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 2020-2022

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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	20CSCSBSMF	Mathematical Foundation of CS	3	0	1	4	50	50	100
Program Core-2	20CSCSPCDT	Advanced Data Structures	3	0	1	4	50	50	100
Program Core-3	20CSCSPCSC	Soft Computing	3	0	1	4	50	50	100
Program Elective-1	20CSCSPEWS	Wireless Sensor Networks	3	0	1	4	50	50	100
	20CSCSPEAI	Artificial Intelligence	3	0	1				
	20CSCSPEMC	Multicore Architecture & Programming	3	0	1				
Program Elective-2	20CSCSPEMA	Mobile Adhoc Networks	3	0	1	4	50	50	100
	20CSCSPEBD	Big Data Analytics	3	0	1				
	20CSCSPEAD	Advanced Database Management System	3	0	1				
Institute Core	20ALLPICRM	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)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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	20CSCSPCAC	Advanced Computer Networks	3	0	1	4	50	50	100
Program Core-5	20CSCSPCAA	Advanced Algorithms	3	0	1	4	50	50	100
Program Core-6	20CSCSPCAT	Agile Technology	2	0	0	2	50	50	100
Program Elective-3	20CSCSPEML	Machine Learning	3	0	1	4	50	50	100
	20CSCSPEDS	Data Science	3	0	1				
	20CSCSPEBC	Block Chain	3	0	1				
Program Elective-4	20CSCSPECF	Cyber Security	3	0	1	4	50	50	100
	20CSCSPEDL	Deep Learning	3	0	1				
	20CSCSPEAS	Advanced Storage Area Networks	3	0	1				
Institute Elective-1 (Engineering)	20CSCSOEAI	Introduction to Artificial Intelligence	3	0	1	4	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), One institutional Elective has to be chosen from other discipline.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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	20CSCSPWP1	Project Phase – I	0	0	08	08	50	50	100
Program Core-8	20CSCSINNT	Internship	0	0	10	10	50	50	100
Program Elective-5	20CSCSPESP	Software Project Management& Testing	3	0	1	4	50	50	100
	20CSCSPENL	Natural Language Processing	3	0	1	4	50	50	100
	20CSCSPEWT	Web Technology	3	0	1	4	50	50	100
Audit-1 (Non-Credit Mandatory Course)	20CSCSNCSM	Stress Management by Yoga				0			P/F
	TOTAL		3	0	19	22	150	150	300

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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	20CSCSPWP2	Project Phase - II	0	0	20	20	50	50	100
Program Core-10	20CSCSSRSE	Seminar	0	0	2	2	50	50	100
Audit-2 (Non-Credit Mandatory Course)	20CSCSNCTW	Technical Writing				0			P/F
	TOTAL		0	0	22	22	100	100	100

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSBSMF
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, 2nd Edition, 2001.

References:

1 John Vince, Foundation Mathematics for Computer Science, Springer, 2nd Edition, 2020.

2 M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University Press, 2005.

3 Alan Tucker, Applied Combinatorics, Wiley, 6th Edition, 2012.

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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPCDT
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, B-Tree, open-end problems. 7 hrs.

Unit 2:

Hashing: General Idea, Hash Function, Separate Chaining, Hash tables without Linked lists: Linear probing, Quartic probing, double hashing, Rehashing, Universal Hashing, Extendible Hashing, open-end problems. 7 hrs.

Unit 3:

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

Unit 4:

Graph: Definitions, Shortest path: Unweighted shortest paths, Dijkstra Algorithm, Graph with negative edge costs, acrylic graphs, all-pair shortest path, network flow problem, Minimum spanning tree. 8 hrs.

Unit 5:

Advanced data structure: Top-down splay tree, red-black trees, Bottom-up insertion, Top-down red-black tree, top-down deletion, Applications of DFS, Undirected graphs, Biconnectivity, Euler circuit, directed graphs, open-end problems. 7 hrs.

Text Books:

1 Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2014.

2 T. H Cormen, C. E. Leiserson and R. L. Rivest, Introduction to Algorithms, 2nd Edition, Prentice Hall India, 2009.

Reference Text Books:

1 Mark Allen Weiss, Data Structures and Algorithm Analysis in Java, 3rd Edition, Pearson, 2012

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 data structure techniques.
CO2:	Conduct experiments to arrive at expected outcome for given application using data structure techniques.
CO3:	Demonstrate scholarship of knowledge to provide critical analysis of data structure technologies.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPCSC
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.

Text Book:

1. Principles of Soft computing, S N Sivanandam, Deepa S. N, Wiley, 3rd Edition, 2018, ISBN: 9788126527410

References:

1 John Vince, Foundation Mathematics for Computer Science, Springer, 2015.

2 Neuro-fuzzy and soft computing, J.S.R. Jang, C T Sun, E Mizutani, PHI (EEE edition), 1st Edition, 1997, 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.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEWS
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:	Make an effective oral and written presentation of the study on topics related to mobile ad hoc networks.
CO2:	Apply the protocol/technique for collecting data from various sink nodes.
CO3:	Analyse concept of wireless sensor network technology in usage of various applications.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEAI
Course Name	Artificial Intelligence	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

How Should We Instruct AI?: A Mathematical Framework for AI, Utility-Maximizing Agents, Utilitarian Ethics for AI; **How Can AI Agents Learn Environment Models?:** Universal AI, A Formal Measure of Intelligence, Modifications of the Agent Framework, The Ethics of Learned Environment Models — 6 hrs.

Unit 2:

AI in Our Finite Universe: Learning Finite Stochastic Models, When Is the Most Likely Finite Stochastic Model the True Model?, Finite and Infinite Logic, Agents Based on Logical Proof, Consistent Logic for Agents, The Ethics of Finite and Infinite Sets for AI — 8 hrs.

Unit 3:

Learning Human Values: A Two-Stage Agent Architecture, Computing Utility from Human Values, Corrupting the Reward Generator and Three-Argument Utility Functions, Normalizing Utility Values, Rawls' Theory of Justice, Evolving Humanity — 8 hrs.

Unit 4:

Testing AI: An AI Testing Environment, Will the Tested Agent Act in the Real World?, The Ethics of Testing AI; — 8 hrs

Unit 5:

This Is the World on Machine Learning: The digital mirror, A society of models, To share or not to share, and how and where, Google + Master Algorithm = Skynet? — 6 hrs

Text Book:

1. Ethical Artificial Intelligence, Bill Hibbard, , Space Science and Engineering Center, University of Wisconsin – Madison and Machine Intelligence Research Institute, Berkeley, CA, 1st Edition, 2015.
2. The Master Algorithm, PedrosDomingos, BasicBooks, 1st Edition, 2015
3. Artificial Intelligence: A Modern Approach by Stuart Russell, Peter Norvig, 2nd Edition, Pearson Education, 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.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEMC
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 APls for Microsoft Windows, Win32/MFC Thread APls, Threading APls 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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEMA
Course Name	Mobile Adhoc Networks	Total No. of Lecture Hours	36
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. — 7 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. — 7 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. — 7 hrs.

Text Book:

1. Principles of Wireless Networks , KavethPahlavan, K. Prasanth Krishnamurthy, Pearson Publications, Asia, 2nd edition, 2002

2. Mobile Cellular Communications, G.Sasibhusan Rao, Pearson Publications, 1st Edition, 2012.

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:	Engage in independent study to prepare a technical document to address current trends in mobile adhoc networks
CO2:	Conduct experiments by applying concepts of mobile ad hoc network to solve complex problems.
CO3:	Demonstrate In-depth knowledge in mobile ad hoc network technologies/algorithms.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEBD
Course Name	Big Data Analytics	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Hadoop, Features of Hadoop:,Hadoop Conceptual Layer, High Level Architecture of Hadoop,Hadoop Distributed File System, HDFS Daemons, Processing Data with HadoopMapReduce daemons, MapReduce Example, Managing Resources and Applications with Hadoop Map Reduce programming, YARN. 7 hrs.

Unit 2:

Distributed Architectures : Hadoop, spark, HPCC Systems Vs Hadoop. **HPCC Systems architecture** HPCC System functions, Data Lake Architecture, The HPCC Systems design, Thor Vs ROXIE 7 hrs.

Unit 3:

Apache Spark: Spark Introduction, Resilient Distributed Datasets, Spark core programming, Spark shell, Apache Spark – Deployment. **Scala:** Scala Overview, Vals and Variables, basic types, operators. 8 hrs.

Unit 4:

IoT : Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models. 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 5:

IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs Web server – Web server for IoT, Cloud for IoT, Python web application framework designing a RESTful web API, Amazon Web services for IoT 7 hrs.

Text Book:

1. Radha, Vijayalakshmi, Big data and Analytics, Wiley publications, 2016.
2. Andy Konwinski, Holden Karau, MateiZaharia, Patrick Wendell Learning Spark, Lightning-Fast Big Data Analysis, , 1st Edition, O'Reilly, 2015
3. ArshdeepBahga and Vijay Madisetti, Internet of Things - A Hands-on Approach, Universities Press, 2015.
4. Cay S. Horstmann, Scala for the Impatient 2nd Edition, Pearson, 2016
5. https://cdn.hpccsystems.com/whitepapers/wp_introduction_HPCC.pdf

References Books:

1. Paul C. Zikopoulos Dirk deRoos Krishnan Parasuraman Thomas Deutsch David Corrigan James Giles, Harness the Power of Big Data, IBM big data platform, MCGRAWHILL, 2013.
2. Hoboken N J, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing an Presenting Data Author: Education EMC Services, Publisher: Wiley, 2015.

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/Spark on IoT using Cloud
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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEAD
Course Name	Advanced Database Management Systems	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Database System Concepts: Data models, schemas, instance, three schema architecture, data independence, database language, interface, functional dependencies, normal form based on primary key, second normal form, third normal form, boyce-codd normal formal form, multivalued dependency and fourth normal form. 7 hrs.

Unit 2:

Object and Object-Relational Databases: Overview of Object-Oriented Concepts – Objects, Encapsulation, Type and class hierarchies, complex objects; Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Overview of C++ language binding; Conceptual design of Object database. Overview of object relational features of SQL; Object-relational features of Oracle; Implementation and related issues for extended type systems; the nested relational model. 8 hrs.

Unit 3:

Parallel and Distributed Databases: Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery. 7 hrs.

Unit 4:

Data Warehousing, Decision Support and Data Mining: Introduction to decision support; OLAP, multidimensional model; Window queries in SQL; Finding answers quickly; Implementation techniques for OLAP; Data Warehousing; Views and Decision support; View materialization; Maintaining materialized views. 7 hrs

Unit 5:

More Recent Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management. 7 hrs.

Text Book:

1. Elmasri and Navathe, "Fundamentals of Database Systems", Pearson Education, 2013.
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", New Delhi, McGraw Hill, 2004.

References Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill, 2010.
2. Connolly and Begg, "Database Systems", 4th Edition, Pearson Publications, 2005.
3. Henry F. Korth, Abraham Silberschatz, and S. Sudharshan, "Database System Concepts", New Delhi, McGraw Hill, 2006.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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 data base techniques.
CO2:	Conduct experiments to arrive at expected outcome for given application using database techniques.
CO3:	Demonstrate In-depth knowledge in advanced database technologies/theories/ practices.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	2[L-T-P: 2-0-0]	Course Code	20ALLPICRM
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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPCAC
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. 7 hrs.

Unit 3:

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 4:

Wireless Wide Area Networks and LTE Technology: Infrastructure of Wireless Networks, Cellular Networks: Cellular Network Devices and Operation, Handoff, Mobile IP Management in Cellular Networks: Home Agents and Foreign Agents, Agent Discovery Phase, Registration Mobile IP Routing: Generations of Cellular Networks, Long-Term Evolution (LTE) Technology: LTE Networking Devices, Call Establishment in LTE Cells, Handoff in LTE, Downlink and Uplink Schemes in LTE, Frequency Reuse, Wireless Mesh Networks with LTE: Applications of Mesh Networks, Physical and MAC Layers of WMNs 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, Secure Shell(SSH),Transport Layer Security, IP Security, Wireless Security. Firewalls 8 hrs.

Text Books:

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.
3. Nader F. Mir, "Computer and Communication Networks", 2nd Edition, Prentice Hall-2015.

Reference Book:

1. Stallings W., "High Speed Networks and Internet : Performance and Quality of Service", Prentice-Hall-2014

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

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 computer network techniques/protocols.
CO2:	Conduct experiments to arrive at expected outcome for given application using computer network algorithms
CO3:	Demonstrate In-depth knowledge in computer network technologies/theories/ practices.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPCAA
Course Name	Advanced Algorithms	Total No. of Lecture Hours	36
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. 7 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. 7 hrs.

Unit 3:

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

Unit 4:

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 7 hrs

Unit 5:

Advanced Algorithm Design and Analysis: Backtracking – N-Queen's Problem - Branch and Bound – Assignment Problem - P & NP problems – NP-complete problems – Approximation algorithms for NP-hard problems – Traveling salesman problem 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. Anany Levitin "Introduction to the Design and Analysis of Algorithms" Pearson Education, 2001

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:	Review and make effective oral presentation on current trends and prepare a report on advanced algorithms
CO2:	Conduct experiments to arrive at expected outcome for given application using various algorithms
CO3:	Demonstrate In-depth knowledge in advanced algorithm by performing mathematical analysis

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

II SEMESTER

Credits	2[L-T-P: 2-0-0]	Course Code	20CSCSPCAT
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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEML
Course Name	Machine Learning	Total No. of Lecture Hours	36
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 — 7 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 — 7 hrs.

Unit 3:

Computational Learning: Probably Learning, Sample Complexity for Finite and Infinite Hypothesis Spaces, Mistake Bound Model — 7 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

II SEMESTER

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEDS
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 worldcloud, 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, 2013.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman., Mining of Massive Datasets. v2.1,Cambridge University Press, 2010.

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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEBC
Course Name	Block Chain	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction to Blockchain: What is Blockchain, Public Ledgers, Blockchain as public ledgers, Bitcoin, Blockchain 2.0, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Permissioned Model of Blockchain — 7 hrs.

Unit 2

Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency. — 7 hrs.

Unit 3:

Permissioned Blockchain: Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, Execute contracts, Consensus models for permissioned Blockchain, Distributed consensus in closed environment. — 7 hrs.

Unit 4

Bitcoin Basics: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay, Distributed Consensus: Why Consensus, Distributed consensus in open environments. — 7 hrs.

Unit 5

Consensus in a Bitcoin network: Bitcoin Consensus, Proof of Work (PoW) – basic introduction, HashcashPoW, Bitcoin PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem — 8 hrs.

Text Book:

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

References:

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress Publishers, 2017.
2. https://nptel.ac.in/courses/106/104/106104220/
3. https://www.udemy.com/topic/blockchain/
4. https://medium.com/pennblockchain/a-living-list-of-blockchain-resources-5ece5e8cf06

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.

II SEMESTER

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPECF
Course Name	Cyber Security	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Facing the cybercrime problems head-on: Introduction, defining cybercrime, categorizing cybercrime, reasons for cybercrime. **Understanding the people on the scene:** Introduction, Understanding cyber criminals, understanding cyber victims, understanding cyber investigators. 7 hrs.

Unit 2:

The Computer Investigation process: Introduction, defining computer/cyber crime, investigating computer crime, investigating company policy violations, conducting a computer forensic investigation. 7 hrs.

Unit 3:

Investigating Web attacks: Types of Web Attacks, Intrusion Detection, Security Strategies for Web Applications, Investigating Static and Dynamic IP Addresses, Checklist for Web Security, Case study for WiFi password hacking in WEP. 7 hrs.

Unit 4:

Tracking E-Mails and Investigating E-Mail Crime: Introduction to Tracking E-Mails and Investigating E-Mail Crimes, E-mail system, e-mail crime, phishing, case study: Advance Phishing 7 hrs.

Unit 5:

Collecting and Preserving Digital Evidence: Understanding the Role of Evidence in a Criminal Case, Collecting Digital Evidence, Preserving Digital Evidence, Recovering Digital Evidence, case study: Pen drive data recovery. 8 hrs.

Text Books:	
1.	Scene of the cybercrime, Debra Little John Shinder and Michael Cross, 2nd edition, Syngress publishing Inc, Elsevier Inc, 2008
2.	Dave Garza and et al, "Computer Forensic, Investigating Network Intrusions and Cybercrime", EC-Council | Press, 2010
Reference Books:	
1.	Kruse and Henser, Computer Forensics, Addision Wesley, 1st Edition, 2001, ISBN: 0201707195.
2.	Nelson, Phillips, Enfinger and Stuart, A guide to Computer Forensics and Investigation, 2nd Edition, 2006, Thomson publisher.

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Independently carry out the technical details for development of reverse engineering to tackle attack in the cyber world
CO2:	Write a technical report of the essence of computer cyber security/ forensic
CO3:	Analyzing various ways of cyber security attacks

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEDL
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), VariationalAutoencoders, 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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEAS
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, 2003, 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.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

II SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSOEAI
Course Name	Introduction to Artificial Intelligence	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction: What is AI?. Intelligent Agents: Agents and environment, Rationality, the nature of environment, the structure of agents. Problem-solving: Problem-solving agents, Example problems, 7 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. 7 hrs.

Unit 3:

Heuristic Search Techniques: Generate and Test, Hill Climbing, Best first search, Problem Reduction, Constraint Satisfaction. 8 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. 7 hrs

Unit 5:

Learning: Forms of Learning, Inductive learning, Ensemble learning, Support vector machines. 7 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.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

III SEMESTER

Credits	8[L-T-P: 0-0-8]	Course Code	20CSCSPWP1
Course Name	Project Phase – I	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 consolidate 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 5:	Engage in effective communication through presentation of project work, prepare technical reports and paper publication

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

III SEMESTER

Credits	**10[L-T-P: 0-0-10]**	**Course Code**	**20CSCSINNT**
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 behaviour during preparation of Technical document/Report/development of solution
CO 6:	Use formal and informal communications with guide, make presentations and prepare technical document

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

III SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPESP
Course Name	Software Project Management & Testing	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:

IEEE 829-2008 - IEEE Standard for Software and System Test Documentation — 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. https://standards.ieee.org/standard/829-2008.html

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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

III SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPENL
Course Name	Natural Language Processing	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. The Ambiguity of Language: Why NLP Is Difficult . Lexical resources, Word counts, Zipf's laws Collocations Concordances. 7 hrs.

Unit 2:

Essential Information Theory , Part Of Speech Tagging and Sequence Labeling: Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). 7 hrs.

Unit 3:

N-gram Language Models: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. 7 hrs.

Unit 4:

Statistical Alignment and Machine Translation, Clustering : Hierarchical Clustering, Non-Hierarchical Clustering 7 hrs.

Unit 5:

Information Retrieval: Common design features of IR systems, Evaluation measures, The Vector Space Model, Latent Semantic Indexing 8 hrs.

Text Book:

1. Foundations of Statistical Natural Language Processing, MIT press 2009
2. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python (O'Reilly 2009, website 2018) http://www.nltk.org/book/

Reference Books:

1. Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Daniel Jurafsky and James H Martin, Prentice Hall, 2008

Course Outcomes (COs):	
On Completion of the course, the students will be able to	
CO1:	Ability to independently carry out study of Recent Trends in Natural language processing
CO2:	Ability to conduct experiments to arrive at expected outcome for given application using statistical techniques and NLTK toolkit
CO3:	Ability to demonstrate In-depth knowledge in Natural language processing statistical theories

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

III SEMESTER

Credits	4[L-T-P: 3-0-1]	Course Code	20CSCSPEWT
Course Name	Web Technology	Total No. of Lecture Hours	36
CIE Marks	50	SEE Marks	50

Unit 1:

XHTML: Basic syntax, Standard XHTML document structure; Basic text markup, Images; Hypertext Links, Lists, Tables, Forms, The Audio Element, The Video Element, Organization Elements, The Time Element, Syntactic differences between HTML and XHTML. Cascading Style Sheets: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Alignment of text, Color, The Box model, Background images, The and tags, Conflict resolution. 7 hrs.

Unit 2:

JQuery: Introducing jQuery; Adding jQuery to a Page; Modifying Web Pages: An Overview; Understanding the Document Object Model; Selecting Page Elements: The jQuery Way; Adding Content to a Page; Setting and Reading Tag Attributes; Reading, Setting, and Removing HTML Attributes; Acting on Each Element in a Selection. 1. Action/Reaction: Making Pages Come Alive with Events; What Are Events?; Using Events the jQuery Way, Tutorial: Introducing Events; More jQuery Event Concepts. 7 hrs.

Unit 3:

Common jQuery Tasks : Controlling How Links Behave, Opening External Links in a New Window, Creating New Windows 3. Enhancing Web Forms : Understanding Forms, Form Validation Introducing Ajax:What is Ajax, Ajax: Basics, Ajax the jQuery Way, JSON. 7 hrs.

Unit 4:

The Programmable Web and Its Inhabitants: HTTP- Documents in Envelopes, Method Information, Scoping Information, The Competing Architectures, Technologies on the Programmable Web; Writing Web Service Clients: Web Services Are Web Sites, del.icio.us: The Sample Application ,Making the Request: HTTP Libraries (only PHP: libcurl, JavaScript: XMLHttpRequest), Processing the Response: XML Parsers (PHP, JavaScript: responseXML), JSON Parsers: Handling Serialized Data; What Makes RESTful Services Different?: Introducing the Simple Storage Service,Resources, HTTP Response Codes; The ResourceOriented Architecture: Resource-Oriented What Now?, What's a Resource?, URIs, Addressability, Statelessness, Representations, Links and Connectedness, The Uniform Interface. 7 hrs.

Unit 5:

Designing Read-Only ResourceOriented Services: Resource Design, Turning Requirements Into Read-Only Resources, Figure Out the Data Set, Split the Data Set into Resources, Name the Resources, Design Your Representations, Link the Resources to Each Other. The HTTP Response. Designing Read/Write ResourceOriented Services: User Accounts as Resources, Custom Places. Ajax Applications as REST Clients: From AJAX to Ajax, The Ajax Architecture, A del.icio.us Example, The Advantages of Ajax, The Disadvantages of Ajax, REST Goes Better, Making the Request, Handling the Response. 8 hrs.

Text Book:

1. "Programming the World Wide Web" by Robert W. Sebesta, 8 thEdition,Pearson, 2015.
2. JavaScript & jQuery: The Missing Manual, 3rd Edition, By David Sawyer McFarland, Publisher: O'Reilly Media, September 2014
3. RESTful Web APIs, By Leonard Richardson, Mike Amundsen, Sam Ruby, Publisher: O'Reilly Media, September 2013.

References:

1. Professional Ajax, 2nd Edition by Nicholas C. Zakas (Author), Jeremy McPeak (Author), Joe Fawcett (Author) 2007.
2. RESTful Web APIs, Leonard Richardson, Mike Amundsen, Sam Ruby, O'Reilly Media (September 27, 2013) 3. jQuery in Action, Second Edition by Bear Bibeault, 2010.
3. "Learning PHP, MySQL, JavaScript, CSS & HTML5" by Robin Nixon, 3 rd Edition, O'REILLY, 2014.

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 web Technologies.
CO2:	Conduct experiments to arrive at expected outcome for given application using Web Technologies.
CO3:	Demonstrate in-depth knowledge in Web Technologies by implementing concepts.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

III SEMESTER

Credits	Non-Credit Course	Course Code	20CSCSNCSM
Course Name	**Stress Management by Yoga**		
CIE Marks	**50**	**Status**	**P/F**

TOPICS TO BE COVERED:

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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

IV SEMESTER

Credits	**20[L-T-P: 0-0-20]**	**Course Code**	**20CSCSPWP2**
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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

IV SEMESTER

Credits	2[L-T-P: 0-0-2]	Course Code	20CSCSSRSE
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 survey and identify topic/concepts
CO2:	Analyze methodology/technique or algorithm.
CO 3:	Analyze different case studies/scenarios/tools in the selected concept.
CO 4:	Communicate and prepare documentation / reports effectively.
CO 5:	Exhibit reflective learning and work independently

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute affiliated to VTU

IV SEMESTER

Credits	Non-Credit Course	Course Code	20CSCSNCTW
Course Name	Technical Writing		
CIE Marks	50	Status	P/F

CONTENT

- 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.