DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

Master of Technology

in

Computer Science and Engineering

Scheme and Syllabus 2018-2020

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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VISION OF INSTITUTE:

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

MISSION OF INSTITUTE:

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society.

VISION OF DEPARTMENT:

To be a model center for education and training in the frontier areas of Computer Science and Engineering.

MISSION OF DEPARTMENT:

The mission of Computer Science and Engineering department is to educate students in the areas of computer science by providing best practices of teaching learning process for careers in software industry/higher education/research.

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Programme Educational Objectives (PEO)

PEO1: Able to excel professionally by adapting to the dynamic needs of Industry, Academia and Research in the field of Computer Science and Engineering.

PEO2: Able to practice and promote computing technologies for societal needs.

PEO3: Able to contribute to advancement of computer technology by means of research and lifelong learning.

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Program Outcomes (POs)

The Program Outcomes (POs) define the attributes to be developed through the program and are measured at the time of graduation. The POs are significantly addressed through the curriculum (Content, delivery and assessments) and further strengthened through co-curricular and extra-curricular activities.

The POs are as listed below

PO No.	Program Outcomes
PO 1	An ability to independently carry out Research / Investigation and development work to solve practical problems
PO 2	An ability to write and present a substantial technical Report / Document
PO 3	An ability to demonstrate mastery in the area of Computer Science and Engineering, at a level higher than under graduate program in Computer Science and Engineering.

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M.Tech. In Computer Science and Engineering 1st Semester

Course Type	Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
Program Core-1	18CSCSBSMF	Mathematical Foundation of CS	3	0	1	4	50	50	100
Program Core-2	18CSCSPCAD	Advanced Data Structures	3	0	1	4	50	50	100
Program Core-3	18CSCSPCSC	Soft Computing	3	0	1	4	50	50	100
Program Elective-1	18CSCSPEWS	Wireless Sensor Networks	3	0	1	4	50	50	100
	18CSCSPEDI	Digital Image Processing	3	0	1				
	18CSCSPEML	Machine Learning	3	0	1				
	18CSCSPEBC	Block Chain	3	1	0				
Program Elective-2	18CSCSPEMA	Mobile Adhoc Networks	3	0	1	4	50	50	100
	18CSCSPEHC	Human Computer Interaction	3	1	0				
	18CSCSPEBD	Big Data Analytics	3	0	1				
	18CSCSPECC	Cloud Computing	3	0	1				
Institute Core	18ALLPICRM	Research Methodology and IPR	2	0	0	2	50	50	100
	TOTAL		17	5		22	300	300	600

Note: Elective will be offered for a minimum strength of six candidates (out of 18)

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M.Tech. In Computer Science and Engineering 2nd Semester

Course Type	Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
Program Core-4	18CSCSPCAC	Advanced Computer Networks	3	0	1	4	50	50	100
Program Core-5	18CSCSPCAA	Advanced Algorithms	3	0	1	4	50	50	100
Program Core-6	18CSCSPCAT	Agile Technology	2	0	0	2	50	50	100
Program Elective-3	18CSCSPEIO	Internet Of Things	3	0	1	4	50	50	100
	18CSCSPECV	Computer Vision	3	0	1				
	18CSCSPEDS	Data Science	3	0	1				
	18CSCSPEMC	Multicore Architecture & Programming	3	0	1				
Program Elective-4	18CSCSPENS	Network Security	3	0	1	4	50	50	100
	18CSCSPEDL	Deep Learning	3	0	1				
	18CSCSPEAS	Advanced Storage Area Networks	3	1	0				
	18CSCSPEWA	Web Analytics	3	0	1				
Institute Elective-1 (Engineering)	18CSCSOEAI	Artificial Intelligence	4	0	0	4	50	50	100
	TOTAL		18	4		22	300	300	600

Note: Elective will be offered for a minimum strength of six candidates (out of 18) One institutional Elective has to be chosen from other discipline.

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M.Tech. In Computer Science and Engineering 3rd Semester

Course Type	Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
Program Core-7	18CSCSPWP1	Project Phase – I	0	0	08	08	50	50	100
Program Core-8	18CSCSINNT	Internship	0	0	10	10	50	50	100
Program Elective-5	18CSCSPESP	Software Project Management	3	0	1	4	50	50	100
	18CSCSPEDT	Design Thinking and Innovation	3	0	1	4	50	50	100
Audit-1 (Non-Credit Mandatory Course)	18CSCSNCSM	Stress management by Yoga				0			P/F
	TOTAL		3	0	19	22	150	150	300

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M.Tech. In Computer Science and Engineering 4th Semester

Course Type	Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
Program Core-9	18CSCSPWP2	Project Phase - II	0	0	20	20	50	50	100
Program Core-10	18CSCSSRSE	Seminar	0	0	2	2	50	50	100
Audit-2 (Non-Credit Mandatory Course)	18CSCSNCTW	Technical Writing				0			P/F
	TOTAL		0	0	22	22	100	100	100

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Credit Distribution

Semester	Institute Core	Basics of Science	Professional Core	Professional Elective	Institute Elective	Project/ Mini Project	Seminar	Industrial Training / Internship	Non-Credit Mandatory Course	Total Credits
I	02	04	08	08						22
II			10	08	04					22
III				04		08		10		22
IV						20	02			22
Total: Credits	02	04	18	20	04	28	02	10	00	88

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSBSMF
Course Name	Mathematical Foundation of CS	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation Applications of the univariate and multivariate Central Limit Theorem — 7 hrs.

Unit 2:

Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment — 7 hrs.

Unit 3:

Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood — 7 hrs.

Unit 4:

Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems — 7 hrs.

Unit 5:

Computer science and engineering applications Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning. — 8 hrs.

Text Book:

1. K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.

References:

1 John Vince, Foundation Mathematics for Computer Science, Springer.

2 M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis.

3 Alan Tucker, Applied Combinatorics, Wiley

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Independently carry out study of Recent Trends in distribution functions and present results for computing problem or application
CO2:	Conduct experiments to arrive at expected outcome for given application using statistical techniques
CO3:	Demonstrate In-depth knowledge in Mathematical /statistical theories

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPCAD
Course Name	Advanced Data Structures	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Trees: Preliminaries: Implementation of trees, tree traversals with an application, Binary trees: Implementation, expression trees, Binary search tree ADT, AVL tree, splay trees, open-end problems — 7 hrs.

Unit 2:

Hashing: General Idea, Hash Function, Separate Chaining, Linear probing, Quartic probing, double hashing, Rehashing, Extendible Hashing, open-end problems. — 7 hrs.

Unit 3:

Priority Queues: Model, Simple implementation, Binary heap-structure property, heap-order property, operations, D-heaps, Leftist heaps-property, operations, skew heaps, Binomial Queues- structure, operations, implementation. — 7 hrs.

Unit 4:

Graph Algorithm: Definitions, Shortest path algorithms, network flow problems, minimum spanning tree, applications of depth-first search, introductions to NP-completeness, open-end problems. — 7 hrs.

Unit 5:

Dynamic Programming & Greedy Algorithms: Matrix-chain multiplication, Longest common subsequence, Optimal polygon triangulation, Greedy Algorithm-An activity-selection problem, An activity-selection problem, Huffman code, A task-scheduling problem. — 8 hrs.

References:

1 Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.

2 T. H Cormen, C. E. Leiserson and R. L. Rivest, Introduction to Algorithms, 2nd Edition, Prentice Hall India.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Define and explain concepts related to data structure.
CO2:	Investigating Data Structure/Trees of a Data Structure Problem
CO3:	Apply the data structure algorithm and tree to solve complex problem.
CO4:	Analyse different algorithms/trees in data structure.
CO5:	Conducting experiments of data structure concepts using modern tool/simulation.

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPCSC
Course Name	Soft Computing	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems, Artificial Neural Networks: Fundamental concept, Evolution, Basic model of ANN, Important terminologies of ANN, MP neuron, Hebb Network. 7 hrs.

Unit 2:

Supervised Learning Network: Perceptron Networks, Adaptive linear neuron, multiple adaptive linear neurons, Back propagation Network. Radial basis function network. 7 hrs.

Unit 3:

Introduction to Fuzzy logic, classical sets and fuzzy sets: Classical sets, Fuzzy sets. Classical relations and fuzzy relations: Cartesian product of relation, Classical relation, Fuzzy relations, Tolerance and equivalence relations. Membership functions: Features, Fuzzification, methods of membership value assignments. 7 hrs.

Unit 4:

Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy decision making: Individual, multi person, multi objective, multi attributes, and fuzzy Bayesian decision making 7 hrs.

Unit 5:

Genetic algorithms: Introduction, Basic operations, Traditional algorithms,Simple GA, General genetic algorithms, The schema theorem, Genetic programming, applications 8 hrs.

Laboratory:

1. Familiarization of R tool and Python: Simple implementation of Artificial Neural Network and Fuzzy Logic.

Text Book:

1. Principles of Soft computing, S N Sivanandam, Deepa S. N, Wiley, India, ISBN: 9788126527410

References:

1 John Vince, Foundation Mathematics for Computer Science, Springer.

2 Neuro-fuzzy and soft computing, J.S.R. Jang, C T Sun, E Mizutani, PHI (EEE edition) ISBN: 978-81-203-2243-1.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Review and make effective oral presentation on current trends and prepare a report on Soft Computing techniques.
CO2:	Conduct experiments to arrive at expected outcome for given application using soft computing techniques.
CO3:	Demonstrate In-depth knowledge in soft computing by performing mathematical analysis.

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEWS
Course Name	Wireless Sensor Networks	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction of WSN: Background of sensor network technology and its applications, basic sensor network architecture elements, history survey of sensor network, challenges, wireless node technology, WN operating environment. 7 hrs.

Unit 2:

Medium Access Control Protocols: Fundamentals of MAC protocols- Performance requirements, common protocols, MAC protocols for WSNs, Sensor-MAC case study, IEEE 802.15.4 LR-WPANs standard case study. 7 hrs.

Unit 3:

Routing and Data Gathering Protocols: Data dissemination and gathering, routing challenges and design issues in wireless sensor networks, routing strategies in wireless sensor networks. 7 hrs.

Unit 4:

Embedded Operating Systems: Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS. 7 hrs.

Unit 5:

Performance and traffic Management: Introduction, WSN design issues-MAC Protocols, Routing protocols, Transmission Protocols. Performance modelling of WSN-Performance metrics, basic models, network models. 8 hrs.

Text Book:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Define and explain concepts related to wireless sensor network.
CO2:	Make an effective oral and written presentation of the study on topics related to mobile ad hoc networks.
CO3:	Apply the protocol/technique for collecting data from various sink nodes.
CO4:	Analyse concept of wireless sensor network technology in usage of various applications.

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEDI
Course Name	Digital Image Processing	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:
Digital image fundamentals:

Introduction: Digital Image, Steps of Digital Image Processing Systems, Elements of Visual Perception, Connectivity and Relations between Pixels. Simple Operations - Arithmetic, Logical, Geometric Operations. 7 hrs.

Mathematical Preliminaries - 2D Linear Space Invariant Systems,2D Convolution, Correlation 2D Random Sequence , 2D Spectrum.

Unit 2:
Image transforms and enhancement:

Image transforms: 2D Orthogonal and Unitary Transforms-Properties and Examples. 2D DFT- FFT – DCT - Hadamard Transform - Haar Transform - Slant Transform - KL Transform -Properties And Examples. 7 hrs.

Image Enhancement: Histogram Equalization Technique, Point Processing, Spatial Filtering, Nonlinear Filtering, Use Of Different Masks.

Unit 3:

Image compression: Redundancy And Compression Models, Loss Less And Lossy Compression Models. Variable-Length coding, Huffman coding, Bit-Plane Coding, Loss Less Predictive Coding, Lossy Transform (DCT) Based Coding, JPEG Standard - Sub Band Coding. 7 hrs.

Unit 4:

Image Segmentation: Edge Detection, Line Detection - Curve Detection - Edge Linking And Boundary Extraction, Boundary Representation, Region Representation And Segmentation, Morphology-Dilation, Erosion, Opening And Closing. Hit And Miss Algorithms 7 hrs.

Unit 5:
Color and multispectral image processing:

Color Image: Processing Fundamentals, RGB Models, HSI Models, Relationship Between Different Models. 8 hrs.

Multispectral Image Analysis: Color Image Processing, Three Dimensional Image Processing, Computerized Axial Tomography, Stereometry-Stereoscopic Image, Display-Shaded Surface Display.

Text Book:

1. Digital Image Processing, Gonzalez. R.C & Woods. R.E., 3/e, Pearson Education, 2008.
2. Digital Image Processing, Kenneth R Castleman, Pearson Education, 1995.
3. Digital Image Procesing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education, 2009.Pvt Ltd, NewDelhi
4. Fundamentals of Digital image Processing, Anil Jain.K, Prentice Hall of India, 1989.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Able to develop a technical document for the system designed using image processing techniques.(PO2)
CO2:	To demonstrate scholarship of knowledge through performing mathematical analysis to decide the image processing techniques required to obtain the desired functionality.(PO3)
CO3:	To demonstrate scholarship of knowledge through conducting experiments using image processing techniques. (PO3)

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEML
Course Name	Machine Learning	Total No. of Lecture Hours	39
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction, Concept Learning And Decision Trees: Learning Problems , Designing Learning systems, Perspectives and Issues, Concept Learning Version Spaces and Candidate Elimination Algorithm, Inductive bias, Decision Tree learning, Representation, Algorithm, Heuristic Space Search — 8 hrs.

Unit 2:

Bayesian Learning: Bayes Theorem, Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Network, EM Algorithm — 8 hrs.

Unit 3:

Computational Learning: Probably Learning, Sample Complexity for Finite and Infinite Hypothesis Spaces, Mistake Bound Model — 8 hrs.

Unit 4:

Instant Based Learning: K- Nearest Neighbor Learning ,Locally Weighted Regression ,Radial Basis Functions, Case Based Reasoning, Lazy and Eager learning — 7 hrs.

Unit 5:

Learning Set Of Rules: Sequential covering algorithms, Learning Rule Sets, Learning First Order Rules, Learning Sets of First Order Rules, Induction as Inverted Deduction, Inverting Resolution, Introduction to Analytical Learning and Reinforced Learning — 8 hrs.

Text Book:

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (INDIAN EDITION), 2013

References:

1. EthemAlpaydin, “Introduction to Machine Learning”, 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer; 1st edition, 2001.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Demonstrate scholarship of knowledge in the application/analysis of Machine Learning algorithms to solve various types of learning tasks
CO2:	Implement Machine Learning Techniques and present a technical report/document.
CO3:	Carry out research/Investigation for a given Machine Learning Technique

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I SEMESTER

Credits	4[L-T-P: 3-1-0]	Course Code	18CSCSPEBC
Course Name	Block Chain	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:
Introduction: Cryptocurrency, Block Chain basics, Mining, threats and challenges, Fork in Block Chain. 7 hrs.

Unit 2
Bitcoin, Ethereum, Ethereum virtual machines, Smart contracts, Consensus Mechanism, Ethereum use cases. 7 hrs.

Unit 3:
Multichain, features, Consensus mechanism, Deployment, Multi chain Use cases, Sharing data across parties. 7 hrs.

Unit 4
HyperLedger, Node, Channel, Consensus mechanism, Getting started with Hyper Ledger fabric, Use cases. 7 hrs.

Unit 5
Proof of Concept, Use case scenarios, Block Chain in practice. 8 hrs.

Text Book:

1. Block Chain: From Concept to Execution, Debajani Mohanty, BPB Publications, 2nd Edition, 2018

References:

1. Block chain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress Publishers, 2017.
2. Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Block chain Programming for Beginners, Chris Dannen, Apress Publishers, 2017.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Engage in independent study to prepare a Poster presentation of the identified task on Block chain technology.
CO2:	Demonstrate scholarship of knowledge through performing in a group to identify, formulate and solve a problem in Block chain technology.
CO3:	Demonstrate In-depth knowledge in Block Chain technologies/theories/ practices.

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEMA
Course Name	Mobile Adhoc Networks	Total No. of Lecture Hours	39
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction: Introduction to Wireless Networks, Various Generations of Wireless Networks, Virtual Private Networks- Wireless Data Services, Common Channel Signalling, Various Networks for Connecting to the Internet, Blue tooth Technology, Wifi-WiMax - Radio Propagation mechanism , Pathloss Modeling and Signal Coverage — 7 hrs.

Unit 2:

Wireless Local Area Networks: Introduction-WLAN topologies-IEEE 802.11 Standards, MAC Protocols, Comparison of 802.11 a, b, g and n Standards, HIPER LAN, ZigBee 802.15.4, Wireless Local Loop.

Wireless Adhoc Networks: Basics of Wireless Networks, Infrastructure Versus Infrastructure less Networks – Properties of Wireless, AD hoc Networks, Types of Ad Hoc Networks, Challenges in AD Hoc Networks – Applications of Wireless AD Hoc Networks , Routing Protocols for Ad Hoc Networks: Introduction-Proactive Routing Protocols- Reactive Routing protocols-Hybrid Routing Protocols-QoS Metrics-Energy impact issues in Routing. — 8 hrs.

Unit 3:

Mobile Communications: Introduction to cellular concept, Frequency Reuse, Handoff, GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services, Introduction to mobile computing, novel applications, limitations, and architecture. — 8 hrs.

Mobile Data Networks: Location/mobility management, Mobile IP, Dynamic routing protocols, Location-based protocols, Emerging topics: sensor networking, Data-Oriented CDPD network, GPRS and higher data rates, Short messaging service in GSM

Unit 4:

Mobile Ad Hoc Networks (MANETs): Overview, Properties of A MANET, Spectrum of MANET Applications, Routing and Various Routing Algorithms.

Other Wireless Technologies: Introduction, IEEE 802.15.4 and Zigbee, General Architecture, Physical Layer, MAC layer, Zigbee, WiMAX and IEEE 802.16, Layers and Architecture, Physical Layer, OFDM Physical layer. — 8 hrs.

Unit 5:

Security in Ad Hoc Networks: Introduction- Security Attacks, Intrusion Detection System, Intrusion Prevention system, Intrusion Response system, Wired Equivalent Privacy(WEP) -A Security Protocol for Wireless Local Area Networks (WLANs), Security in MANETs. — 8 hrs.

Text Book:

1. Principles of Wireless Networks , KavethPahlavan, K. Prasanth Krishnamurthy, Pearson Publications, Asia, 2002

2. Mobile Cellular Communications, G.SasibhusanRao, Pearson Publications.

References:

1 Guide to Wireless Ad Hoc Networks: Series: Computer Communications and Networks, Misra, Sudip; Woungang, Isaac; Misra, Subhas Chandra, 2009, Springer

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Present of report on application pertaining to the adhoc networks in particular to mobile nodes.
CO2:	Apply the knowledge of network concepts for mobile adhoc networks
CO3:	Analyse concept of various networking techniques of adhoc networks
CO4:	Conduct experiment to arrive at expected outcome for given concept of adhoc networks
CO5:	Understand the various concepts of adhoc networks.

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I SEMESTER

Credits	4[L-T-P: 3-1-0]	Course Code	18CSCSPEHC
Course Name	Human Computer Interaction	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms — 7 hrs.

Unit 2:

Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle –usability engineering – Prototyping in practice – design rationale. — 7 hrs.

Unit 3:

Design rules – principles, standards, guidelines, rules. — 7 hrs.
Evaluation Techniques – Universal Design

Unit 4:

Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW — 7 hrs.

Unit 5:

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. — 8 hrs.

Text Book:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction" 3rd Edition, Pearson Education, 2004,
2. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, OReilly, 2009.

References:

1. Interaction Design: Beyond Human-Computer Interaction, 4th Edition Jenny Preece, Helen Sharp, Yvonne Rogers, 2015
2. Designing Interfaces: Patterns for Effective Interaction Design, 2nd edition.Jenifer Tidwell. O'Reilly, 2011

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Develop a technical document on current trends / case studies by surveying the literatures of Human Computer Interaction.
CO2:	Demonstrate scholarship of knowledge through analysis and critical thinking to decide the interactions in HCI systems.

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEBD
Course Name	Big Data Analytics	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Classification of Digital Data, Structured Data, Semi-Structured Data, Unstructured Data, Introduction to Big Data, Challenges of Big Data, Introduction to Big Data Analytics, Classification of Analytics, Introduction to Data Science, Terminologies Used in Big Data Environment. 7 hrs.

Unit 2:

Big Data technology landscape: CAP theorem, NoSQL, Types of NoSQL Databases, Advantages of NoSQL, SQL versus NoSQL, Aggregate Data Models, Aggregates, Key-value and Document Data Models, Relationships, Graph Databases, Schema-less Databases, Distribution Models, Sharding 7 hrs.

Unit 3:

Hadoop, Features of Hadoop, Key Advantages of Hadoop, Versions of Hadoop, Hadoop Ecosystems, Hadoop Distributions, Hadoop versus SQL, RDBMS versus Hadoop, Hadoop Components, Hadoop Conceptual Layer, High Level Architecture of Hadoop, Hadoop Distributed File System, HDFS Daemons, Processing Data with Hadoop 7 hrs.

Unit 4:

MapReduce daemons, MapReduce Example, Managing Resources and Applications with Hadoop Map Reduce programming, YARN, Hadoop Ecosystem: Pig, Hive, Sqoop, Hbase. . 8hrs

Unit 5:

Apache Spark and R, Spark Introduction, Resilient Distributed Datasets, Spark core programming, Spark shell, Apache Spark – Deployment. Use the R package as a tool to perform basic data analytics, reporting, and apply basic data visualization techniques. 7 hrs.

Text Book:

1. Radha, Vijayalakshmi, Big data and Analytics, Wiley publications, 2016.
2. Tom White, Hadoop: The Definitive Guide, Third Edition, O'Reilley, 2014.
3. Eric Sammer, Hadoop Operations, O' Reilley, 2016.
4. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.

References Books:

1. Harness the Power of Big Data, IBM big data platform Paul C. Zikopoulos Dirk deRoos Krishnan Parasuraman Thomas Deutsch David Corrigan James Giles, Mcgrawhill, 2013
2. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing an Presenting Data Author: Education EMC Services, Publisher: Wiley ISBN:

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Engage in independent study to prepare a Technical document to address current trends in NoSQL
CO2:	Conduct experiments by applying concepts of Big Data Analytics to solve business cases
CO3:	Demonstrate scholarship of knowledge to provide critical analysis of big data technologies

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I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPECC
Course Name	Cloud Computing	Total No. of Lecture Hours	39
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems. 7 hrs.

Unit 2:

Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing. 8 hrs.

Unit 3:

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems 8 hrs.

Unit 4:

Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems. 8 hrs.

Unit 5:

Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems. 8 hrs.

Text Books:

1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier (MK) 2013.

Reference Books:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.
2. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Present and document current trends and issues in Cloud Computing technology.
CO2:	Apply the knowledge of cloud technology to demonstrate the working principles of cloud for different application.
CO3:	Analyse concept of cloud computing technology in usage of various application.
CO4:	Conduct practical experiments for demonstrating cloud computing technology.
CO5:	Understand the concepts of cloud computing technology for different application.

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I SEMESTER

Credits	2[L-T-P: 2-0-0]	Course Code	18ALLPICRM
Course Name	Research Methodology and IPR	Total No. of Lecture Hours	26
CIE Marks	50	SEE Marks	50

Unit 1:

Meaning and sources of research problem, , Objectives and Characteristics of research–Errors in selecting research problem, Research methods Vs Methodology - Types of research-Criteria of good research – Developing a research plan. 5 hrs.

Unit 2:

Investigations of a research problem - Selecting the problem - Necessity of defining the problem–Data collections-analysis- Importance of literature review in defining a problem - Survey of literature - Necessary instrumentations 5 hrs.

Unit 3:

How to write paper-conference articles-poster preparation, thesis report writing, inclusion of references, journal reviewing process, journal selection process, filling about journal template, developing effective research proposal-plagiarism-research ethics 5 hrs.

Unit 4:

Nature of Intellectual property, IPRs- Invention and Creativity - Importance and Protection of Intellectual Property Rights (IPRs) –procedure for grant of patents and patenting under PCT-types of patents-technological research and innovation- international cooperation on IP. 5 hrs.

Unit 5:

A brief summary of : Patents-Copyrights-Trademarks, patent rights-licensing and transfer of technology-patent databases-case studies on IPR-Geographical indications-new developments in IPR-protection of IPR rights 6 hrs.

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Write and present a substantial technical report/document
CO2:	Demonstrate a degree of mastery over the area of specialization

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPCAC
Course Name	Advanced Computer Networks	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Basic Concepts: Application, requirements, perspectives, scalable connectivity, cost-effective resource sharing, support for common services, manageability, protocol layering, performance, bandwidth and latency, delay X bandwidth product, perspectives on connecting, classes of links, Rings(802.5, FDDI) –Token Ring Media Access Control, Token Ring Maintenance, FDDI. 7 hrs.

Unit 2:

Networking: Datagram's, virtual circuit switching, source routing, bridges and LAN switches, Internetwork, service model, global addresses, datagram forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), virtual networks and Tunnels, Distance Vector (RIP), Link State (OSPF), routing areas, inter domain routing (BGP), IPv6, challenges for mobile networking and routing to mobile hosts (mobile IP). 7 hrs.

Unit 3:

End to end protocols: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP)-End-to-end issues, segment format, connection Establishment and Termination, sliding window revisited, triggering transmission, adaptive retransmission, record boundaries, TCP extensions, Transport for Real-Time Applications-requirements, RTP details, control protocol. 7 hrs.

Unit 4:

Congestion Control and Resource Allocation: Issues in resource allocation – network model, taxonomy, evaluation criteria; Queuing discipline – FIFO, Fair Queuing; TCP congestion control – additive increase/multiplicative decrease, slow start, fast retransmit and fast Recovery, Congestion-avoidance mechanisms – DECbit, Random Early Detection (RED), Source-based congestion control. 7 hrs.

Unit 5:

Network Security: Cryptographic Building Blocks-Principles of Ciphers, Symmetric-Key Ciphers, Public-Key Ciphers. Key Pre-distribution: Pre-distribution of Public Keys, Pre-distribution of Symmetric Keys. Authentication Protocols-Originality and Timeliness Techniques, Public-Key Authentication Protocols, Symmetric-Key Authentication Protocols. Example Systems-Pretty Good Privacy (PGP), Secure Shell (SSH), Transport Layer Security, IP Security, Wireless Security. Firewalls 8 hrs.

Text Book:

1. Larry Peterson and Bruce S Davis "Computer Networks: A System Approach" 5th Edition, Elsevier - 2014.
2. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI – 2014.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Develop technical report for advance topics in networking.
CO2:	Apply and analyse various network protocols, congestion control mechanism and network security algorithms / protocols.
CO3:	Implement and demonstrate routing and congestion control algorithms / methods.

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPCAA
Course Name	Advanced Algorithms	Total No. of Lecture Hours	39
CIE Marks	50	SEE Marks	50

Unit 1:

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods. 9 hrs.

Unit 2:

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. 8 hrs.

Unit 3:

Maximum bipartite matching**,** Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT 7 hrs.

Unit 4:

String-Matching Algorithms: Naïve string Matching; Rabin- Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms. 7 hrs

Unit 5:

Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms 8 hrs

Text Book:

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.

Reference Books:

1. Ellis Horowitz, SartajSahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Universities press, 2007.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Apply algorithms to solve problems in graph theory and string matching algorithms
CO2:	Analyze time complexity of algorithms
CO3:	Design and implement FFT algorithms

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II SEMESTER

Credits	2[L-T-P: 2-0-0]	Course Code	18CSCSPCAT
Course Name	Agile Technology	Total No. of Lecture Hours	26
CIE Marks	50	SEE Marks	50

Unit 1:

Why Agile? : Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, How to Be Agile? : Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor. 5 hrs.

Unit 2:

Understanding XP: The XP Lifecycle, The XP Team, XP Concepts, Adopting XP: Prerequisites, recommendations, challenge of change, applying XP, assessing Agility 5 hrs.

Unit 3:

Practicing XP: Thinking: Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives, Collaborating: Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand-Up Meetings, Coding Standards, Iteration Demo, Reporting, Releasing: No Bugs, Version Control, Ten-Minute Build, Continuous Integration, Collective Code Ownership 5 hrs.

Unit 4:

Documentation. Planning: Vision, Release Planning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, Estimating. Developing: Incremental requirements, Customer Tests, test-Driven Development, Refactoring, Simple Design, Incremental Design and Architecture, Spike Solutions, Performance Optimization, Exploratory Testing 5 hrs.

Unit 5:

Mastering Agility: Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading, Improve the Process: Understand Your Project, Tune and Adapt, Break the Rules, Rely on People: Build Effective Relationships, Build the Process for the People, Eliminate Waste: Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput 6 hrs.

Text Book:

1. James shore, Chromatic, The Art of Agile Development (Pragmatic guide to agile software development), O'Reilly Media, Shroff Publishers & Distributors, 2007.

Reference Books:

1. Robert C. Martin, Agile Software Development, Principles, Patterns, and Practices, Prentice Hall; 1st edition, 2002
2. Craig Larman Pearson Education, Agile and Iterative Development A Manger's Guide, First Edition, India, 2004

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Engage in independent study to prepare a Technical document to address current trends in Agile technology
CO2:	Demonstrate In-depth knowledge in Agile technologies/theories/ practices
CO3:	Demonstrate scholarship of knowledge to provide critical analysis of agile technologies

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEIO
Course Name	Internet Of Things	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Demystifying the IoT Paradigm: Why the IoT is Strategically Sound, The brewing and Blossoming trends in IT Space, Illustrating the device-to-device/Machine-to-machine Integration concept, Explaining the aspect of device-to-cloud integration, The emerging Flavors — 7 hrs.

Unit 2:

Realization of IoT Ecosystem using Wireless Technologies: Architecture for IoT using Mobile Devices, Mobile Technologies for supporting IoT Ecosystem, Energy harvesting for power conservation in the IoT System, Low Power Wide Area Networking Technologies. Infrastructure and service discovery protocols for the IoT Ecosystem: Layered Architecture for IoT, Protocol Architecture of IoT, Infrastructure Protocols — 7 hrs.

Unit 3:

IoT Physical Devices and Endpoints - Introduction to Raspberry PI-Interfaces (serial, SPI, I2C). Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins — 7 hrs.

Unit 4:

The next-generation clouds for IoT Applications and Analytics: Reflecting the cloud- enabled environments, IoT and cloud-inspired smarted environments, Describing the emerging field of IoT Data analytics: The key drivers for IoT Data analytics, The renowned edge analytics use cases, Why have Cloud based IoT data analytics? — 7 hrs.

Unit 5:

Smart Use cases of IoT, Security Management of an IoT Ecosystem — 8 hrs.

Text Book:

1. Pethuru Raj and Anupama C Raman, The Internet of Things – Enabling Technologies, Platforms, and use cases, CRC Press, Taylor and Francis, 2017.
2. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.

Reference Books:

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Oral presentation of IoT applications and analytics of the result obtained
CO2:	Perform triggering of Raspberry PI- interfaces with gadgets using Python
CO3:	Demonstration of how mobile devices can be sink with IoT devices for certain applications
CO4:	Experiment on how IoT data can be moved to cloud for analytics purpose
CO5:	Understand the concepts on how IoT has its impact on present real time situation.

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPECV
Course Name	Computer Vision	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Cameras: Pinhole Cameras: Perspective Projection, Affine Projection.

Radiometry—Measuring Light: Light in Space, Foreshortening, Solid Angle, Radiance, Light at Surfaces, Simplifying Assumptions, The Bidirectional Reflectance Distribution Function, Example: The Radiometry of Thin Lenses. 7 hrs.

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Normalized Correlation and Finding Patterns, Scale and Image Pyramids.

Unit 2:

Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesizing Textures for Rendering Shape from Texture.

The Geometry Of Multiple Views: Two Views: Epipolar Geometry, The Calibrated Case, Small Motions, The Uncalibrated Case, Weak Calibration Three Views: Trifocal Geometry, The Calibrated Case ,The Uncalibrated Case, Estimation of the Trifocal Tensor 7 hrs.

Stereopsis: Reconstruction: Image Rectification, Human Stereopsis, Binocular Fusion, Using More Cameras

Unit 3:

Segmentation By Clustering: What Is Segmentation?, Human Vision: Grouping and Gestalt, Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels , Segmentation by Graph-Theoretic Clustering 8 hrs.

Segmentation By Fitting A Model : The Hough Transform, Fitting Lines , Fitting Curves , Fitting as a Probabilistic Inference Problem, Robustness : M-estimators, RANSAC, Example: Using RANSAC to Fit Fundamental Matrices

Unit 4:

Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering , Data Association, Applications and Examples :Vehicle Tracking 8 hrs.

Unit 5:

Model-Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency ,Obtaining Hypotheses by Pose Clustering , Obtaining Hypotheses Using Invariants , Verification, Application: Registration in Medical Imaging Systems, Curved Surfaces and Alignment 6 hrs.

Text Book:

1. Computer Vision: A Modern Approach by David A. Forsyth, Jean Ponce, 2nd Edition, Pearson Education, 2015.

References:

1. Computer Vision: Algorithms and Applications, by Richard Szeliski, Springer,2011

2. Multiple View Geometry in Computer Vision by Richard Hartley andAndrew Zisserman , Second Edition,Cambridge University Press,2004.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Develop a technical document for the designed vision based system.
CO2:	Demonstrate scholarship of knowledge through performing mathematical analysis of the computer vision based systems.
CO3:	Demonstrate scholarship of knowledge through simulation /conducting experiments to develop an application in the computer vision domain.

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEDS
Course Name	Data Science	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Getting Started with Raw Data: The world of arrays with NumPy, Empowering data analysis with pandas, Data cleansing, Data Operations. Inferential Statistics: Various forms of distribution, Az-score, p-score, One-tail test, F distribution, Chi-square distribution, ANOVA — 7 hrs.

Unit 2:

Finding a Needle in a haystack: What is data mining, Presenting the analysis, studying the Titanic. Making Sense of Data through Advanced Visualization: Charts, plots, Heatmaps, histograms, scatter plot matrix, Area plots. — 7 hrs.

Unit 3:

Uncovering Machine Learning: Decision tress, Linear regression, Logistic regression, Naïve Bayes Classifier, k-means clustering. Performing predictions with Linear Regression: Simple Linear regression, Multiple regressions, training and testing a model. — 7 hrs.

Unit 4:

Estimation the likelihood of events: Logistic regression, Generating recommendation with collaborative filtering: Used-based, Item-based — 7 hrs.

Unit 5:

Analyzing unstructured data with text mining: Pre-processing data, creating a world cloud, word and sentence tokenization, parts of speech tagging, stemming and lemmatization, performing sentiment analysis on world leaders using Twitter. — 8 hrs.

Text Book:

1. Samir Madhavan, Mastering Python for Data Science, PACKT Books, Pack Publishing, 2015

Reference Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly

2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Present a report on how data is collected, managed and stored for data Science
CO2:	Demonstrate scholarly knowledge while uncovering the concept of machine learning for analysis
CO3:	Experiments to be conducted on the estimation of the likelihood of events for generating recommendation
CO4:	Perform sentiment analysis for twitter real- time data
CO5:	Recollect how data science can be applied in real time application

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEMC
Course Name	Multicore Architecture & Programming	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction to Multi-core Architecture: Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper-Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. System Overview of Threading : Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization — 7 hrs.

Unit 2:

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control- based Concepts, Fence, Barrier, Implementation-dependent Threading Features — 8 hrs.

Unit 3:

Threading APIs: Threading APIs for Microsoft Windows, Win32/MFC Thread APIs, Threading APIs for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signalling, Compilation and Linking. — 7 hrs.

Unit 4:

Open MP: A Portable Solution for Threading: Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to Open MP, Open MP Library Functions, Open MP Environment Variables, Compilation, Debugging, performance. — 7 hrs.

Unit 5:

Solutions to Common Parallel Programming Problems: Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA-32,Data Organization for High Performance. — 7 hrs.

Text Book:

1. Shameem Akhter and Jason Roberts: Multicore Programming, Increased Performance through Software Multi-threading, Intel Press, 2006.

Reference Books:

1. Calvin Lin, Lawrence Snyder: Principles of Parallel Programming, Pearson Education, 2009.
2. Michael J. Quinn: Parallel Programming in C with MPI and OpenMP, Tata McGraw Hill, 2004.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Demonstrate scholarship of knowledge to analyze various types of Multithreading/Multicore architectures/techniques & Estimate their Performance
CO2:	Implement Parallel Solutions using multi-threading with the help of appropriate tools and present a technical report/document.
CO3:	Apply threading API's to solve practical problems to exploit parallelism in Multicore Environment

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPENS
Course Name	Network Security	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Data security: Review of cryptography. Examples RSA, DES, ECC. Authentication, non-repudiation and message integrity. Digital signatures and certificates. Protocols using cryptography (example Kerberos). Attacks on protocols — 7 hrs.

Unit 2:

Network security: Firewalls, Proxy-Servers, Network intrusion detection. Transport security: Mechanisms of TLS, SSL, IPSec. — 7 hrs.

Unit 3:

Web security – SQL injection, XSS, etc. Software security and buffer overflow. Malware types and case studies. Access Control, firewalls and host/network intrusion detection — 7 hrs.

Unit 4:

Other topics: Biometric authentication, Secure E-Commerce (ex. SET), Smart Cards, Security in Wireless Communication. — 7 hrs.

Unit 5:

Recent trends in IoT security, IDS and Biometric. — 8 hrs.

Text Books:	
1.	W. R. Cheswick and S. M. Bellovin. Firewalls and Internet Security. Addison Wesley, 1994.
2.	W. Stallings. Cryptography and Network Security. Prentice Hall, 1999.
3.	B. Schneier. Applied Cryptography. Wiley, 1999.
Reference Books:	
1.	Cryptography and Network Security: Atul kahate, Mc Graw Hill, 2nd Edition.
2.	Current and Emerging Trends in Cyber Operations: Policy, Strategy and Practice (Palgrave Macmillan's Studies in Cybercrime and Cybersecurity) 1st Edition. 2015 Edition.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Present issues and threats related to security in particular to the cyber application.
CO2:	Apply the knowledge of Security to data, network, web, Biometric and IOT.
CO3:	Analyse concept of various Security for data, network, web, Biometric and IOT.
CO4:	Conduct experiment to arrive at expected outcome for given of Network Security application
CO5:	Understand the concepts of Network Security at various levels.

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEDL
Course Name	Deep Learning	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction: Feed forward Neural networks, Gradient descent and the back propagation algorithm, Unit saturation, vanishing gradient problem, ways to mitigate it. RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout — 7 hrs.

Unit 2:

Convolutional Neural Networks : Architectures, convolution / pooling layers — 7 hrs.

Unit 3:

Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures Recursive neural network (RNN) — 7 hrs.

Unit 4:

Deep Unsupervised Learning: Autoencoders (standard, sparse, denoising, contractive, etc), Variational Autoencoders, Adversarial Generative Networks, Autoencoder and DBM Attention and memory models, Dynamic memory networks — 7 hrs.

Unit 5:

Applications of Deep Learning to NLP/Computer Vision: Introduction to NLP and Vector Space Model of Semantics, Word Vector representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW), Named Entity Recognition, Opinion Mining using Recurrent Neural Networks, Sentence Classification using Convolutional Neural Networks.Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, Video to text with LSTM models. Attention models for computer vision tasks. — 8 hrs.

Text Books:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book. (2015)..
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, OReilly, 2017.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Demonstrate scholarship of knowledge in the application/analysis of Deep Learning algorithms to solve various types of learning tasks, NLP and Computer Vision tasks
CO2:	Implement Deep Learning Techniques and present a technical report/document.
CO3:	Independently work for a given problem so as to find the applicability of the Deep learning techniques

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II SEMESTER

Credits	4[L-T-P: 3-1-0]	Course Code	18CSCSPEAS
Course Name	Advanced Storage Area Networks	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction: The Data Storage and Data Access Problem .The Battle for Size and access. Decoupling the Storage Component: Putting Storage on the Network. Decoupling the Storage Component: Creating a Network for Storage — 7 hrs.

Unit 2:

Storage Fundamental: Storage Architectures, Device Overviews, Connectivity Options — 7 hrs.

Unit 3:

Network Attached Storage: NAS Hardware Devices, NAS Software Components, NAS Connectivity Options. — 7 hrs.

Unit 4:

Storage Area Networks :Architecture Overview, Hardware Devices, Software Components — 7 hrs

Unit 5:

Storage Network Backup and Recovery: General Conditions for Backup ,Backup Considerations Backup Granularity, Network Backup Services , Backup Clients Performance Bottlenecks of Network Backup, Backup File Systems Next Generation Backup — 8 hrs

Text Book:

1. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2011
2. Dr. Vaishali Khairnar, Nilima Dongre " Storage Network Management and Retrieval," Wiley, India

Reference Books:

1. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
2. ULF Troppen, Rainer Erkens and Wolfgang Muller , " Storage Networks Explained: Basic and Applications of Fibre Channel SAN, NAS and ISCSI and Infiniband " , Wiley

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Prepare a technical document for the identified storage equipment/ product/ system.
CO2:	Comprehend network management theories and practices to arrive at a business model for storage solutions.
CO3:	Demonstrate In-depth knowledge in storage area network technologies/theories/ practices.

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II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEWA
Course Name	Web Analytics	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:
Graphs: Basic definitions, paths and connectivity, distance and BFS, Network Dataset, **Representing and Measuring Networks:** Representing Networks, some summary statistics and characteristics of networks — 7 hrs.

Unit 2:
Strong and Weak Ties, Networks in their Surrounding contexts, Positive and negative relationship — 7 hrs.

Unit 3:
The structure of the web, Link analysis and web search, Information cascades — 7 hrs.

Unit 4:
Power laws and Rich-get-richer phenomena — 7 hrs

Unit 5:
Epidemics: Diseases and the networks that transmit them, Branching processes, The SIR epidemic model, The SIS epidemic model. — 8 hrs

Text Book:

1. Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010(available for free download).
2. Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010.

Reference Books:

1. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011. Analyzing Social Media Networks with Node XL: Insights from a Connected World. Morgan Kaufmann, 304.
2. Avinash Kaushik. 2009. Web Analytics 2.0: The Art of Online Accountability

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Present a report on a real time social network issue.
CO2:	Conduct experiment for link analysis, strong and weak ties along with positive and negative relationship
CO3:	Demonstrate scholarship od knowledge using Power laws and Riche-get-richer phenomena

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II SEMESTER

Credits	4[L-T-P: 4-0-0]	Course Code	18CSCSOEAI
Course Name	Artificial Intelligence	Total No. of Lecture Hours	48
CIE Marks	50	SEE Marks	50

Unit 1:

What is AI? Intelligent Agents: Agents and environment, Rationality, the nature of environment, the structure of agents. Problem-solving: Problem-solving agents, Example problems, — 9 hrs.

Unit 2:

Logical Agents: Knowledge-based agents, The Wumpus world Logic, Propositional logic, Propositional theorem proving, Effective propositional model checking Agents based on propositional logic. — 10 hrs.

Unit 3:

Heuristic Search Techniques: Generate and Test, Hill Climbing, Best first search, Problem Reduction, Constraint Satisfaction, Means Ends Analysis — 10 hrs.

Unit 4:

Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships. Computable functions and predicates, Resolution, Natural Deduction. Weak Slot- and filter structures: Semantic Nets, Frames, Strong slot-and-filter structures: Conceptual dependency, scripts, CYC. — 10 hrs

Unit 5:

Learning: Forms of Learning, Inductive learning, Ensemble learning, Support vector machines. — 9 hrs

Text Book:

1. Artificial Intelligence: A Modern Approach by Stuart Russell, Peter Norvig, 2nd Edition, Pearson Education, 2013.
2. Artificial Intelligence, by Elaine Rich, Kevin Knight, Shiva Shankar B Nair: Tata McGraw Hill 3rd edition. 2013

Reference Books:

1. Artificial Intelligence by George F Luger, 5th Edition Pearson Education, 2009.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Demonstrate the understandability of Artificial intelligence concept and develop technical reports
CO2:	Analyze the modern view of AI as the study of agents and investigate various AI search Models and Generic search strategies.
CO3:	Design Logics for representing Knowledge and learning algorithms for improving the performance of AI systems.

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III SEMESTER

Credits	8[L-T-P: 0-0-8]	Course Code	18CSCSPWP1
Course Name	Project Phase-1	Total No. of Lecture Hours	-
CIE Marks	50	SEE Marks	50

Course Outcomes (COs): On Completion of the course, the students will be able to	
CO 1:	Engage in independent study to research through literature and cosolidate and comprehend to Identify the Engineering problem to offer solution to societal / environmental / IT industry problem.
CO 2:	Identify the necessary Engineering concepts, Technology, algorithms and modern tools to solve the problem.
CO 3:	Develop requirements and apply the identified concepts to design solution for a set of requirements
CO 4:	Prepare Gantt chart / estimate cost of project / Analysis of project based on various parameters and resources (Cpu requirement,Memory usage, Power requirement, Bandwidth, Time Complexity)
CO 8:	Engage in effective communication through presentation of project work, prepare technical reports and paper publication

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III SEMESTER

Credits	10[L-T-P: 0-0-10]	Course Code	18CSCSINNT
Course Name	Internship	Total No. of Lecture Hours	-
CIE Marks	50	SEE Marks	50

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO 1:	Apply domain knowledge in proposing solution for IT problem
CO 2:	Develop/implement the design with appropriate techniques, resources and contemporary tools and deliver solution with stipulated planning
CO 3:	Work independently.
CO 4:	Work in collaboration/multidisciplinary environment.
CO 5:	Exhibit integrity and ethical behavior during preparation of Technical document/Report/development of solution
CO 6:	Use formal and informal communications with guide, make presentations and prepare technical document

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III SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPESP
Course Name	Software Project Management	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Projects and their Environments: What is a Project?, Project management, Project Manager, Benefits of Project Management, The Project Environment**:** Internal and External Environment, Programs, Mission, Goals, Objectives and Strategy, Portfolios Management, Scoring Matrix, Financial Evaluation Criteria. 7 hrs.

Unit 2:

Software project planning: understand project needs, create and diagnose project plan integration: The Charter, Project Management Plan. Scope: Beginning the Scope, Scope Contents, Triple Constraints, Priority Matrix, Scope Issues Sample Scope Statement. 7 hrs.

Unit 3:

Estimation, Project schedules: Managing project cost, Estimation project cost, calculating total project cost, monitoring and controlling project cost. 7 hrs.

Unit 4:

Project quality management: Key Concepts, Quality Planning, Quality Assurance, Quality Control Risks, Risks Strategies, Planning Risk Management, Identify Risks, Risk Assessment, Risk Monitoring and Control. 7 hrs.

Unit 5:

Software Management Tools: Scrum, Jira, Podio, Notion. 8 hrs.

Text Book:

1. Andrew Stellman and Jennifer Green, Applied software project management: publications, 2012
2. Roger Warburton and Vijay Kanabar, The Art and Science of Project Management, RW Press Newport, 2nd Edition, 2013.

Reference Books:

1. Nicholas, J. and Steyn, H., "Project Management for Business, Engineering and Technology", ELSEVIER.
2. Prasanna Chandra, "Project Planning, Analysis, Selection, Implementation and Review", New Delhi, Tata McGraw Hill Publications, 2000.
3. S Ramanathan, "Software Project Management: A Guide for Service Providers", Amazon, 2016.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Engage in independent study to prepare a Poster presentation of the identified issues with project life cycle
CO2:	Conduct experiments to analyze different software project planning case studies
CO3:	Demonstrate In-depth knowledge in software project Management technologies/theories/ practices

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III SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	18CSCSPEDT
Course Name	Design Thinking and Innovation	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Design Strategy: Introduction to design strategy, Design thinking and the tools, Exploring the elements of corporate strategy, Design strategy, Plan and conduct primary market research, Craft a meaningful problem definition statement, Communicate corporate strategy. 7 hrs.

Unit 2:

Prototyping and product ideation: Creating usable models and frameworks for gathering user feedback and testing solutions, through prototypes and a minimum viable product. 7 hrs.

Unit 3:

Design strategy in practice: Corporate case studies - Two practical case studies which demonstrate how two Australian based companies are using design strategy to innovate and solve problems every day. 7 hrs.

Unit 4:

Transition Design: System Shifting, Service Design in Action, Value Creation in Business through Design Thinking 7 hrs.

Unit 5:

Strategic Design Thinking - Innovation in Products, Services, Experiences and Beyond 8 hrs.

Text Book:

1. http://www.rcsc.gov.bt/wp-content/uploads/2017/07/dt-guide-book-master-copy.pdf
2. http://asimetrica.org/wp-content/uploads/2014/06/design-thinking.pdf

References:

1. Joseph H. II Editor(s): Natalie W. Nixon, "Innovation in Products, Services, Experiences and Beyond," Fairchild books, 2015.
2. http://cdn2.hubspot.net/hubfs/287355/ebook-DesignThinking-V5.pdf
3. Change by Design, Tim Brown (kindle Edition)

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Independently carryout study of design thinking concepts and present results for a computing system
CO2:	Develop Prototype/Solution/product for a given problem scenario
CO3:	Analyse and decide based on story backlogs/case studies and master the concepts of design thinking

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III SEMESTER

Credits	Non-Credit Course	Course Code	18CSCSNCSM
Course Name	Stress Management by Yoga		
CIE Marks	50	SEE:Status	P/F

1. Definitions of Eight parts of yog. (Ashtanga)
2. Yama and Niyama, Do`s and Don't's in life.
3. Ahinsa, satya, astheya, bramhacharya and aparigraha, Shaucha, santosh, tapa, swadhyay, ishwarpranidhan
4. Asana impact on body systems
5. Stress management by meditation

Text Book:

1. B.K.S. Iyengar (Author), John J. Evans (Author), Douglas Abrams (Author) 'Light on Life: The Yoga Journey to Wholeness, Inner Peace, and Ultimate Freedom (Iyengar Yoga Books), 2006.
2. B.K.S. Iyengar Light on Pranayama, 2005

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Knowledge about the impact of various asana on different organs and body system
CO2:	Knowledge about stress management

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IV SEMESTER

Credits	20[L-T-P: 0-0-20]	Course Code	18CSCSPWP2
Course Name	Project Phase-II	Total No. of Lecture Hours	-
CIE Marks	50	SEE Marks	50

Course Outcomes (COs):

On Completion of the course, the students will be able to

CO 4:	Prepare Gantt chart / estimate cost of project / Analysis of project based on various parameters and resources (Cpu requirement,Memory usage, Power requirement, Bandwidth, Time Complexity)
CO 5:	Implement algorithms, and/or techniques that contribute to the software solution of the project using identified tools.
CO 6:	Demonstrate the standards / norms / ethical practices during implementing the solution
CO 7:	Analyse and interpret experimental results / Test and validate the conformance of the developed prototype against the original requirements of the problem .
CO 8:	Engage in effective communication through presentation of project work, prepare technical reports and paper publication

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IV SEMESTER

Credits	2[L-T-P: 0-0-2]	Course Code	18CSCSSRSE
Course Name	Seminar	Total No. of Lecture Hours	-
CIE Marks	50	SEE Marks	50

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO 1:	Conduct literature surveyand identify topic/concepts
CO2:	Analyze methodology/technique or algorithm.
CO 3:	Analyze different case studies/senarios/tools in the selected concept.
CO 4:	Communicate and prepare documentation / reports effectively.
CO 5:	Exhibit reflective learning and work independently

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IV SEMESTER

Credits	Non-Credit Course	Course Code	18CSCSNCTW
Course Name	Technical Writing		
CIE Marks	50	SEE:Status	P/F

Document development process
- Estimating Technical Documentation
- Documentation Planning
- Selection of Tools
- Information Architecture
- Templates and Page design
- Audience Profiling

Text Book:

1. B.N. Basu, Technical Writing, 2007

2. O. N. Pandey, Technical Writing, 2013

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Write a thesis for a university degree or a research paper for publication in a journal.
CO2:	Document step by step through several examples, how to plan, organize, draft, develop and prepare such a document for presentation.