100
MCS-252	Distributed Computing & AI Lab	CC	2	-	-	4	25	25	50	100
MCS-211	Seminar	SM	1	-	-	-	-	-	-	100
GP-201	General Proficiency	GP	1	-	-	-	-	-	-	100
	Total		**21**	**15**		**8**	**175**	**175**	**350**	**900**

PROGRAM ELECTIVE COURSES:

ELECTIVE NO.	ELECTIVES (CODE WITH SUBJECT NAME)	
Program Elective-III	MCS-201	1. Advance Software Engineering
	MCS-225	2. Developing Applications in the Cloud
	MCS-226	3. Virtual and Augmented Reality
	MCS-230	4. Blockchain Technology
	MCS-228	5. Microservice Architecture
	MCS-229	6. Information Retrieval and Natural Language Processing
	MCS-241	7. Cyber Security and Laws

OPEN ELECTIVE COURSES:

Open Elective – I	MCS-227	1. Information and communication theory 2. Research Methodology and IPR 3. Game Theory 4. Any course offered by other department/Swayam/MOOCS with same credit scheme

SEMESTER: III

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE:EVALUATION			
COURSE			Credits	L	T	P	CWA	MSE	ESE	Total
Code	Title	Component								
MCS-301	Soft Computing	CC	3	3	-	-	25	25	50	100
	Program Elective-IV	PEC	3	3	-	-	25	25	50	100
MCS-300	Dissertation-Phase I	DS	6	-	-	-	25	25	50	100
MCS-311	Seminar	SM	1	-	-	-	-	-	-	100
GP-301	General Proficiency	GP	1	-	-	-	-	-	-	100
	Total		**14**	**6**	**-**	**-**	**75**	**75**	**150**	**500**

PROGRAM ELECTIVE COURSES:

ELECTIVE NO.	ELECTIVES (CODE WITH SUBJECT NAME)	
Program Elective-IV	MCS-321	1. Service oriented cloud architecture
	MCS-324	2. Intrusion detection system
	MCS-325	3. Robotic Process Automation
	MCS-326	4. Secure Coding Practices
	MCS-327	5. Full Stack Web and Multiplatform Mobile App Development

SEMESTER: IV

	COURSE DETAILS			TEACHING PERIODS			WEIGHTAGE:EVALUATION			
COURSE			Credits	L	T	P	C WA	MSE	ESE	Total
Course	Title	Component								
MCS-400	Dissertation Phase-II	DS	24	-	-	-	25	-	75	100
MCS-411	Seminar	SM	1	-	-	-	-	-	-	100
MCS-462	Comprehensive Viva-Voce	CM	2	-	-	-	-	-	-	100
GP-401	General Proficiency	GP	1	-	-	-	-	-	-	100
	Total		**28**	**-**	**-**	**-**	**25**		**75**	**400**

AUDIT COURSES (AC)

SEMESTER	**III**			
Registration for any of these courses is optional to students SL.	**COURSE CODE**	**COURSE TITLE**	**PERIODS PER WEEK**	**CREDITS**

NO						
			L	T	P	
1.	AC101	English for Research Paper Writing	2	0	0	0
2.	AC102	Disaster Management	2	0	0	0
3.	AC103	Sanskrit for Technical Knowledge	2	0	0	0
4.	AC104	Value Education	2	0	0	0
5.	AC105	Constitution of India	2	0	0	0
7.	AC-110	Employability Skills-I	2	0	0	0

SEMESTER IV

Registration for any of these courses is optional to students SL. NO	**COURSE CODE**	**COURSE TITLE**	**PERIODS PER WEEK**	**CREDITS**		
1.	AC107	Stress Management by Yoga	2	0	0	0
2.	AC108	Personality Development Through Life Enlightenment Skills	2	0	0	0
3.	AC109	Unnat Bharat Abhiyan	2	0	0	0
4.	AC-110	Employability Skills-I	2	0	0	0
5.	AC106	Pedagogy Studies	2	0	0	0
Total Credits						**0**

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 102 Course Title: **Mobile Computing**
2. Contact Hours: L: 3 T: - P: --
3. Examination Duration (Hrs): Theory 3 Hrs Practical Nil
4. Relative Weight: CWS 25 PRS MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 1
7. Subject Area: Core Course
8. Pre-requisite: The knowledge about the spectrum and information about the radio waves. The knowledge of Computer networks and protocols is essential.
9. Objective: Introduction of an advanced element of learning in the field of wireless communication. Expose the students to the concepts of wireless devices and mobile computing.

Learning Outcomes: Students successfully completing this module will be able to:

1. Understand general knowledge of Mobile and Wireless Communication technology
2. Get an in depth understanding of the fundamental problems in the area of mobile computing and study the existingand proposed solutions for these problems from both research and development perspective
3. Build knowledge on various Mobile Computing algorithms.
4. Understand about data management issuses, connection/ disconnection issues and solutions.
5. Understand about mobile agent and mobile ad-hoc algorithms

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Issues in mobile Computing, Overview of Wireless Telephony, IEEE 802.11 & Blue Tooth, location management: HLR-VLR, channel Allocation in cellular systems, GSM Multiple Access Scheme, GSM Channel Organization, Mobile services, System architecture, Handover and new data services, Wireless Multiple access protocols.	10
Unit II	Data Management Issues, data replication for mobile computers, adaptive Clustering for mobile Wireless networks. Coda File System, Disconnected operation, Mobile computing with Rover	8

	Toolkit.	
Unit III	Distributed location Management, pointer forwarding strategies, energy Efficient Indexing on air, Energy Indexing for wireless broadcast data, mobile IP, TCP Over wireless.	8
Unit IV	Mobile Agents Computing, Security and fault tolerance, transaction Processing in Mobile computing Environment, Security Issues, wireless forensics, IDS, blackhole attacks.	8
Unit V	Mobile Ad hoc Networks (MANETs): Overview, Characteristics of a MANET, application, Routing Protocol, Global State Routing (GSR), Dynamic Sate Routing (DSR), Fisheye State Routing (FSR), Ad hoc On-Demand Distance Vector (AODV), Destination, Sequenced Distance-Vector Routing (DSDV), optimized link state routing OLSR.	8
	Total	42

Text Books

1. Dharma Prakash Agrawal, Qing-An Zeng, "Introduction to Wireless and Mobile Systems" ,Thomson Publishers, 3rd Edition, 2010.
2. William Stallings, " Wireless Communications and Networks", Pearson education india, Second Edition, 2009.
3. Jochen Schiller, " Mobile Communications", Pearson education india, Second Edition, 2008.
4. Raj Pandya, "Mobile and Personal Communication Systems & Services" , Eastern Economy Edition.
5. Yi-Bing Lin, ImrichChlamtac, "Wirelessand Mobile Network Architectures" , Wiley India Edition, 2008.
6. KumkumGarg, "Mobile computing theory and practices", Pearson Publication, 2010.

Name of Department:- Computer Science & Engineering

1. Subject Code: MCS 103 Course Title: **Advanced Operating Systems**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 hrs Practical --
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 1
7. Subject Area: Core Course
8. Pre-requisite: Student should have studied operating system concepts
9. Objective: To get a comprehensive knowledge of distributed systems and its architecture.

   Learning Outcomes:
   - Have a good understanding of process and thread management.
   - To understand basics of inter process communication between co operating processes.
   - To understand the deadlock and shared memory issues and their solutions in distributedenvironments.
   - To know the security issues and protection mechanisms for distributed environments.
   - To get a knowledge of multiprocessor operating system and database operating systems.
10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit-I	**Introduction:**Operating Systems Strategies: User' perspectives, technologies and examples of Batch Systems, Timesharing Systems, Personal computer systems, Embedded systems, and small communicating computers; The genesis of modern operating systems.	8
Unit II	**Using the Operating Systems:**The programmer's abstract machine; Resources; Processes and threads; **Process Synchronization:** Inter-process communication; Synchronization: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores;	8
Unit III	**Operating Systems Organization:**Basic functions; General implementation considerations; Contemporary OS kernels. *Design Strategies:*Design considerations; Monolithic kernels; Modular organization; Microkernel; Layered organizations; Operating Systems for distributed system. **Primary and Secondary Memory Management.**	10

Unit IV	Distributed Process Management; Process Migration; Distributed Global States; Distributed Mutual Exclusion; Distributed Deadlock.	10
Unit V	**Real World Examples:** Linux, Windows NT/2000/XP: Process descriptors, Thread descriptors, Thread scheduling. Linux, Windows NT/2000/XP: Kernel	8
	Total	44

Text Books

1. Gary Nutt: Operating Systems, 3rd Edition, Pearson, 2004.
2. William Stallings: Operating Systems: Internals and Design Principles, 6th Edition, Prentice Hall, 2008.

Reference Books:

1. Silberschatz, Galvin, Gagne: Operating System Concepts, 8th Edition, Wiley, 2008
2. Andrew S. Tanenbaum, Albert S. Woodhull: Operating Systems, Design and Implementation, 3rd Edition, Prentice Hall, 2006.
3. Pradeep K Sinha: Distribute Operating Systems, Concept and Design, PHI, 2007

Name of Department:- Department of Computer Science and Engineering

1. Subject Code: MCS-104 Course Title: **Networking Protocols**
2. Contact Hours: L: 3 T: - P: -
3. Examination Duration (Hrs): Theory 3 Practical -
4. Relative Weight: CWS 25 PRS NIL MTE 25 ETE 50 PRE NIL
5. Credits: 3
6. Semester: 1
7. Subject Area: Core course
8. Pre-requisite: Computer Networks
9. Objective: To provide students with the incite of the network protocols that play an important role while communicating over LAN, WAN and Internet.

   Course outcomes: Students should be able to

   1. Explain the concepts of networking technologies, addressing schemes and further Identify suitability of different active and passive components with their merits and limitations
   2. Identify and make use of protocols for mapping computer addresses, error handling and reporting required in a given context along with appropriate networking architecture.
   3. Propose, design, and calculateIP addressing schemes for sub-netting to fulfill networking requirements of an organization.
   4. Analyze limitations of private, hybrid and public networks for data transmission and choose solution for conserving IP addresses and secure transmission of data.
   5. Appreciate system for mapping Domain Names to Addresses
   6. Determine features essential for transmission of real time streaming media over the Internet
10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Review of Network Technologies: Two approaches to Network Communication, WAN and LAN, Ethernet Technology, FDDI, Asynchronous transfer mode, WAN technologies, ARPANET. Internetworking Concept and Architectural Model, Application-Level Interconnection, Network – Level Interconnections, Properties of the Internet, Internal Architecture, Internet addresses: Universal identifiers,	8

	Classful addressing scheme, Network and Directed Broadcast Addresses, limited broadcast, Subnet and Supernet extensions, IP multicast address, Weaknesses in Internet addressing.	
Unit II	Mapping Internet Addresses to Physical Addresses (ARP): The address resolution problem, two type of physical addresses, Resolution through direct mapping and dynamic binding, The address resolution cache, ARP cache timeout, ARP Refinements, Relationship of ARP to other protocols, ARP implementation, ARP encapsulation and identification, ARP protocol format Determining an Internet Address At Startup (RARP): Introduction, Reverse address resolution protocol (RARP), Timing RARP transactions, Primary and backup RARP servers. Dynamic Host Configuration Protocol (DHCP): IP address allocation, Multiple addresses, lease termination and renewal, options and message types and options	8
Unit III	Error and Control Messages: Internet Control Message Protocol, Error reporting Vs. Error Correction, ICMP Message delivery, ICMP Message format, Testing destination reachability and status. Classless and Subnet Address Extensions (CIDR): Introduction, Review of relevant facts, Minimizing network numbers, Transparent routers, Proxy ARP, Subnet addressing, Variable-Length subnets, Implementation of subnets with masks, Subnet mask representation, Routing in the presence of subnets, RoutingAlgorithms, Maintenance of subnet masks, Broadcasting to subnets, Classless addressing (Supernetting), The effect of supernetting on routing, CIDR address blocks and bit masks, Address blocks and CIDR notations, A classless addressing example, Data structures and algorithms for classless lookup IPv6: Base and extension headers, address space, address types, multicast and broadcast.	10
Unit IV	Private Network Interconnection (NAT, VPN): Introduction, Private And Hybrid Networks, A Virtual Private Network (VPN), VPN Addressing And Routing, A VPN With Private Addresses Network Address Translation (NAT), NAT Translation Table Creation, Multi-Address NAT, Port-Mapped NAT, Interaction Between NAT And ICMP, Interaction Between NAT And Applications, Conceptual Address Domains, Slirp And Masquerade	8
Unit V	The Domain Name system (DNS): Introduction Names For Machines, Flat Namespace, Hierarchical Names, Delegation Of Authority For Names,	8

	Subset Authority, Internet Domain Names, Official And Unofficial Internet Domain Names, Named Items And Syntax Of Names, Mapping Domain Names To Addresses, Domain Name Resolution, Efficient Translation, Caching: The Key To Efficiency, Domain Server Message Format, Voice And Video Over IP (RTP): Introduction, Real-Time Transport Protocol (RTP), Streams, Mixing, And Multicasting, RTP Encapsulation, RTP Control Protocol (RTCP), RTCP Operation, IP Telephony And Signaling, Resource Reservation And Quality Of Service, QoS, Utilization, And Capacity, RSVP, COPS	
	Total	42

Text Books:

1. Douglas E.Comer, “Internetworking with TCP/IP, Principles, Protocols and Architectures”, Vol. I, 6 edition, Pearson Education India, 2015
2. Behrouz A. Forouzan, “TCP/IP Protocol Suite”,4 edition, McGraw Hill Education, 2017
3. Gary R and Richard Stevens, “TCP/ICP Illustrated ”, vol 1 and vol.2, 2 edition, Pearson Education India, 2014

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS-202 Course Title: **Distributed Computing**
2. Contact Hours: L: 3 T: - P: -
3. Examination Duration (Hrs): Theory 3 Practical
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Core Course
8. Pre-requisite: Computer Networks
9. Objective:To provide the students with a foundation forunderstanding, analyzing and designing reliable distributed systems. The course involves case studies of prominent architectures like Google File Systems.

   Learning outcomes:

   1. The way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way
   2. gain a clear understanding of the concepts that underlie distributed computing systems along with design and implementation issues
   3. To understand basics of inter process communication between co operating processes in distributed environment.
   4. To understand the deadlock and shared memory issues and their solutions in distributedenvironments.
   5. understand key mechanisms and models for distributed systems including logical clocks, causality, vector timestamps, consistent global states, replication, fault tolerance etc
   6. learn how to design and implement distributed applications using technologies like RMI
10. Details of the Course:-

Sl. No.	Contents	Contact Hours
1	Characterization of Distributed Systems: Introduction, Examples of distributedSystems, Resource sharing and the Web Challenges. Theoretical Foundation for Distributed System: Limitation of Distributed system,absence of global clock, shared memory, Logical clocks,	9

	Lamport's& vectors logicalclocks, Causal ordering of messages, global state, termination detection.	
2	Distributed Mutual Exclusion: Classification of distributed mutual exclusion,requirement of mutual exclusion theorem, Token based and non token based algorithms,performance metric for distributed mutual exclusion algorithms.	8
3	Distributed Deadlock Detection: system model, resource Vs communication deadlocks,deadlock prevention, avoidance, detection & resolution, centralized dead lock detection,distributed deadlock detection, path pushing algorithms, edge chasing algorithms Agreement Protocols: Introduction, System models, classification of AgreementProblem, Byzantine agreement problem, Consensus problem, Interactive consistencyProblem, Solution to Byzantine Agreement problem, Application of Agreement problem	9
4	Elections in a distributed environment: Concept, A ring-based election algorithm, The bully algorithm Distributed Objects and Remote Invocation: Communication between distributedobjects, Remote procedure call, Events and notifications, Java RMI case study. Transactions and Concurrency Control: Transactions, Nested transactions, Locks,Optimistic Concurrency control, Timestamp ordering, Comparison of methods forconcurrency control	8
5	Case Study: Distributed File Systems File service architecture, Sun Network File System, Introduction to Goolge File System, HDFS and MapReduce	8
	Total	42

Text Books:

4. MukeshSinghal and NiranjanShivaratri, "Advanced Concepts in Operating Systems", McGraw Hill, Edition 1, Reprint 2011
5. Coulouris, Dollimore and Kindberg, "Distributed System: Concepts and Design", PearsonEd, Edition 5, 2017
6. Gerald Tel, "Distributed Algorithms", Cambridge University Press, 1991.
7. Tom White, "Hadoop: The Definitive Guide", O' Reilly, Edition 4, 2015

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 203 Course Title: **Artificial Intelligence and Expert Systems**
2. Contact Hours: L: 3 T: - P: -
3. Examination Duration (Hrs): Theory 3 hrs Practical Nil
4. Relative Weight: CWS 25 PRS MTE 25 ETE 50 PRE
5. Credits: 3
6. Semester: 2
7. Subject Area: Core Course
8. Pre-requisite: Probability and statistics automata and languages
9. Objective: To study the idea of intelligent agents and search methods, representing knowledge, reasoning and decision making in uncertain world, to construct plans and methods for generating knowledge and concepts of expert systems.

   Learning Outcomes

   1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
   2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
   3. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
   4. Demonstrate profciency developing applications in an 'AI language', expert system shell, or data mining tool.
   5. Demonstrate profciency in applying scientifc method to models of machine learning.
   6. Apply the knowledge of AI and agents in developing multidisciplinary real world projects.

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	**Introduction to Artificial Intelligence:**Overview of AI-general concepts-AI Problems-Underlying Assumptions-What is an AI-AI vs Natural Intelligence-Application of AI-Problem Spaces and Search – Search techniques – BFS, DFS – Heuristic search techniques-Importance of Heuristic Functions.	8

Unit II	**Knowledge Representation:**Knowledge-General Concepts – Representations and Mappings-Approaches to Knowledge Representation-Procedural vs Declarative Knowledge-Predicate logic-representing simple fact – instance and ISA relationships – resolution-natural deduction-Natural Deduction-Structured Representation-Semantic Networks.	8
Unit III	**Knowledge Organisation and Manipulation:**Procedural Vs declaration knowledge-forward Vs backward reasoning – matching techniques – control knowledge/strategies-symbol reasoning under uncertainty – introduction to non – monotonic reasoning-logic for monotonic reasoning-implementation issues-augmenting a problem solver-statistical reasoning-Bayesian Networks-Dempester-Shafer theory-Experts Systems.	8
Unit IV	**Perceptron – Communication and Expert Systems:**Natural language processing – pattern recognition – visual image understanding – expert system architecture.	8
Unit V	**Knowledge Acquisition:**Knowledge acquisition-general concepts – learning – learning by induction – explanation based learning.	8
	Total	40

Text Books

1. Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw Hill, New Delhi, 1991.
2. Stuart Russell and Peter Norvig, Artificial Intelligence: A modern approach. Prentice Hal, 1995

References

1. Nilson N.J. Principles of Artificial Intelligence, Springer Verlag, Berlin, 1980.
2. Patterson, Introduction to Artificial Intelligence and Expert systems, Prentice Hall of India, New Delhi, 1990.

Name of Department:-Computer Science and Engineering

1. Subject Code: MCS 301 Course Title: **Soft Computing**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 Practical
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 3
7. Subject Area: Core Course
8. Pre-requisite: Basic knowledge of artificial Intellegence subject
9. Objective: To familiarize with soft computing concepts. To introduce the ideas of Neural networks, fuzzy logic and use of heuristics based on human experience.To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.

Learning outcomes:

1. Recognize the feasibility of applying a soft computing methodology for a particular problem
2. Able to apply Artificial Neural Networks to solve various problems
3. Apply neural networks to pattern classification and regression problems
4. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
5. Apply genetic algorithms to combinatorial optimization problems
6. Evaluate and compare solutions by various soft computing approaches for a given problem.

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Fundamentals of ANN: The Biological Neural Network, Artificial Neural Networks - Building Blocks of ANN and ANN terminologies: architecture, setting of weights, activation functions - McCulloch-pitts Neuron Model, Hebbian Learning rule, Perception learning rule, Delta learning rule.	8
Unit II	Models of ANN: Single layer perception, Architecture, Algorithm, application procedure - Feedback Networks: Hopfield Net and BAM - Feed Forward Networks: Back Propogation Network (BPN) and Radial Basis Function Network (RBFN) – Self Organizing Feature Maps: SOM and LVQ	8
Unit III	Fuzzy Sets, properties and operations - Fuzzy relations, cardinality, operations and properties of fuzzy relations, fuzzy composition.	8

Unit IV	Fuzzy variables - Types of membership functions - fuzzy rules: Takagi and Mamdani – fuzzy inference systems: fuzzification, inference, rulebase, defuzzification.	8
Unit V	Genetic Algorithm (GA): Biological terminology – elements of GA: encoding, types of selection, types of crossover, mutation, reinsertion – a simple genetic algorithm – Theoretical foundation: schema, fundamental theorem of GA, building block hypothesis.	10
	Total	42

Text Books

1. S. N. Sivanandam, S. Sumathi, S.N. Deepa, Introduction to Neural Networks usingMATLAB 6.0 , Tata McGraw-Hill, New Delhi, 2006
2. S. N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Wiley-India, 2008.
3. D.E. Goldberg, Genetic algorithms, optimization and machine learning, Addison Wesley 2000.

Reference Books

1. Satish Kumar, Neural Networks – A Classroom approach, Tata McGraw-Hill, New Delhi, 2007.
2. Martin T. Hagan, Howard B. Demuth, Mark Beale, Neural Network Design,
3. Thomson Learning, India, 2002.
4. B. Kosko, Neural Network and fuzzy systems, PHI, 1996.
5. Klir& Yuan, "Fuzzy sets and fuzzy logic – theory and applications, PHI, 1996.
6. Melanie Mitchell, An introduction to genetic algorithm, PHI, India, 1996.

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 124 Course Title: **Data Warehousing and Data Mining**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 Practical
4. Relative Weight: CWS 25 PRS MTE 25 ETE 50 PRE
5. Credits: 3
6. Semester: 1
7. Subject Area: Departmental Elective -1
8. Pre-requisite: DBMS
9. Objective: To understand about data and data ware housing and architecture required for data flow. Methodology and tool and technology understanding

   Learning Outcomes:

   1. To understand the need for data warehouse;
   2. To identify components in typical data warehouse architecture;
   3. To design a data warehouse in support of business problem solving;
   4. To understand typical knowledge discovery process and the different algorithms available by popular commercial data mining software; and
   5. To obtain hands-on experience with some popular data mining software.
   6. Find the association rules.
10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Introduction to Data Warehousing: Evolution of Data Warehousing, Data Warehousing concepts, Benefits of Data Warehousing, Comparison of OLTP and Data Warehousing, Problems of Data Warehousing.	8
Unit II	Architecture: Operational Data and Datastore, Load Manager, Warehouse Manager, Query Manager, Detailed Data, Lightly and Highly summarised Data, Archive/Backup Data, Meta-Data, architecture model, 2-tier, 3-tier and 4-tier data warehouse, end user Access tools.	8
Unit III	Tools and Technologies: Extraction, cleaning and Transformation tools, Data Warehouse DBMS, Data Warehouse Meta-Data, Administration and management tolls, operational vs. information systems. OLAP & DSS support in data warehouse.	8
Unit IV	Designing Data warehouse Database, Database Design Methodology for Data Warehouses, Data Warehousing design Using Oracle, OLAP and data mining: Online Analytical processing, Data mining.	8

Unit V	Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining Various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction - Basic Concepts - Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Backpropagation – Support Vector Machines	10
	Total	42

Text Books

1. Paul Raj Poonia, "Fundamentals of Data Warehousing", John Wiley & Sons, 2010
2. Sam Anahony, "Data Warehousing in the real world: A practical guide for building decision support systems", John Wiley, 2008.

References

1. W. H. Inmon, "Building the operational data store", John Wiley, 1999.
2. Kamber and Han, "Data Mining Concepts and Techniques", Hartcourt India P. Ltd., 2011.

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 125 Course Title: **Cloud Computing**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 Practical
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Departmental Elective-I
8. Pre-requisite: Undergraduate course in Distributed System, ability to program e.g. C or Java.
9. Objective: To identify cloud computing models, characteristics, and technologies relevant to area of work. To identify appropriate programming tools that allow for the flexibility, scalability and interoperability required for a cloud application.
10. Learning Outcomes:
    This course contributes to the following program learning outcomes:

    1. To provide students with the fundamentals and essentials of Cloud Computing
    2. Describe the different paradigms of cloud computing.
    3. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
    4. Use the cloud services.
    5. To understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing
    6. To enable students exploring some important cloud computing driven commercial systems such as GoogleApps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.

11. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Introduction to Cloud Computing: History of Cloud Computing, Cloud Architecture, Cloud Storage, Why Cloud Computing Matters, Advantages of Cloud Computing , Disadvantages of Cloud Computing,Organizations in the Cloud Today, Cloud Services.	6
Unit II	Developing Cloud Services: Web-Based Application, Pros and Cons of Cloud Service Development, Types of Cloud Service Development, Software as a Service, Platform as a Service, Web Services, On-Demand Computing, Discovering Cloud Services Development Services and Tools, Amazon Ec2, Google App Engine, IBM Clouds.	10
Unit III	Cloud Computing for Everyone: Centralizing Email Communications, Collaborating on Schedules, Collaborating on To-Do Lists, Collaborating Contact Lists, Cloud Computing for the Community, Collaborating on	10

	Group Projects and Events, Cloud Computing for the Corporation.	
Unit IV	Using Cloud Services: Collaborating on Calendars, Schedules and Task Management, Exploring Online Scheduling Applications, Exploring Online Planning and Task Management, Collaborating on Event Management, Collaborating on Contact Management, Collaborating on Project Management, Collaborating on Word Processing, Collaborating on Databases, Storing and Sharing Files.	10
Unit V	Other Ways to Collaborate Online: Collaborating via Web-Based Communication Tools, Evaluating Web Mail Services, Evaluating Web Conference Tools, Collaborating via Social Networks and Groupware, Collaborating via Blogs and Wikis.	6
	Total	42

Text Books

1. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.

2. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 124 Course Title: **Internet of things**
2. Contact Hours: L: 3 T: - P: -
3. Examination Duration (Hrs): Theory 3 Practical -
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE
5. Credits: 3
6. Semester: I
7. Subject Area: Elective course
8. Pre-requisite: Fundamentals of Computer and any Programming Language
9. Learning outcomes:

1.Explain the terms used in IoT.
2. Describe key technologies in Internet of Things.
3. Identify components needed to provide a solution for certain applications.
4. Analyze security requirements in an IoT system.
5. Design wireless sensor network architecture and its framework along with WSN applications.
6. Understand business models for the Internet of Things.

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	INTRODUCTION Introduction to Internet of Things: History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks: IoT Definitions, IoT Architecture, General Observations, ITUT Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities.	8
Unit II	FUNDAMENTAL IoT MECHANISMS AND KEY TECHNOLOGIES Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology.	10
Unit III	RADIO FREQUENCY IDENTIFICATION TECHNOLOGY RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPCGlobal Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things. Wireless Sensor Networks: History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes,	10

	Securing Communication WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure establishment.	
Unit IV	RESOURCE MANAGEMENT IN THE INTERNET OF THINGS Clustering, Software Agents, Clustering Principles in an Internet of Things Architecture, Design Guidelines, and Software Agents for Object Representation, Data Synchronization. Identity portrayal, Identity management, various identity management models: Local, Network, Federated and global web identity, user-centric identity management, device centric identity management and hybrid-identity management, Identity and trust.	10
Unit V	INTERNET OF THINGS PRIVACY, SECURITY AND GOVERNANCE Vulnerabilities of IoT, Security requirements, Threat analysis, Use cases and misuse cases, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT. Internet of Things Application: Smart Metering Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards.	10
	Total	48

Text Books 1.

1. 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
2. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer
3. Parikshit N. Mahalle&Poonam N. Railkar, “Identity Management for Internet of Things”, River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).

Reference Books

1. HakimaChaouchi, “The Internet of Things Connecting Objects to the Web” ISBN : 978-1- 84821-140-7, Willy Publications
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications
3. Daniel Kellmereit, Daniel Obodovski, “The Silent Intelligence: The Internet of Things”,. Publisher: Lightning Source Inc; 1 edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978-0989973700.
4. Fang Zhaho, Leonidas Guibas, “Wireless Sensor Network: An information processing approach”, Elsevier, ISBN: 978-81-8147-642-5.

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 129 Course Title: **Algorithms Design and Techniques**
2. Contact Hours: L: 3 T: - P: -
3. Examination Duration (Hrs): Theory 3 Practical -
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE
5. Credits: 3
6. Semester: I
7. Subject Area: Elective course
8. Pre-requisite: Basic understanding of Data Structures, Fundamentals of any programming language
9. Objective: To provide students with the insight and understanding on a wide range of advanced algorithmic problems, their computational complexity, relations and variants, and application to solving practical problems efficiently.

Learning outcomes:

1.Applying different asymptotic notations to analyze time complexity of Various algorithms
2. Analyze the various Dynamic data structure like link lists,stacks,queues ,AVL trees etc for designing efficient algorithms
3. Provide optimal solutions to complex problems by applying greedy and dynamic programming approaches like fractional knapsack,0/1 knapsack, Longest Common Subsequence, Levenshtein Edit distance etc
4. Apply Heuristic Algorithms to predict the complexity of various NP complete problems
5. Implement various graph algorithms like Dijkstra's, Bellman-ford, Prim's, DFS to provide optimized results for real world problems
6.Understand pattern matching algorithms and apply them in various domains of computer science to solve some complex problems.

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	**Review: Analysis Techniques** Mathematical Review, Growth of Functions: Asymptotic notations- Big Oh, Omega, Theta, Small-oh; Solving Recurrence relations, The Master's method; Amortized Analysis, Review and analysis of sorting methods: insertion sort, merge sort, quick sort etc.	10
	Dynamic Data Structures and Algorithmic Techniques Dynamic Data structures: Linked lists, Stacks, Queues,	

Unit II	Implementing Stacks using queues, binary trees, AVL trees, Heaps; Hashing.	8
Unit III	**Algorithmic Techniques and Analysis** Basic algorithmic techniques: Greedy methods - Fractional Knapsack, divide- and-conquer with some examples and their analysis, Dynamic programming- 0/1 Knapsack, Unbounded Knapsack, Longest Common Subsequence, Levenshtein Edit distance, Subset sum problem.	8
Unit IV	**Graph Algorithms and String-Matching Algorithms** Graph Algorithms and their analysis: Minimum Spanning tree, Shortest path - Dijkstara, Bellman Ford Algorithm; Floyd Warshall, Johnson's Algorithm for sparse graphs; Transitive closue, Flow networks and Ford-Fulkerson method; Graph Traversal algortihms - BFS, DFS, Topological sorting, Strongly connected components. String Matching Algortihms.	10
Unit V	**NP Completeness and Approximation Algorithms** NP Complete Problems, P Vs NP, Approximation Algorithms, Heuristic Algorithms.	6
	Total	42

Text books:

1. T. H. Cormen, C E Leiserson, R L Rivest and C Stein, "Introduction to Algorithms, 3rd Edition", Prentice-Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul, "Algorithms, Cengage Learning", 2002.
3. Michael T. Goodrich, Roberto Tamassia, "Data Structures and Algorithms in Java", 3rd Edition, John Willy & Sons, 2010.

Reference Books:

1. Anany V. Levitin, "Introduction to the Design & Analysis of Algorithms", 2/E, Pearson Education India, 2011.
2. Ellis Horowitz, SartajSahni, S.Rajasekharan, "Fundamentals of Computer Algorithms", 2nd Edition, Universities press, 2007.
3. NarasimhaKarumanchi, "Data Structures and Algorithms made easy", 2nd Edition Career Monk Publications, 2011.

Name of Department: - Computer Science and Engineering

1. Subject Code: MCS 131 Course Title: **Applied Data Science**
2. Contact Hours: 3 - -
3. Semester: **I**
4. Prerequisite: Fundamental of Python
5. Course Outcomes: After completion of the course students will be able to

    1. Analyze data science methodologies in order to assess best practice guidance when applied to real-world problems in specific contexts
    2. Evaluate key concepts of statistics, data visualization and data science techniques
    3. Assess when to apply Data Science techniques in practical situations
    4. Contextualise, implement machine learning models using different statistical tools
    5. Understand fundamental principles of statistics and data scienceapplications and technologies
    6. Provide strategies to address processing of datasets with a variety of characteristics.

6. Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit – I	**Data Science in Real life:** Defining Data Science, What do Data Science People do, Data Science in Business, Use Cases for Data Science **Introduction to R:** Importance of R, Data Types and Variables in R, Operators in R, Conditional Statements in R, Loops in R, R script, Functions in R	**10**

Unit – II	**Data Preprocessing:**Discrete random variables, Continuous random variable, Discrete random variables. Missing values, Data-collection, staging, cleaning, tranformation, consolidation, Data consistency	**8**
Unit – III	**Data Visualization:** Introduction to Data Visualization, Data Visualization using Graphics in R, Use of Colors, size and shape Function of ggplot, File Formats of Graphic Outputs	**9**
Unit – IV	**Machine Learning:** Introduction to Machine Learning: Introduction to modern dataanalysis, Definition of Machine Learning. Classification- K-Nearest Neighbors approach, Naïve Bayes, Decision Trees. Evaluation of performance Measures: Quality assessment: Accuracy,Precision, Recall, F - measure, Confusion-matrix, Kappa and learningcurves-ROC Regression Analysis, Clustering, Association Rules	**10**
Unit – V	**Statistics for Data Science:** Discrete random variables, Continuous random variable, Discrete random variables. Markov-chain Monte Carlo, Descriptive Statistics- Sample covariance , Sample covariance matrix, Outlier. Bayesian classification, Central Limittheorem, Data Exploration & preparation, Confidence Interval, The hypothesis-testing, Z-Score.	**10**
	Total	**47**

Text Books:

1. C. Bishop, “Pattern Recognition and Machine Learning, Springer”, 2006.

2. John M. Quick, “Statistical Analysis with R”, Pckt Publishing, 2010 Sheldon
3. Han, J., Kamber, M., Pei, J. Data Mining: Concepts and Techniques, Third Edition. – Morgan Kaufmann Publishers, 2011. – 740 pp.

Name of Department: - Computer Science and Engineering

1. Subject Code: MCS 132 Course Title: **Applied Cyber Security**
2. Contact Hours: 3 - -
3. Semester: **I**
4. Prerequisite: Fundamental of network security
5. Course Outcomes: After completion of the course students will be able to

1. Understand the importance of a systematic procedure for investigation of data found on digital storage media that might provide evidence of wrong-doing.
2. Identify and document potential security breaches of computer data that suggest violations of legal, ethical, moral, policy and/or societal standards
3. Use tools for faithful preservation of data on disks for analysis and find data that may be clear or hidden on a computer or another device
4. Work with computer forensics tools used in data analysis, such as searching, absolute disk sector viewing and editing, recovery of files, password cracking, etc.
5. Present the results of forensics analysis as an expert.
6. Discuss the Cyber Laws and Cyber Crimes.

6. Details of the Course: -

UNIT	CONTENTS	Contact Hrs
Unit - I	**Cyber Crimes, Laws and Cyber Forensics:** Introduction to IT laws & Cyber Crimes, The World and India **Cyber Forensics Investigation**: Introduction to Cyber Forensic Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Encryption and Decryption methods, Search and Seizure of Computers, Recovering deleted evidences, Password Cracking	**9**
Unit - II	**Digital Forensics Fundamentals:** Introduction to Incident response, digital forensics stepwise procedure, Computer/network/Internet forensic and anti-forensics , Unix/Linux incident response, Unix/Linux forensics investigation steps and technologies, Memory forensics, Windows incident response tools , Windows forensics tools **Data and Evidence Recovery**- Introduction to Deleted File Recovery, Formatted Partition Recovery, Data Recovery Tools, Data	**9**

	Recovery Procedures and Ethics, Preserve and safely handle original media, Document a "Chain of Custody", Complete time line analysis of computer files based on file creation, file modification and file access, Recover Internet Usage Data, Recover Swap Files/Temporary Files/Cache Files, Introduction to Encase Forensic Edition, Forensic Tool Kit (FTK) etc, Use computer forensics software tools to cross validate findings in computer evidence-related cases, Dump Analysis, Browser forensics, Multimedia forensics, Taking RAM dump and Volatile Memory Analysis	
Unit – III	**Software Security:** Memory Layout, Buffer Overflow, Code Injection, Other Memory Exploits, Format String Vulnerabilities, Defenses against low-level exploits: Memory Safety, Type Safety, Avoiding Exploitation, Return Oriented Programming, Control Flow Integrity, Secure Coding; Web Security: Basics, SQL Injection, Countermeasures, Session Hijacking, Cross Site Scripting, Program Analysis **Image Analysis**: Using software to analyze an image, Searching image for evidence, File carving	**10**
Unit – IV	**Hardware Security:** Digital System Specification, Watermarking, Good Watermarks, Fingerprinting, Hardware metering, Physical Attacks and Countermeasures, Modular Exponentiation (ME) Basics, ME in Cryptography, ME Implementation and Vulnerability, Montgomery Reduction	**8**
Unit – V	**Analysis and Validation:** Types of Investigation Software, Validating Forensics Data, Data Hiding Techniques, Performing Remote Acquisition, Network Forensics, Email Investigations, Cell Phone and Mobile Devices Forensics, Virtual Machin Forensics, Cloud forensics, Live forensics **Case Studies:** Blackmailing, Credit-Card fraud, Hosting Obscene Profiles, Illegal money transfer, Fake Travel Agent	**8**
	Total	**44**

TEXT BOOKS:

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, —"Computer Forensics and Investigations", Cengage Learning, India Edition, 2016
2. MarjieT.Britz, "Computer Forensics and Cyber Crime": An Introduction", 3rd Edition, Prentice Hall

REFERENCES:

1. Kenneth C.Brancik —"Insider Computer Fraud Auerbach Publications Taylor"; Francis Group
2. "CEH official Certfied Ethical Hacking Review Guide", Wiley India Edition, 2015

Name of Department: - Computer Science and Engineering

1. Subject Code: MCS 133 Course Title: **Applied AI using Python**
2. Contact Hours: 3 - -
3. Semester: **I**
4. Prerequisite: Fundamental of python
5. Course Outcomes: After completion of the course students will be able to

    1. Understand the basics of the theory and practice of Artificial Intelligence.
    2. Learn the basics of Artificial Intelligence programming.
    3. Understand various searching techniques use to solve the AI problems.
    4. Apply knowledge representation techniques and problem solving strategies to common AI applications.
    5. Build self-learning and research skills to tackle a topic of interest on his/her own or as part of a team.
    6. Apply the knowledge of AI and agents in developing multidisciplinary real world projects

6. Details of the Course: -

UNIT	CONTENTS	Contact Hrs
Unit - I	Introduction: Introduction to Artificial Intelligence, Simulation of sophisticated & Intelligent Behavior indifferent area, problem solving in games, natural language, automated reasoning visual perception, heuristic algorithm versus solution guaranteed algorithms.	**9**
Unit - II	Understanding Natural Languages Parsing techniques, context free and transformational grammars, transition nets, augmented transition nets, Fillmore's grammars, Shanks Conceptual Dependency, grammar free analyzers, sentence generation, and translation.	**9**
Unit – III	Knowledge Representation First order predicate calculus, Horn Clauses, Introduction to PROLOG, Semantic Nets Partitioned Nets, Minskey frames, Case Grammar Theory, Production Rules KnowledgeBase, The Inference System, Forward & Backward Deduction	**10**
Unit – IV	Expert System Existing Systems (DENDRAL, MYCIN), domain exploration, Meta Knowledge, ExpertiseTransfer, Self Explaining System	**8**
Unit – V	Pattern Recognition Introduction to pattern Recognition, Structured Description, Symbolic Description, Machineperception, Line Finding, Interception, Semantic, & Model, Object Identification, SpeechRecognition.	**8**
	Total	**44**

Text/ Reference Books:

1. Charnick “Introduction to Artificial Intelligence.” Addision Wesley.

2. Rich & Knight, “Artificial Intelligence”.TMH

3. Winston, “LISP”, Addison Wesley.

4. Marcellous, “Expert Systems Programming”, PHI.

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS-128 Course Title: **Machine Learning**
2. Contact Hours: L: 3 T: 1 P: 2
3. Semester: I

4. Course Outcomes: After completion of the course students will be able to

1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
3. Appreciate the underlying relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
4. Utilize the structure and design concepts of neural networks applications to solve real life problems
5. Plan and execute successful machine learning and big data projects, including selecting an adequate process for the specific task and avoiding the machine learning pitfalls.
6. Understand the issues raised by current research in the field of machine learning

5.Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit - I	**Review of Statistical Concepts:** Mean, Median, Mode, Outliers, Range, Average Deviation, Absolute Deviation, Squared Deviation, Standard Deviation, Total Sum of Squares. **Review of Linear Algebra:**Vectors and Matrices, Addition and Multiplication of Scalars, Matrix Multiplication Properties, Inverse and Transpose. **Introduction to Machine Learning:** What is Machine Learning, Introduction to ML's three approaches: Supervised, Unsupervised and Reinforcement Learning. **Introduction to Matlab/Octave:**BasicOpeartions, Moving Data Around, Flow Control, Vectorization. **Introduction to Python:** BasicOpeartions**,** Lists, Tuples,	**10**

	Dictionaries, Flow Control, Strings, File handling, Numpy, Scikit-learn, Orange.	
Unit - II	**Validation Techniques:** Hold out, K-Fold Cross Validation, Leave one out, Bootstrapping. **Supervised Learning Algorithms:**Linear Regression, Logistic Regression, Decision Trees, Random Forest, Support Vector Machine,K-Nearest Neighbours, CN2 Algorithm, Naive Bayes, Artificial Neural Networks. **Ensemble Learning:** Bagging,Random Forest, AdaBoost, Bucket of Models, Stacking	**10**
Unit – III	**Clustering:** K-means, Silhoutte Scores, Hierarchical Clustering, Fuzzy c-means, DBScan **Dimensionality Reduction:**Low Variance Filter, High Correlation Filter, Backward Feature Elimination,Forward Feature Selection,Principle Component Analysis, Projection Methods. **Association Rule Learning:** Support, Confidence, Lift, Conviction, Apriori Algorithm, Eclat Algorithm.	**8**
Unit – IV	**The Rise of Deep Learning:**Mask R-CNN, Yolo, AlexNet, VGG, MobileNet, Deeplab, Fully Convolutional Networks, Image captioning (CNN+LSTM), Word2vec, Doc2Vec, Autoencoder. **Deep Learning Tools:** TensorFlow, PyTorch, Keras	**14**
Unit – V	**Reinforcement Learning:** Agent, Environment, Rewards, States, Actions, Policy, Value, Q-value, Trajectory, Three approaches to Reinforcement Learning, Markov Decision Process, Q Learning, State-Action-Reward-State-Action (SARSA), Deep Q-Network (DQN), Deep Deterministic Policy Gradients (DDPG), Motey Carlo Methods, OpenAI Gym.	**7**
	Total	**49**

Text and Reference Books

1. John Paul Mueller and Luca Massaron ,"Machine Learning For Dummies",
2. "A Course in Machine Learning", Hal Daumé III.
3. Toby Segaran,"Programming Collective Intelligence: Building Smart Web 2.0 Applications",
4. WilliRichert and Luis Pedro Coelho ,"Building Machine Learning Systems with Python",
5. RaúlGarreta and Guillermo Moncecchi,"Learning scikit-learn: Machine Learning in Python",
6. ", Peter Harrington ,"Machine Learning in Action

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 201 Course Title: **Advanced Software Engineering**
2. Contact Hours: L: 3 T: - P: -
3. Examination Duration (Hrs): Theory 3hrs Practical -
4. Relative Weight: CWS 25 PRS - MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Core course
8. Pre-requisite: Software development experience in at least one mainstream programming language such as C, C++, Java and designing tool handling knowledge.
9. Objective: This course objectives are to develop understanding of the concepts and methods required for the construction of large software intensive systems with extensive understanding of the software engineering activities.

Learning Outcomes: This course contributes to the following learning outcomes:

1. A solid understanding to the methods of modern software engineering
2. A critical understanding of and be able to apply state-of-the-art software development methodologies
3. To model complex software systems using standards-based notations, and understand their role in the project life-cycle
4. To develop, adapt and test medium-sized software systems, using available tools as appropriate
5. To understand software project planning, software quality assurance , management of SCM and CBSE
6. Apply practices such as test-driven development, standup meetings, and pair programming to their software engineering practices.

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	**Overview:** Introduction, Socio-technical system, critical System, Software process, Software engineering activities, Skills and Challenges, ,The process of software development: basic and Industry oriented process models. **Software Requirement specification**: Software requiremets, Requirement Engineering processes, Syetem models, Specification techniques for software, Critical system specification, Clean Room Software Engineering,	9

	Formal specification.	
Unit II	**Design concepts and principles:** Architectural Design, Distributed Systems Architecture, Application Architectures, Object-Oriented Design, Real-Time Systems, User-Interface Design.	9
Unit III	**Varification and Validation**, Software Testing: sytem testing, component testing, Designing test cases, Debugging – Introduction to O-O testing, Critical Systems Validation. *Software Maintenance:* Necessity, Categories: Preventive, Corrective and Perfective, Maintenance Cost; Risk Management.	8
Unit IV	**Software project planning:** Software Metrics: Various Size Oriented Measures, Halstead's Software Science, Function Point(FP) Based measures,Cyclomatic Complexity measures, COCOMO model. ***Software Quality Assurance(SQA):*** Software Reliability – The ISO 9000 Quality standards – Capability Maturity Model (CMM). ***Software Configuration Management (SCM):*** The SCM process and standards CVS (Concurrent Versions System)- Change control –Source Code Control System (SCCS). **Software Reuse:** Reusable artifacts, Reusable process models,Domain Analysis, Domain Engineering, Component-Based Engineering (CBSE) .	10
Unit V	Study of Reenginerring, *Case Study of a project.* *Note*: Students are required to do case study of one project during the course work.*	6
	Total	42

Text Books

1. Ian Somerville, "Software Engineering", Pearson Education India, 8th edition, 2008.
2. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", 6th edition, McGraw Hill, 2010.

3. Bernd Bruegge and Allen H. Dutoit, “Object-Oriented Software Engineering: Using UML, Patterns, and Java”, Pearson Education India, 2nd Edition, 2004.
4. SagarNaik, PiyuTripathy, “Software Testing and Quality Assurance: Theory and Practice”, Wiley & Sons, 2011
5. Bob Hughes, Mike Cotterell, “Software project management”, McGraw-Hill Higher Education, 2009.
6. Steinberg D, Palmer D, “Extreme Software Engineering: A Hands-On Approach”, Prentice Hall, 2003.
7. Ahern M D, Clouse A, Turner R, “CMMI Distilled: A Practical introduction to Integrated Process Improvement”, Second Edition, Pearson Education, Inc, 2004

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 225 Course Title: **Developing Applications in the Cloud**
2. Contact Hours: L: 3 T: - P: -
3. Semester: II

4. Pre-requisite: Fundamentals of Cloud computing

5. Course Outcomes: After completion of the course students will be able to

- Understand the development environments platforms
- Analyze Various Practical Cloud Applications
- Develop cloud services in collaborative environments
- Understand Advance Cloud Computing Concepts
- Describe Application Deployment & Cloud Management Concepts
- Use Various Cloud Platforms

6.Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit - I	**Cloud Computing Fundamentals**: Cloud computing and its model, Client –Server Computing Model, Cluster and Grid Computing, Data Intensive Computing, Public, Private andHybrid Cloud, Cloud Services Providers	**9**
Unit - II	**Cloud Platforms in Industry** Amazon Web Services: Compute Services, Storage Services, Communication Services, Additional ServicesGoogleAppEngine: Architecture & Core Concepts, Application Life Cycle, Cost Model, ObservationsMicrosoft Azure: Azure Core Concepts, SQL Azure, Windows Azure Platform ApplianceIBM Cloud, Salesforce, Heroku	**9**
Unit – III	**Advanced Cloud Computing** Energy Efficiency in Clouds, Green Cloud Computing Architecture, Market based Management of Clouds, Market-Oriented Cloud Computing , Reference Model for MOCC , Federated Clouds/Intercloud , , Characterization and Definition , Cloud Federation Stack , Technologies for Cloud Federation , Third Party Cloud Services , MetaCDN , Spot Cloud , Cloud Authentication	**10**

	Protocols , Security Threats with Cloud Apps	
Unit – IV	**Cloud Management** Introduction to Cloud Management, Fundamentals of Cloud Management, Management Services, Cloud properties, Multi-tier Application Deployment in Clouds, Challenges & Requirements, Service Level Agreements (SLAs),Billing& Accounting, Cloud Policy and Governance: Risk Management and Regulatory Practices.	**8**
Unit – V	**Cloud Application** Current Trends in Cloud Computing, Future scope of Cloud-computing in Various Field like IOT, Machine Learning. Case Study on AWS, EC2 (Compute), S3(Storage),RedShift(Data Warehouse),GitHub, Repository, Introduction to GitHub: Introduction of Creating Repository, How to use Github Repository	**9**
	Total	**45**

Text/Reference Books

1. RajkumarBuyya, Vecchiola&Selvi,"Mastering Cloud Computing" (Published by Mc Graw Hill Education Pvt. Ltd) - 2013
2.Imad.M.Abbadi,"Cloud Management & Security" (WILEY Publication 2014)
3. by ArshdeepBahga, Vijay Madisetti,"Cloud Computing – A Hands-On Approach" (2014)

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 226 Course Title: **Virtual and Augmented Reality**
2. Contact Hours: L: 3 T: - P: -
3. Semester: II

4. Pre-requisite: Excellent in mathematics and Computer Graphics

5. Course Outcomes: After completion of the course students will be able to

1. Demonstrate an understanding of techniques, processes, technologies and equipment used in virtual reality
2. Identify appropriate design methodologies for immersive technology development, especially from a physiological perspective
3. Exploit the characteristics of human visual perception in Virtual Reality techniques
4. Provide rendering to VR specific problems
5. Effectively categorize the benefits/shortcomings of available VR technology platforms.
6. Discuss the use of geometry in virtual reality

6. Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit - I	**Introduction**: Goals, VR definitions, Birds-eye view (general, hardware, software, sensation and perception), Applications of VR, Technical framework, Mixed and Augmented Reality **Geometry of Virtual Worlds**: Geometric modeling, Transforming models, Matrix algebra, 2D and 3D rotations, Axis-angle representations, Quaternions, Converting and multiplying rotations, Homogeneous transforms, Eye Transforms, Canonical view transform, Viewport Transform	**8**
Unit - II	**Light and Optics:** Interpretations of light, Refraction, Simple lenses, Diopters, Imaging properties of lenses, Lens aberrations, Photoreceptors, Sufficient resolution for VR, Light Intensity, Eye movements for VR, Neuroscience of vision	**9**
Unit – III	**Visual Perception and Tracking Systems**: Depth perception, Motion Perception, Frame rates and displays, Orientation Tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach	**9**

Unit – IV	**Visual Rendering**: Shading models, rasterization, Pixel shading, VR specific problems, Distortion shading, Post-rendering image wrap	**9**
Unit – V	Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.	**8**
	Total	**43**

Text Books:

1. Grigore C. Burdea , Philippe Coiffet," Virtual Reality Technology", Wiley-IEEE press
2. Marschner, Shirley "Fundamentals of Computer Graphics", 4th Edition, CRC Press 2016
3. LaValle "Virtual Reality", Cambridge University Press, 2016
4. Virtual Reality by Steve Lavalle (online open book)

Reference Books:

1. K. S. Hale and K. M. Stanney, "Handbook on Virtual Environments", 2nd edition, CRC Press, 2015
2. George Mather," Foundations of Sensation and Perception:" Psychology Press

Name of Department: - Computer Science and Engineering

1. Subject Code: MCS 230 Course Title: **Blockchain Technology**
2. Contact Hours: 3 - -
3. Semester: **II**
4. Prerequisite: Fundamental of Cryptography
5. Course Outcomes: After completion of the course students will be able to

1. Explain blockchain technology and its immutable property
2. Know the working of distributed ledger
3. Analyse the different consensus protocols
4. Use Ethereum to implement Blockchain
5. Apply blockchain techniques in different applications
6. Develop blockchain based frameworks to secure a communication environment

6. Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit - I	Introduction to blockchain- Overview of blockchain, structure of a block, block header, block identifiers: block header hash and block height, genesis block, linking of blocks, merkle trees, and use of merkle root in payment verification	**8**
Unit - II	Application of cryptography to blockchain- Overview of ECDSA, DSA and RSADS, use of hash functions to chain blocks, use of digital signatures to sign transactions	**10**
Unit – III	Distributed ledger- Introduction to distributed systems, fault tolerance and paxos, byzantine agreement, authenticated agreement, eventual consistency &bitcoin consistency- availability and partitions, bitcoin, smart contracts, weak consistency, distributed storage, consistent hashing mechanism	**8**
Unit – IV	Blockchain mining and consensus- Overview of various consensus algorithms, decentralized consensus, independent verification of transactions, mining nodes, aggregating transactions into blocks, constructing the block header, successfully mining of block, validating a new block, assembling and selecting chains of blocks, consensus attacks, DoS attack on blockchain, changing the consensus rules, soft fork signaling with block version	**10**
Unit – V	Ethereum- Differences between ethereum and bitcoin, block format, mining algorithm, proof-of-stake (PoS) algorithm, account management, contracts and transactions, decentralized applications	**10**

	using ethereum proof-of-stake (PoS) algorithm, contracts and transactions, other blockchain platforms. Applications- Blockchain in banking and finance, smart contracts, blockchain enabled secure Internet of Things, blockchain in healthcare, blockchain based supply chain management.	
	Total	**46**

Text Books:

- George Icahn, “Blockchain: the complete guide to understanding blockchain technology”, 2020.
- Antony lewis, “The basics of bitcoins and blockchains: an introduction to cryptocurrencies and the technology that powers them” 2020.

Reference Books:

- Andreas M. Antonopoulos, “Mastering Bitcoin: unlocking digital cryptocurrencies”, O'Reilly Media,(2e) 2017.
- Roger Wattenhofer, “Distributed Ledger Technology, The science of the Blockchain”, Inverted Forest Publishing,(2e), 2017
- Antonopoulos, Andreas M. and Wood, Gavin. Mastering Ethereum. O’Reilly Media, 2018.

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS-228 Course Title: **Microservice Architecture**

   3 - -

2. Contact Hours: L: 3 T: P:

3. Examination Duration (Hrs): Theory 3 Practical -

4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE

5. Credits: 3

6. Semester: 2

7. Subject Area: Elective course

8. Learning outcomes:

   1. Understand microservices architecture
   2. Design, Develop, Deploy and Monitor microservice based system
   3. Implement software architecture patterns for a distributed system to allow scalability whilst maintaining consistency
   4. Comprehend implications and challenges of microservices (and how to overcome those challenges)
   5. Add theirmicroservices to a continuous integration & continuous delivery pipeline
   6. Estimate, and reduce maintenance and running costs

9. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Microservice Design Principles: Why Microservice, Monolithic Application, Complex Release Cycles, Scaling the Team, Scaling the System Ideal software development practice, Microservices characteristics, Fine-grained SOA, Microservice Design Principles: Designing small microservices, designing independent microservices, Designing resilient microservices, Technical Drivers, Business Drivers	8
Unit II	Microservices Topology: Topology overview, Remote Access, Bounded Context, Fallacies of Distributed Computing; Architectural Quantum: Defining Quantum, Quantum Communication, Quantum Example, Micro Hexagonal Service Design Pattern, Service Taxonomy, Identifying a Taxonomy, Transactions, Data Dependencies, Workflow and Choreography, Code Structure and Reuse	10

Unit III	Core Services: Replication, Shared Libraries, Shared Services, Service Consolidation, Purpose of an API, Service Mesh, Defining Service Domains, Stamp Coupling and Bandwidth Issues, Using Field Selectors; Event-Driven Microservices: Using Messaging Between Services. Asynchronous Messaging, Workflow Event Pattern, Broadcast Capabilities, Request/Reply, Leveraging Events for Responsiveness	8
Unit IV	Codebase Practices: Microservice Template, Code Repository Setup, Microservice Decomposition, Inter Service Communication, Service Registration, Service Discovery, Orchestration and Choreography, Use Cases for Orchestration, Use Cases for Choreography, Issues with Gateway Orchestration, Using Microservice Orchestrators, Orchestration and Loose Coupling, Integrating Microservices Ecosystems, Aggregation vs. Orchestration, Issues with Orchestration, Interfacing With Custom or Third-Party Systems, Migrating Functionality to Microservices	10
Unit V	Microservices and Distributed Data: Change Control Issues, Connection Issues, Bounded Context and Data; Physical Database Instances: Connection Pooling, Performance Issues, Fault Tolerance, Failover Mechanism, Circuit breakers, Logging Techniques, Data Sharing and Choreography, Using Replicated Caching, Data Domains, Data Ownership, Data Services and Data Abstraction Layers, Microservices Migration Patterns: Identifying Logical Components, Flattening and Refactoring Components, Identifying Component Dependencies	8
	Total	44

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 229 Course Title: **Information Retrieval and Natural Language Processing**
2. Contact Hours: L: 3 T: -
3. Examination Duration (Hrs): Theory 3 Practical
4. Relative Weight: CWS 25 PRS MTE 25 ETE 50 PRE
5. Credits: 3
6. Semester: 1
7. Subject Area: Departmental Elective -1
8. Objective:

5. Course Outcomes: After completion of the course students will be able to

1. Demonstrate key concepts from NLP are used to describe and analyze language
2. Examine linguistic properties of English Language
3. Implement POS Tagging and Named Entity Recognition using Python
4. Construct NLP solutions by choosing between traditional and deep learning techniques
5. Explore different Information Retrieval model
6. Acquire the necessary experience to design, and implement real applications using Information Retrieval systems.

6. Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit - I	Introduction to Natural Language Understanding: Overview, Differences between Programming Languages and Natural Languages, Modern Applications of NLP, Basic Steps of NLP: Tokenization, Stemming, Lemmatization, POS Tags, Named Entity Recognition, Chunking Why NLP is hard- Ambiguity in Language Regular Expressions Introduction to NLP libraries: SpaCy and NLTK	**8**
Unit - II	Data Sourcing for NLP, Web Scrapping using Python Bag of Words Model, Implementation of Bag of Words model in Python using NLTK Linguistic Analysis, Language Properties, Syntactic and Semantic	**9**

	Analysis Tool, Morphenes in Linguistics, Difference between Inflectional and Derivational Morphene	
Unit – III	POS Tagging and Named Entity Recognition in SpaCy, Parts-of-Speech Tagging Baseline, Named Entity Recognition Baseline, Analyzing Sentence Structure, Converting text to features and labels, Naive Bayes Classifier, Leveraging Confusion Matrix How to identify the who, what, and where of your texts using pre-trained model Modeling and Semantic Analysis in NLP, Latent Semantic Analysis, Semantics and Word Vectors with SpaCy	**9**
Unit – IV	Introduction toInformationretrieval, Dictionary and Postings, Tolerant Retrieval, Term Weighting and Vector Space model, Query Expansion, Probabilistic Information Retrieval, Text classification, Examples of Text Classification, Linear Classifiers, Deep Learning Techniques	**10**
Unit – V	Evaluate an information retrieval system, average precision (AP) and the normalized discounted cumulative gain (nDCG), practical issues in evaluation, including statistical significance testing and pooling, feedback techniques in information retrieval, eb crawling, web indexing, optimize ranking of documents in web search	**9**
	Total	**45**

Text/ Reference Books:

1. D. Jurafsky, J. H. Martin, Speech and Language Processing, Pearson Education
2. Nitin Indurkhya and Fred J Damerau, "Handbook of natural language processing," Chapman and Hall/CRC
3. C.D. Manning, P. Raghavan, H. Schütze. Introduction to Information Retrieval, Cambridge

Name of Department: - Computer Science and Engineering

1. Subject Code: MCS-321 Course Title: **Services Oriented Cloud Architecture**
2. Contact Hours: L: 3 T: - P: -
3. Semester: **3**
4. Prerequisite: MCS225
5. Course Outcomes: On completion of this course, the student should be able to

   1. Define and understand semantic web, web services and cloud services.
   2. Describe and demonstrate semantic web, web services and cloud services.
   3. Analyze and design service oriented web applications.
   4. Apply semantic web and service oriented knowledge to design and develop a multi tier cloud application.
   5. Deploy multi tier cloud applications.
   6. Evaluate the performance of the multi tier cloud applications.

6. Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit – I	Modules, global assemblies (packages) and sattalite assemblies. Software module dependencies. Interfaces and namespaces. SOLID principles, IoC containers. Introduction to full stack cloud applications, client side, server side and application layer examples. Technologies used at client side, server side and application side.	**10**
Unit – II	Object to Service, Distributed applications and Web services. Technologies and frameworks for distributed and server side application development.	**9**
Unit – III	SOA: Cloud service accessibility;cloud service visibility; cloud service extensibility;Cloud service SLAs; cloud service deploymentusing SOA contract-management techniques; SOA policymanagement techniques	**9**
Unit – IV	Designing domain specific cloud services, Semantic web and web services. RESTful, AJAX, JSON, Web API, Web Socket application in cloud services.	**9**
Unit – V	Windows communication foundation services (WCF), Hosting and consuming WCF services, evaluating performance of WCF services in cloud platform.	**8**

	Total	**45**

Text Books:

1. Barrie Sisisky, ,“Cloud Computing Bible” Published by Wiley Publishing, Inc.
2. Berners Lee, Godel and Turing ,“Thinking on the Web” -, Wiley inter science, 2008.
3. Peter Mika, “Social Networks and the Semantic Web”, Springer, 2007.
4. “Metrial provided” by course instructor

Reference Books:

1. Thomas Erl,“Cloud Computing: Concepts, Technology & Architecture” Published May 2013
2. David S. Linthicum ,“Cloud Computing and SOA Convergence in your Enterprise, a step by step guide”

Name of Department:- Department of Computer Science and Engineering

1. Subject Code: MCS-321 Course Title: **Service oriented Cloud Architecture**
2. Contact Hours: L: 3 - -
3. Examination Duration (Hrs): Theory 3 Practical -
4. Relative Weight: CWS 25 PRS NIL MTE 25 ETE 50 PRE NIL
5. Credits: 3
6. Semester: 3
7. Subject Area: Departmental Elective (DE) III
8. Pre-requisite: Fundamental knowledge in Operating Systems, and Networks
9. Objective: Understand the concept of IDS/IPS and the two major categorizations: by features/models, and by location.
10. Course Outcomes: On completion of this course, the student should be able to

    1. Evaluate semantic web and cloud based web services.
    2. Demonstrate service oriented cloud based services.
    3. Analyse and design service oriented web applications.
    4. Apply semantic web and service oriented knowledge to design and develop a multi-tier cloud application.
    5. Deploy multi-tier cloud applications.
    6. Evaluate the performance of the multi-tier cloud applications.

11 Details of the Course:-

Units	**Contents**	**Contact Hrs.**
Unit I	Modules, global assemblies (packages) and satellite assemblies, Software module dependencies. Interfaces and namespaces. SOLID principles, IoC containers. Introduction to full stack cloud applications, client side, server side and application layer examples. Technologies used at client side, server side and application side, Case study on full stack cloud applications.	9
Unit II	Object to Service, Distributed applications and Web services. Technologies and frameworks for distributed and server side application development, Case study on Distributed applications and Web services.	9
Unit III	SOA: Cloud service accessibility; cloud service visibility; cloud service extensibility; Cloud service SLAs; cloud service deployment using SOA contract-management techniques; SOA policy management techniques,	9

	Case study on Cloud service SLAs.	
Unit IV	Designing domain specific cloud services, Semantic web and web services. RESTful, AJAX, JSON, Web API, Web Socket application in cloud services, Multi-tier Cloud applications, Case study on Semantic web and web services applications.	9
Unit V	Windows communication foundation services (WCF), Hosting and consuming WCF services, evaluating performance of WCF services in cloud platform, Case study on WCF services.	9
Total		45

Text books:

1. Barrie Sisisky, Cloud Computing Bible Published by Wiley Publishing, Inc.
2. Berners Lee, Godel and Turing Thinking on the Web, Wiley inter science, 2008.
3. Peter Mika, Social Networks and the Semantic Web, Springer, 2007.

Reference books:

1. Thomas Erl Cloud Computing: Concepts, Technology & Architecture Published May 2013
2. David S. Linthicum Cloud Computing and SOA Convergence in your Enterprise, a step by step guide.

Name of Department:- Department of Computer Science and Engineering

1. Subject Code: MCS 324 Course Title: Intrusion Detection Systems
2. Contact Hours: L: 3 - -
3. Examination Duration (Hrs): Theory 3 Practical -
4. Relative Weight: CWS 25 PRS NIL MTE 25 ETE 50 PRE NIL
5. Credits: 3
6. Semester: 3
7. Subject Area: Deparmental Elective (DE) III
8. Pre-requisite: Fundamental knowledge in Operating Systems, and Networks
9. Objective: Understand the concept of IDS/IPS and the two major categorizations: by features/models, and by location.

Learning outcomes

1. Understand about network attacks, IDS & IPS and various schemes.
2. Appraise Intrusion Detection tools and techniques for data collection.
3. Create theoretical foundation of IDS using machine learning.
4. Implement and deploy Internet security system
5. Define security and IDS management
6. To explore various case studies and have knowledge about legal issuses and standards

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Network Attacks: attack taxonomies, Introduction to Intrusion Detection: Overview, Basics of Intrusion detection and prevention Systems, Types of IDS Systems, IDS and IPS Anlysis Schemes, IDS and IPS Myths	7
Unit II	Detection Approaches:misuse detection, Anamoly detection, specification based detection, Hybrid detection. Data Collection: Host based, Network based, Application Based, Application integrated IDs, Hybrid data collection.	8
Unit III	Theoretical Foundation of Detection:Taxonomy of anomaly detection system, Fuzzy logic, Bayes theorem, Artificial Neural Networks, Support Vector Machine,Evalutionary Computation, Association rules, Clustering: Taxonomy. IDS and IPS architecture: Tired architecture, sensors, agents, manager components	9
Unit IV	*IDS and IPS Internals:* Information Flow in IDS and IPS, Detection of Exploits, Malicious code detection, output routines,defending IDS/IPS	9

	Implementation and Deployment: Internet Security systems, Configuring real secure, creating and implementing event filters, reporting, signatures, upgrading.	
Unit V	Security and IDS Management: Data correlation, Incident response, Policy and procedures, Laws, Standards and Organizations. Security business issues. Case studies with Open Source IDS: Snort, Suricata, Security onion, data correlation	9
	Total	42

Text Books:

1. Ali A. Ghorbani , Wei Lu , MahbodTavallaee, "Network Intrusion Detection and Prevention: Concepts and Techniques (Advances in Information Security), Springer US, 2010
2. Carl Enrolf, Eugene Schultz, Jim Mellander, "Intrusion detection and Prevention", McGraw Hill, 2004
3. Earl Carter, Jonathan Hogue, "Intrusion Prevention Fundamentals", Pearson Education , 2006
4. S. Stolfo, S. Bellovin, S. Hershkop, A. Keromytis, S. Sinclair, S. Smith, eds "Insider Attack and Cyber Security: Beyond the Hacker", Springer, 2008

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS-325 Course Title: **Robtics and Process Automation**
2. Contact Hours: L: 3 T: - P: -
3. Examination Duration (Hrs): Theory 3 Practical -
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE
5. Credits: 3
6. Semester: 3
7. Subject Area: Elective course
8. Pre-requisite: Fundamental of Mathematics.
9. Objective: To provide students with the insight and understanding on a wide range of automation processes and robotics.

Learning outcomes:

1. To understand fundamental concept of Automation.
2. describe in detail the structure and operation of robotic tooling, including actuators, mechanics and sensors,
3. describe other parts of automated manufacturing systems, including process control, component flows, machine safety and personal safety,
4. describe computer-aided production tools and data communication within an industrial robotics network,
5. Able to understand concepts of language and programming involve to develop a Robot.
6. To get knowledge of practical application of Robotics.

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	**Introduction to automation** Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, continuous versus discrete control, computer process control. Hardware components for automation and process control, sensors, actuators, analog to digital converters, digital to analog converters, input/output	10

	devices for discrete data	
Unit II	**Automated production lines** Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, automated assembly systems, fundamentals of automated assembly systems, quantitative analysis of assembly systems, automatic identification methods, barcode technology, radio frequency identification, other AIDC technologies	8
Unit III	**Industrial Robotics** Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robotics, various generations of robots, degrees of freedom – Asimov's laws of robotics dynamic stabilization of robots.	8
Unit IV	**Sensors and Intelligent Robots: AI and Robotics, Need for sensing systems, sensory devices, types of sensors, Robot vision systems, soft computing**	8
Unit V	**Robot Language and programming** Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, Classification of robot languages, Computer control and Robot software. Application of Robots: Robotics applications, Robotics in India, Future of Robotics	8
	Total	42

Text books:

1. Automation, Production systems, and computer integrated manufacturing- MikellP.Groover 3rd edition, Pearson 2009

2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012

3. Robotics Technology and Flexible automation, S. R. Deb and S. Deb, McGraw Hill International, 2nd edition

Reference Books:

1. Robotics for Engineers –YoramKoren, McGraw Hill International, 1st edition, 1985.

2. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.

3. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS-326 Course Title: Secure Coding Practices
2. Contact Hours: L: 3 T: - P: -
3. Examination Duration (Hrs): Theory 3 Practical -
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE
5. Credits: 3
6. Semester: 3
7. Subject Area: Elective course
8. Learning outcomes:

1. Use the Design Principles of Secure Coding
2. Create strategies and controls to provide secure authentication.
3. Practice protecting against various kinds of cross-site scripting (XSS) attacks.
4. Form plans to mitigate injection vulnerabilities in your web application.
5. Examine code to find and patch vulnerable components.
6. Exploit penetration testing

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Principles of Secure Coding: Robust programming and Secure programming, writing robust code with examples, common programming problems, design principles of secure coding, informal, formal, and ad - hoc coding methods, improving the security and robustness of programs	10
Unit II	Identifying Security Vulnerabilities: Foundational Topics in Secure Programming, Threat modeling and applied cryptography, encryption and secure hashing, STRIDE method, Injection problems in web applications, SQL injection, cross-site scripting, and command injection, exploiting application vulnerabilities, sensitive data exposure issues, protecting customer's data, effectively storing password-related information, Problems Arising From Broken Authentication, relationship between authentication, session management, and access control.	8
	Identifying Security Vulnerabilities in C/C++Programming: Common errors, how to program more robustly, remediate fragile C++ library	

Unit III	code.,Remediate examples of problems that apply to C/C++ interactions with the programming environment.Identify problems with privilege, trusted environments, input validation, files & sub-processes, resource managementasynchronicity, & randomness in C/C++	8
Unit IV	Exploiting and Securing Vulnerabilities in Java Applications: Injection issues, steal data, exploit Cross Site Scripting issues to compromise a user's browser, break authentication to gain access to data and functionality reserved for the 'Admins',exploit vulnerable components to run our code on a remote server and accessing secrets, various mitigation strategies, penetration testing, patched binaries	8
Unit V	Case Study: A complete application development for exploiting vulnerabilities and mitigating them	8
	Total	42

Name of Department:- Computer Science and Engineering

1. Subject Code: MCS 327 Course Title: **Full Stack Web and Multiplatform Mobile App Development**
2. Contact Hours: L: 3 T: - P: -
3. Semester: III

4. Pre-requisite: Fundamentals of mobile application development

5. Course Outcomes: After completion of the course students will be able to

1. List the various HTML tags and use them to develop the user-friendly web pages.
2. Define the CSS with its types and use them to provide the styles to the web pages at various levels.
3. Use the JavaScript to develop the dynamic web pages.
4. Develop and apply current standard-compliant scripting/programming techniques for the successful deployment of mobile applications targeting a variety of platforms,
5. Carry out appropriate formative and summative evaluation and testing utilising a range of mobile platforms,
6. Interpret a scenario, plan, design and develop a prototype hybrid and native mobile application,

7.Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit I	HTML Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of HTML5 CSS Need for CSS, introduction to CSS, basic syntax and structure, using CSS, type of CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, Introduction to Bootstrap.	8
Unit II	JavaScript and jQuery Client-side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: JavaScript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML: Combining HTML, CSS and JavaScript, Events and buttons. Introduction to jQuery. Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas,	8

UNIT	CONTENTS	Contact Hrs
Unit III	PHP Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files. Advance Features: Cookies and Sessions, Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables. XAMPP Server Configuration. Web Application Deployment	10
Unit IV	Getting started with Mobility, Building blocks of mobile apps:App user interface designing – mobile UI resources (Layout, UI elements, Draw-able, Menu), Activity- states and life cycle, interaction amongst activities. App functionality beyond user interface - Threads, Async task, Services – states and life cycle, Notifications, Broadcast receivers, Telephony and SMS APIs Native data handling – on-device file I/O, shared preferences, mobile databases such as SQLite, and enterprise data access (via Internet/Intranet)	11
Unit V	Sprucing up mobile apps Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record, location awareness, and native hardware access (sensors such as accelerometer and gyroscope) Testing mobile apps Debugging mobile apps, White box testing, Black box testing, and test automation of mobile apps, JUnit for Android, Robotium, MonkeyTalk	8
	Total	45

Text/ Reference Books:

1. Ralph Moseley and M. T. Savaliya ,Developing Web Applications, , Wiley-India
2. "Web Technologies", Black Book, dreamtech Press
3. "HTML 5", Black Book, dreamtech Press
4. Joel Sklar ,"Web Design", Cengage Learning
5. Harwani, "Developing Web Applications in PHP and AJAX", McGrawHill
6. P.J. Deitel& H.M. Deitel ,Internet and World Wide Web How to program,, Pearson

Name of Department: - Department of Computer Science& Engineering

1. Subject Code: MCS 227 Course Title **Information and Communication Theory**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 hrs Practical Nil
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Inter Departmental Elective-I
8. Pre-requisite: Students should have brief idea about communication systems engineering and statistical signal processing.
9. **Objective:**To provide an understanding about communication theory and process, basic communication issues and up-to-date with differing theories of communication.

   Learning Outcomes:

   1. Describing communication process and signals.
   2. Understanding about various Amplitude modulation, angle Modulation and demodulation systems.
   3. To provide various angle Modulation and demodulation systems
   4. To demostrate information theory concepts.
   5. To appraise fundamental limits in information theory
   6. To explain various noise performance of various receiver and basic information theory with some channel coding theorem.

10. Details of the Course:-

S. No.	Contents	Contact Hours
Unit I	**Introduction to Communication systems:**Communication process, Source of Information, Types of communication, Introduction to signals, Analysis and Transmission of signals, Fourier Series and Fourier Transform and their properties. Random Process, Power spectral density. *Continuous Wave Modulation:*Amplitude Modulation, Sidebands, Angle Modulation, Noise in Continuous wave modulation, Noise Theory, Noise in AM & FM receivers, SNR(Signal to Noise Ratio), Comparison of performances.	8

Unit II	**Pulse Modulation :** Introduction, Sampling Theorem, Nyquist's criterion, Pulse code modulation (PCM), DPCM, Delta & Adaptive Delta modulation, Principles of Digital Data Transmission, Baseband &Passband Pulse Modulation, Base-band M-ary PAM systems, Multiplexing techniques, Spread Spectrum Modulation. Digital Modulation formats, Coherentbinary modulation techniques, Coherent quadrature modulation techniques. Non-coherent binary modulation techniques.	8
Unit III	**INFORMATION THEORY:**Introduction to Uncertainty, Information and Entropy ,Properties of entropy, Discrete Messages and Information Content, Concept of Amount of Information, Measure of information, Average information content of symbols in long independent and dependent sequences. Markov statistical model for information source, Entropy and information rate of mark-off source.	8
Unit IV	**FUNDAMENTAL LIMITS IN INFORMATION THEORY:** Encoding of the source output, Shannon's encodingalgorithm, Huffman coding, Lempel-Ziv (LZ) coding, Shannon's Theorem, Channel Capacity, Bandwidth- S/N trade-off, Mutual information and channel capacity, Lossy Source coding. Source coding theorem, Huffman coding, Discrete memoryless Channels, Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem, Information capacity theorems, Rate Distortion Theory.	10
Unit V	**ERROL CONTROL CODING:**Introduction, , Types of codes, Linear Block Codes: Matrix description, Error detection and correction , Cycle Codes, Algebraic structures of cyclic codes, RS codes, Golay codes, Shortened cyclic codes, Burst error Detecting and correcting codes. Random Error correcting codes, Convolution codes, Comparison of coded and uncoded systems	8
	Total	42

Text Books

1. B. P. Lathi, "Modern digital and analog Communication systems", Oxford University Press, USA; 3 edition ,March 26, 1998.
2. Simon Haykin, "Digital and Analog communication systems",JohnWildy India Lts,2008
3. K. Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd,2008
4. Singh and Sapre,"Communication Systems: Analog and digital", TMH,1995.

Reference Books:

1.Harold P.E, Stern Samy and A Mahmond,"Communication Systems", Pearson Edn.,2004
2. RanjanBose,"ITC and Cryptography", TMH, *II edition*, 2007
3. Glover and Grant,"Digital Communications", Pearson Ed., 2010
4. Bernard Sklar, "Digital communications", Pearson education,2002.

Name of Department: - Department of Computer Science& Engineering

1. Subject Code: MCS 227 Course Title **Game Theory**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 hrs Practical Nil
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 2
7. Subject Area: Inter Departmental Elective-I
8. Pre-requisite: Familiarity with formal mathematical reasoning, probability theory, calculus, basics of computational complexity, and (soft constraint) familiarity with computer programming

9. Course Outcomes: After completion of the course students will be able to
    1. Identify strategic situations and cast them as game
    2. The ability to apply solution concepts to examples of games, and to state and explain them precisely
    3. Analyze economic situations using game theoretic techniques
    4. Learning the real-world applications of game theory
    5. Characterizing the stable point (Nash equilibrium) of various games
10. Detailed Syllabus

UNIT	CONTENTS	Contact Hours
Unit I	Introduction to game theory, Dominant Strategy Equilibria, Pure Strategy Nash Equilibria, computing Nash equilibrium	8
Unit II	Mixed strategy Nash equilibrium, existence of Nash equilibrium, computation of Nash equilibrium, matrix games, minimax theorem, extensive form games, subgame perfect equilibrium, games with incomplete information, Bayesian games, Complexity of computing a Nash equilibrium	12
Unit III	Social choice functions and properties, incentive compatibility, revelation theorem, Gibbard-Satterthwaite Theorem, Arrow's impossibility theorem,	10

	Vickrey-Clarke-Groves mechanisms, dAGVA mechanisms, Revenue equivalence theorem, optimal auctions	
Unit IV	Cooperative Game Theory, Correlated equilibrium, two person bargaining problem, coalitional games, core, Shapley value, other solution concepts in cooperative game theory: stable set, Bargaining set, Kernel	10
Unit V	Sequential learning in games, Multi-agent learning using game theory, Application og game theory in task allocation domain	8

Text Books:

1. Y. Narahari “Game theory and mechanism design,” First Edition,World Scientific, 2014

Reference Books:

1. Martin J. Osborne “An Introduction to Game Theory,” First Edition, Oxford University Press. 2003
2. Noam Nisan, Tim Roughgarden, Éva Tardos, Vijay V. Vazirani. “Algorithmic Game Theory,” First Edition, Cambridge University Press 2007
3. Ivan Pastine, Tuvana Pastine, and Tom Humberstone “Introducing Game Theory: A Graphic Guide,” First Edition, Icon Books Ltd 2017
4. Michael Maschler, Eilon Solan, Shmuel Zamir “Game Theory,” Second Edition, Cambridge University Press 2020