GLOBAL ACADEMY OF TECHNOLOGY

RR Nagar, Bengaluru – 560098

Department of Computer Science and Engineering

(Accredited by NBA 2019-2022)

M.TECH in COMPUTER SCIENCE and ENGINEERING

DRAFT SCHEME and SYLLABUS

FOR AUTONOMOUS PROGRAM 2020-21

GLOBAL ACADEMY OF TECHNOLOGY

Autonomous Institution Affiliated to VTU, Belagavi.

Scheme of Teaching and Examination for M.Tech Programs

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2020 – 21)

I SEMESTER M. Tech.

Sl. No.	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
			Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P					
1	20MCS11	Linear Algebra and Calculus	4	-	-	3	50	50	100	4
2	20MCS12	Computational Algorithms	4	-	-	3	50	50	100	4
3	20MCS13	Machine Learning	4	-	-	3	50	50	100	4
4	20MCS14	Soft Computing	4	-	-	3	50	50	100	4
5	20MCS15X	Professional Elective A	3	-	-	3	50	50	100	3
6	20MCS16X	Professional Elective B	3	-	-	3	50	50	100	3
7	20MCSL17	Machine Learning Laboratory	-	-	4	3	50	50	100	2
		TOTAL	**22**	**-**	**4**	**-**	**350**	**350**	**700**	**24**

List of Professional Elective Courses

Professional Elective A:

Sl. No.	Course Code	Course Title	Credits
1	20MCS151	Cloud Computing Technology	3
2	20MCS152	Wireless Network Security	3
3	20MCS153	Visualization - Tools and Techniques	3
4	20MCS154	Blockchain	3

Professional Elective B:

Sl. No.	Course Code	Course Title	Credits
1	20MCS161	Advanced Web Programming	3
2	20MCS162	Data Science	3
3	20MCS163	Large Data Indexing	3
4	20MCS164	Applied Cryptography	3

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II SEMESTER M. Tech.

Sl. No.	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
			Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P					
1	20MCS21	Data Analytics using R	4	-	-	3	50	50	100	4
2	20MCS22	Multicore Architecture and Programming	4	-	-	3	50	50	100	4
3	20MCS23X	Professional Elective C	3	-	-	3	50	50	100	3
4	20MCS24X	Professional Elective D	3	-	-	3	50	50	100	3
5	20GCS25X	Global Elective	3	-	-	3	50	50	100	3
6	20MCSL26	Software Development for Portable Devices Laboratory	-	-	4	3	50	50	100	2
7	20MCSMP27	Mini Project	-	-	4	3	100	-	100	3
8	20MCS28	Research Methodology and IPR	1	2	-	3	50	50	100	2
		TOTAL	**18**	**2**	**8**	**-**	**450**	**350**	**800**	**24**

List of Professional Elective Courses

Professional Elective C

Sl. No.	Course Code	Course Title	Credits
1	20MCS231	Natural Language Processing	3
2	20MCS232	Cloud Security	3
3	20MCS233	Computer System Performance Analysis	3
4	20MCS234	Deep learning	3

Professional Elective D

Sl. No.	Course Code	Course Title	Credits
1	20MCS241	Digital Forensic and Cyber Crime	3
2	20MCS242	Computer Vision	3
3	20MCS243	Human Computer Interaction	3
4	20MCS244	Agile Technology	3

Global Elective

Sl. No.	Course Code	Course Title	Credits	Teaching Department
1	20GCS251	Industry 4.0	3	CSE
2	20GCS252	Python Programming	3	CSE
3	20GCS253	Business Analytics	3	CSE
4	20GCS254	Data mining and Data warehousing	3	CSE
5	20GCS255	Software Oriented Architecture	3	CSE
6	20GCS256	Linear Programming	3	CSE

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III SEMESTER M. Tech.

Sl. No.	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
			Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P					
1	20MCS31	Project Management and Professional Ethics	4	-	-	3	50	50	100	4
2	20MCS32X	Professional Elective E	3	-	-	3	50	50	100	3
3	20MCS33X	Professional Elective F	3	-	-	3	50	50	100	3
4	20MCS34 I	Internship	To be completed during the intervening vacation of I and II semesters and /or II and III semesters)			3	50	50	100	6
5	20MCS35 P	Project work Phase I	-	-	4	3	50	50	100	4
		TOTAL	**10**	**-**	**4**	**-**	**250**	**250**	**500**	**20**

Internship: All the students must undergo mandatory internship of 8 weeks during the vacation of I and II semesters and /or II and III semesters.

List of Professional Elective Courses

Professional Elective E

Sl. No.	Course Code	Course Title	Credits
1	20MCS321	Wireless and Mobile Networks	3
2	20MCS322	Advanced Computer Networks	3
3	20MCS323	Digital Image Processing	3
4	20MCS324	Cognitive Architecture	3

Professional Elective F

Sl. No.	Course Code	Course Title	Credits
1	20MCS331	Operating System Design	3
2	20MCS332	Data Clustering	3
3	20MCS333	Design Thinking and Innovation	3
4	20MCS334	Social Network Analysis	3

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IV SEMESTER M. Tech.

Sl. No.	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
			Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P					
1	20MCS41 P	Project work Phase 2	-	-	4	3	50	50	100	18
2	20MCS42	Technical Seminar	-	-	2	3	100	-	100	2
		TOTAL	**-**	**-**	**6**	**-**	**50**	**50**	**200**	**20**

ASSESSMENT:

THEORY:

Weightage for Continuous Internal Evaluation (CIE) is 50 marks: The CIE Assessment pattern is based on internal test and Alternative Assessment Tool (AAT). Total of two tests will be conducted and weightage for each test will be for 20 marks. Alternative Assessment Tool will carry 10 marks.

Flexible assessment component: Design of experiment / implementation of research paper / literature review / modeling a given system / building a system / oral seminar / mini project / video submission / term paper / any other with the approval from the departmental head.

Weightage for Semester End Examination (SEE) is 50 marks: The duration of SEE is 3 hours and will be conducted for 100 marks and further reduced to 50 marks. A total of 10 questions will be set from five modules. Students are required to answer five questions selecting one question from each module carrying 20 marks. Choice of questions is within the module.

LABORATORY:

Weightage for Continuous Internal Evaluation (CIE) is 50 marks: The CIE Assessment pattern is based on the performance of the student on a weekly basis and internal test. Weekly basis performance will be evaluated for 30 marks while the internal test will carry 20 marks.

Weightage for Semester End Examination (SEE) is 50 marks: The duration of SEE is 3 hours and will be conducted for 100 marks and further reduced to 50 marks.

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SEMESTER – I

LINEAR ALGEBRA AND CALCULUS

Course Code	20MCS11	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Credits	04	SEE Duration	03 Hours

Module-1

Linear Equations: Fields; system of linear equations, and its solution sets; elementary row operations and echelon forms; matrix operations; invertible matrices, LU-decomposition

10 hours

Module-2

Vector Spaces: Vector spaces; subspaces; bases and dimension; coordinates; summary of row-equivalence; computations concerning subspaces.

10 hours

Module-3

Linear Transformations: Linear transformations; algebra of linear transformations; isomorphism; representation of transformations by matrices; linear functional; inverse of a linear transformation.

10 hours

Module-4

Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization.

Symmetric Matrices and Quadratic Forms: Eigen Values and Eigen Vector, Diagonalization; quadratic forms; constrained optimization; Singular value decomposition.

10 hours

Module-5

Calculus of Variations: Concept of functional-Eulers equation. functional dependent on first and higher order derivatives, functional on several dependent variables. Isoperimetric problems-variation problems with moving boundaries.

10 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Analyze whether a system is consistent or inconsistent and its solution is unique or infinite.
CO2	Perform row operations on matrices and find bases and dimension of vector spaces.
CO3	Linearly transform the system from one dimension to another and represent the pertinent linear transformation in matrix form.
CO4	Compute orthogonal and orthonormal vectors required to analyze Machine Learning techniques.
CO5	Apply techniques of constrained optimization and singular value decomposition for problems.

Reference Books:

1. Gilbert Strang, Linear Algebra and its Applications, Thomson Learning Asia, 3rd Edition, ISBN-10: 8177583336, 2003.
2. David C.Lay, Steven R.Lay and J.J.McDonald, Linear Algebra and its Applications, Pearson Education Ltd, 5th Edition, ISBN 0-321-98238-X, 2015.
3. Kenneth Hoffman and Ray Kunze, Linear Algebra, Pearson Education (Asia) Ptv. Ltd, 2nd Edition, ISBN-10: 0135367972, 2004.
4. E. Kreyszig, Advanced Engineering Mathematics, Wiley, 10th Edition, ISBN-13 : 978-0470458365, 2015.

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SEMESTER – I

COMPUTATIONAL ALGORITHMS

Course Code	20MCS12	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Credits	04	SEE Duration	03 Hours

Module-1

Foundations: The role of Algorithms in computing, Analyzing algorithms, Designing Algorithms, Growth of Functions-Asymptotic notation, Mathematical Background for algorithm analysis, Recurrences, The substitution method, The recursion-tree method, The master method, Randomized algorithms, Linear time sorting.

Divide and Conquer Approach : Divide and Conquer Approach: Analysis of Merge sort, Analysis of Quick sort, Strassen, Fibonacci, Polynomial Multiplication.

10 hours

Module-2

Dynamic Programming: Assembly-line Scheduling, Matrix-chain multiplication, Elements of dynamic programming, Matrix-chain multiplication, Longest common subsequence.

Elements of the greedy strategy, Huffman codes, Minimum Spanning Trees, Aggregate analysis, The accounting method, Table Doubling, The potential method.

10 hours

Module-3

Graph Algorithms, NP Completeness: Single-Source Shortest Paths-The Bellman-Ford algorithm, Dijkstra's algorithm, Difference constraints and shortest paths All-Pairs Shortest Paths-The Floyd-Warshall algorithm Maximum Flow-Flow networks, The Ford-Fulkerson method, Maximum bipartite matching, Red Black Tree, NP-Completeness: NP-completeness and reducibility, NP completeness proofs, NP-complete problems.

10 hours

Module-4

Approximation Algorithm: Approximation algorithms: The vertex-cover problem, The traveling-salesman problem, The set covering problem, The subset-sum problem.

Applied Algorithms:

Number-Theoretic: Number Theoretic notion, Greatest common divisor, The Chinese remainder theorem, RSA.

String Matching Algorithms: The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm.

Probabilistic Algorithm: Game Theoretic Techniques.

Randomized Algorithms: Monte Corlo and Las Vegas algorithm.

10 hours

Module-5

Linear Programming: Standard and Slack Forms, Formulation, Simplex algorithm, Duality, Parallel Algorithms, Dynamics Multithreading, Greedy Scheduler, Multithreaded Algorithms, cache oblivious algorithm.

10 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Analyze worst-case running times of algorithms using asymptotic analysis.
CO2	Describe the divide-and-conquer paradigm and clarify when an algorithmic design situation calls for it.
CO3	Describe the greedy paradigm and clarify when an algorithmic design situation calls for it.
CO4	Demonstrate a familiarity with applied algorithmic settings.
CO5	Apply the concept of linear programming to optimize the solution.
CO6	Describe the idea of backtracking, branch and bound strategy to solve some problems.

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, PHI, India, 2nd Edition, ISBN 0-07-013151.
2. Horowitz, Sahani and Rajsekaran, Fundamentals of Computer Algorithms, ISBN 0-7167-8316-9, Galgotia.
3. Rajeev Motwani, Prabhakar Raghavan, Randomized Algorithm, ISBN 0-521-47465-5, Cambridge University Press.
4. Aho, Hopcroft, Ullman: The Design and analysis of algorithms, ISBN-13: 978-0201000290.Pearson Education.

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SEMESTER – I

MACHINE LEARNING

Course Code	20MCS13	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Credits	04	SEE Duration	03 Hours

Module-1

Supervised Learning (Regression/Classification) - Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, and Generalized Linear Models Support Vector Machines.

10 hours

Module-2

Unsupervised Learning - Clustering: K-means/Kernel K-means, Specter clustering, Dimensionality Reduction: PCA and kernel PCA, Generative Models (mixture models and latent factor models).

10 hours

Module-3

Machine Learning algorithm

A: Machine Learning Algorithms - Evaluating Machine Learning algorithms and Model Selection.

B: Ensemble Methods - Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random forests) , brief introduction to deep learning models.

10 hours

Module-4

Reinforcement Learning- Introduction Learning task, Q Learning, Q functions, algorithm for Q learning, example. Nondeterministic Rewards and actions, Scalable Machine Learning (Online and Distributed Learning).

10 hours

Module-5

Convex optimization models: linear optimization, convex quadratic optimization, second order cone optimization, semidefinite optimization, convex composite optimization

Methods for convex optimization: gradient descent, Newton method, interior point methods, active set, prox methods, accelerated gradient methods, coordinate descent, cutting plances, stochastic gradient.

10 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the basics of supervised learning methods for regression and classification.
CO2	Explain unsupervised learning algorithms.
CO3	Compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a machine learning approach.
CO4	Understand the basics of reinforcement learning and scalable machine learning.
CO5	understand various convex optimization techniques applicable to machine learning.

Reference Books:

1. Tom M. Mitchell, Machine Learning, MGH, 1st Edition, ISBN-13 : 978-1259096952, 2013.
2. Boyd and Vandenberghe, Convex Optimization, Cambridge University Press, ISBN: 9780511804441, 2004.
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, ISBN 978-0-387-31073-2, 2007.
4. Sebastien Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in Machine Learning, ISBN-13: 978-1601988607, 2015.

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SEMESTER – I

SOFT COMPUTING

Course Code	20MCS14	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Credits	04	SEE Duration	03 Hours

Module-1

Introduction: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems, Artificial Neural Networks: Fundamental concept, Evolution, Basic model of ANN, Important terminologies of ANN, McCulloch- Pitts Neuron, Linear Separability, Hebb Network.

10 hours

Module-2

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

10 hours

Module-3

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

10 hours

Module-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.

10 hours

Module-5

Genetic algorithms: Introduction, Biological background, Traditional optimization algorithms, Genetic algorithm and search space, General algorithm Vs traditional algorithms, Simple GA, General genetic algorithm, Stopping condition for GA.

10 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the concepts of soft computing techniques such as neural, fuzzy, and hybrid approaches.
CO2	Explain the basics of supervised learning neural networks.
CO3	Illustrate the concept of Fuzzy sets, fuzzy relation and fuzzy operators.
CO4	Apply the concepts of Fuzzy sets in defuzzification and decision-making process.
CO5	Understand the principles of genetic algorithm in comparison with traditional computing.

Reference Books:

1. Principles of Soft computing, S N Sivanandam, Deepa S. N, Wiley, India, ISBN: 9788126527410.
2. John Vince, Foundation Mathematics for Computer Science, Springer, ISBN 978-3-319-21437-5.
3. Neuro-fuzzy and soft computing, J.S.R. Jang, C T Sun, E Mizutani, PHI (EEE edition), ISBN: 978-81-203-2243-1.

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SEMESTER – I

CLOUD COMPUTING TECHNOLOGY

(Professional Elective – A)

Course Code	20MCS151	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Cloud computing: Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Major challenges faced by cloud computing; Cloud Infrastructure: 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 vendorlock-in, Service- and compliance-level agreements, User experience and software licensing. Exercises and problems.

8 hours

Module-2

Cloud Computing: Application Paradigms: Challenges of cloud computing, Existing Cloud Applications and New Application Opportunities, Workflows: coordination of multiple activities, Coordination based on a state machine model: The ZooKeeper, The MapReduce Programming model, A case study: The Grep The Web application, HPC on cloud, Biology research.

8 hours

Module-3

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and para virtualization, Hardware support for virtualization, Case Study: Xen a VMM based para virtualization, Optimization of network virtualization, The darker side of virtualization, Exercises and problems.

8 hours

Module-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; Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Exercises and problems.

8 hours

Module-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.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Explain industry relevance of cloud computing in terms of challenges, vulnerabilities, SLAs.
CO2	Describe the application paradigms of cloud computing in terms of Map Reduce Programming.
CO3	Describe the Virtualization principles.
CO4	Explain the Resource management policies, scheduling algorithms in cloud computing.
CO5	Demonstrate the working of a VM instance along with security risks.

Reference Books:

1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier (MK), 1st Edition, 2013, ISBN: 9780124046276.
2. Kai Hwang, Geoffery C.Fox, Jack J Dongarra: Distributed Computing and Cloud Computing, from parallel processing to internet of things. Elsevier(MK), 1st Edition, 2012, ISBN: 978-0-12-385880-1.
3. Rajkumar Buyya, James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey, 1st Edition, 2014, ISBN: 978-0-470-88799-8.
4. John W Rittinghouse, James F Ransome: Cloud Computing Implementation, Management and Security, CRC Press, 1st Edition, 2013, ISBN: 978-1-4398-0680-7.

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SEMESTER – I

WIRELESS NETWORK SECURITY

(Professional Elective – A)

Course Code	20MCS152	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Network Security-Introduction, Weaknesses in network Security, Relevant Resources, Objectives of a security Strategy, Security aspects concerning the Internet**.**

Overview of wireless network security technology: Wireless network security Fundamentals-Overview of Wireless Network Security fundamentals, Types of wireless network security Technology- Wireless Network Security Technologies, Wireless Network Security Technology Perspectives, Wireless Networks at risk: Assessing Vulnerabilities, End point Security Control.

8 hours

Module-2

Designing wireless network security:

Wireless network security design issues, Cost justification and consideration Standard design issues.

8 hours

Module-3

Installing and deploying wireless network security: Testing techniques- Phase I,II,III,IV, Internetworking Wireless Security - Operation modes of Performance Enhancing Proxy (PEP), Adaptive usage of PEPs over a Radio Access Network (RAN), Problems of PEP with IPSec: Threats, Problems of Interworking between PEP and IPSec, Solutions to the Problems, Installation and Deployment-Installation, Deployment.

8 hours

Module-4

Maintaining Wireless Network Security-Configuring Secure Access, Management of Wireless Network Security, Ongoing Maintenance, Standards Development, Ensuring Site Security.

Security in Wireless Networks and Devices: Introduction, Cellular Wireless Communication Network Infrastructure, Development of Cellular Technology, Limited and Fixed Wireless Communication Networks, Wireless LAN (WLAN) or Wireless Fidelity (Wi-Fi) , WLAN (Wi-Fi) Technology, Mobile IP and Wireless Application Protocol, Standards for Wireless Networks , The IEEE 802.11, Bluetooth, Security in Wireless Networks, WLANs Security Concerns, Best Practices for Wi-Fi Security.

8 hours

Module-5

Security in Sensor Networks : Introduction , The Growth of Sensor Networks, Design Factors in Sensor Networks , Routing, Power Consumption, Fault Tolerance, Scalability , Product Costs, Nature of Hardware Deployed, Topology of Sensor Networks, Transmission Media, Security in Sensor Networks, Security Challenges, Sensor Network Vulnerabilities and Attacks, Securing Sensor Networks *Security Mechanisms and Best Practices for Sensor Networks, Trends in Sensor Network Security Research.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Explore the existing weaknesses, threats, security issues in wireless networks.
CO2	Analyze security design issues, cost justification, and standard design issues.
CO3	Analyze the wireless installation and deployment techniques in real-world networks.
CO4	Improve security in wireless network devices, sensor networks through maintaining wireless network security.

Reference Books:

1. John R.Vacca, Guide to Wireless Network security, 1st Edition, 2006, Springer Publishers, ISBN 978-0-387-29845-0.
2. Joseph MiggaKizza, A Guide to Computer Network Security, Springer, 2009, ISBN: 978-1-84800-916-5.
3. William Stallings, Cryptography and Network Security,4th Edition, November 16, 2005, ISBN 13: 9780131873162.
4. Wireless Network Security - A Guide for Small and Medium Premises, Lahti University of Applied Sciences Degree programme in Business Information Technology Bachelor's Thesis Spring 2018, Hoa Gia Bao Nguyen.

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SEMESTER – I

VISUALIZATION – TOOLS AND TECHNIQUES

(Professional Elective – A)

Course Code	20MCS153	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 hours

Module-1

Visualization: Introduction, Issues, Data Representation, Data Presentation, Interaction.

8 hours

Module-2

Fundamentals For Data Visualization: Visualization stages, Experimental Semiotics based on Perception Gibson's Affordance theory, A Model of Perceptual Processing, Types of Data.

8 hours

Module-3

Computer Visualization: Exploring Complex Information Spaces, Fisheye Views, Applications, Comprehensible Fisheye views, Fisheye views for 3D data, Non-Linear Magnification, Comparing Visualization of Information Spaces, Abstraction in computer Graphics, Abstraction in user interfaces.

8 hours

Module-4

Multidimensional Visualization: One Dimension, Two Dimensions, Three Dimensions, Multiple Dimensions Trees, Web Works.

Data Mapping: Document Visualization, Workspaces.

8 hours

Module-5

Case study: Small interactive calendars, Selecting one from many, Web browsing through a keyhole, Communication analysis, Archival analysis.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Summarize the basic model of the information visualization and interactive systems.
CO2	Review Visualization techniques and mapping the data to visual representations.
CO3	Understand Fisheye visualizations in the information space.
CO4	Visualize different types of information.
CO5	Summarize the visualization problems such as interactive calendar, web browsing and archival analysis.

Reference Books:

1. Colin Ware, Information Visualization Perception for Design, Margon Kaufmann Publishers, 3rd Edition, Morgan Kaufmann; 3rd edition, ISBN-13: 978-0123814647, 2012.
2. Robert Spence, Information visualization-An Introduction, Pearson Education, 3rd Edition, ASIN: B00S15FHFE, 2014.
3. Stuart.K.Card, Jock.D.Mackinlay and Ben Shneiderman, Readings in Information Visualization Using Vision to think, Morgan Kaufmann Publishers, 1st Edition, ISBN-13 : 978-1558605336, 1999.
4. Thomas Strothotte, Computer Visualization Graphics Abstraction and Interactivity, Springer Verlag Berlin Heiderberg, ISBN-13: 978-3-642-64149-7.

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SEMESTER – I

BLOCKCHAIN

(Professional Elective – A)

Course Code	20MCS154	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 hours

Module-1

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, and Zero Knowledge Proof.

8 hours

Module-2

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

8 hours

Module-3

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

8 hours

Module-4

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum-Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin.

8 hours

Module-5

Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the basics of distributed system and cryptographic algorithms.
CO2	Discuss about Blockchain terminologies and usage of consensus algorithms.
CO3	Develop Smart contracts which can be applied for various areas use cases.
CO4	Understand about various applications of Blockchain.

Reference Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016), ISBN-13: 978-0691171692.
2. Wattenhofer, The Science of the Blockchain, Createspace Independent Pub; 1st Edition, ISBN-13 : 978-1522751830, 2016.
3. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 1st Edition, ISBN-10: 1449374042, 2015.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – I

ADVANCED WEB PROGRAMMING

(Professional Elective – B)

Course Code	20MCS161	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 hours

Module-1

Introducing .NET: The .NET Framework, C#, VB, and the .NET Languages, The Common Language Runtime, The .NET Class Library.

The C# Language: C# Language Basics, Variables and Data Types, Variable Operations, Object-Based Manipulation, Conditional Logic, Loops, Methods.

Types, Objects, and Namespaces: The Basics About Classes, Building a Basic Class, Value Types and Reference Types, Understanding Namespaces and Assemblies, Advanced Class Programming.

8 hours

Module-2

Web Form Fundamentals: Writing Code, Using the Code-Behind Class, Adding Event Handlers, Understanding the Anatomy of an ASP.NET Application, Introducing Server Controls, Using the Page Class, Using Application Events, Configuring an ASP.NET Application.

Web Controls: Stepping Up to Web Controls, Web Control Classes, List Controls, Table Controls, Web Control Events and AutoPostBack, Validation, Understanding Validation, Using the Validation Controls, Rich Controls, The Calendar, The AdRotator, Pages with Multiple Views, User Controls and Graphics, User Controls, Dynamic Graphics, The Chart Control, Website Navigation: Site Maps, URL Mapping and Routing, The SiteMapPath Control, The TreeView Control, The Menu Control.

8 hours

Module-3

Error Handling, Logging, and Tracing: Avoiding Common Errors, Understanding Exception Handling, Handling Exceptions, Throwing Your Own Exceptions, Using Page Tracing

State Management: Understanding the Problem of State, Using View State, Transferring Information Between Pages, Using Cookies, Managing Session State, Configuring Session State, Using Application State, Comparing State Management Options

Styles, Themes, and Master Pages: Styles, Themes, Master Page Basics, Advanced Master Pages.

8 hours

Module-4

ADO.NET Fundamentals: Understanding Databases, Configuring Your Database, Understanding SQL Basics, Understanding the Data Provider Model, Using Direct Data Access, Using Disconnected Data Access.

Data Binding: Introducing Data Binding, Using Single-Value Data Binding, Using Repeated-Value Data Binding, Working with Data Source Controls.

The Data Controls: The GridView, Formatting the GridView, Selecting a GridView Row, Editing with the GridView, Sorting and Paging the GridView, Using GridView Templates, The DetailsView and FormView.

8 hours

Module-5

XML: XML Explained, The XML Classes, XML Validation, XML Display and Transforms.

Security Fundamentals: Understanding Security Requirements, Authentication and Authorization, Forms Authentication, Windows Authentication.

ASP.NET AJAX: Understanding Ajax, Using Partial Refreshes, Using Progress Notification, Implementing Timed Refreshes, Working with the ASP.NET AJAX Control Toolkit.

8 hours

Course Outcomes: At the end of the course the student will be able to:	
CO1	Write well-documented programs using the C# programming language.
CO2	Use web forms and form controls to develop web applications.
CO3	Implement Error Logging Modules and Handlers error logging.
CO4	Illustrate the connection between application and data sources using ADO.NET
CO5	Create interactive web applications using ASP.NET AJAX and manage the data.

Reference Books:

1. Matthew MacDonald, Beginning ASP.NET 4.5 in C#, Apress, ISBN 978-1-4302-4252-9, 2012.
2. Anne Bohem and Joel Murach, C# 2015, Murach., 3rd Edition, ISBN-13 : 978-1890774943, 2016.
3. Mary Delamater and Anne Bohem, Murach's ASP.NET 4.6 Web Programming in C#2015, SPD, 6th Edition, ISBN-13: 978-1890774950, 2016.
4. Benjamin Perkins, Jacob Vibe Hammer, John D Reid, Beginning C# 7 Programming with Visual Studio 2017, Wiley, 1st Edition, ISBN-13: 978-0134016191, 2018.

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SEMESTER – I

DATA SCIENCE

(Professional Elective – B)

Course Code	20MCS162	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 hours

Module-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.

8 hours

Module-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.

8 hours

Module-3

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

8 hours

Module-4

Estimation the likelihood of events: Logistic regression, generating recommendation with collaborative filtering: Used-based, Item-based.

8 hours

Module-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 hours

Course Outcomes:

At the end of the course the student 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.

Reference Books:

1. Samir Madhavan, Mastering Python for Data Science, PACKT Books, Pack Publishing, ISBN: 9781784390150, 2015.
2. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly, ISBN: 9781449363895.
3. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press, ISBN-13. 978-1107077232.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – I

LARGE DATA INDEXING
(Professional Elective – B)

Course Code	20MCS163	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 hours

Module-1

Fundamentals of Big data: Introduction, – Challenges of Conventional systems, Four Vs, Drivers for Big data, Big data analytics, Big data applications.

8 hours

Module-2

Big data tools: Introduction to Hadoop, - Hadoop components, MapReduce, Pig, Hive, HBase, Cassandra, Oozie, Flink, Flume, spark. Distributed programming using Hadoop.

8 hours

Module-3

Big Data Storage Techniques: Limitation of existing storage, Archival storage, On-Disk Storage, No SQL database, NewSQL database, In-Memory Storage, cloud storage.

8 hours

Module-4

Indexing in Bigdata: Distributed database, Global vs local index, Multidimensional index, Big data indexing challenges, Pattern for indexing large datasets, AI-indexing approach- Latent Semantic Indexing, Hidden Markov Model. Non-AI approach: The Tree-based indexing strategies, Hash Indexing Strategy, Custom Indexing Strategy, Inverted Indexing Strategy, comparison of different indexing strategies.

8 hours

Module-5

Case study: Case studies and projects: Understanding business scenarios, Feature engineering and visualization, Scalable and parallel computing with Hadoop and Map-Reduce.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Identify Big Data and its Business Implications.
CO2	Use Hadoop related tools for Big Data Analytics and perform basic Hadoop administration.
CO3	Classify different storage techniques.
CO4	Illustrate different indexing techniques.
CO5	Demonstrate the real-time application projects using business scenarios.

Reference Books:

1. Chris Eaton, Dirk Deroos et al, Understanding Big data, McGraw Hill, ISBN-13: 978-9339221270, 2012.
2. Boris lublinsky, Kevin t. Smith, Alexey Akubovich, Professional Hadoop Solutions, Wiley, ISBN: 9788126551071, ISBN-13 : 978-8126551071, 2015.
3. Tom White, Hadoop: The Definitive Guide, O'reily Media, ISBN: 9781449311520, 2012.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – I

APPLIED CRYPTOGRAPHY

(Professional Elective – B)

Course Code	20MCS164	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 hours

Module-1

Introduction: Security Trends, the OSI Security Architecture, Security Attacks, Security Services, Security Mechanism, A Model for Network Security.

Overview of Cryptography : Information security and cryptography: Background on functions Basic terminology and concepts, Symmetric-key encryption, Digital Signatures, Authentication and Identification, Public Key Cryptography, Hash Functions, Protocols and mechanism, Key establishment, management and certification, Pseudorandom numbers and sequences, classes of attacks and security models.

8 hours

Module-2

Mathematical Background : Probability theory, Information theory, Complexity theory, Number theory, Abstract Algebra, Finite fields. Finite Fields-Groups, Rings and Fields, Modular Arithmetic, The Euclidean Algorithm, Finite Fields of the Form GF(p), Polynomial Arithmetic, Finite Field of the Form GF(2n).

Number Theoretic Reference Problems-The integer factorization problem, The RSA problem, The quadratic residuosity problem, Computing Square roots, The discrete logarithm problem, The Diffie Hellman problem, Composite moduli, Computing individual bits, The subset sum problem, Factoring polynomial over finite fields.

8 hours

Module-3

Stream Ciphers: Introduction, Feedback shift registers, Stream ciphers based on LFSRs, Other stream ciphers.

Block Ciphers: Introduction and overview, Background and general concepts, Classical ciphers and historical development, DES, FEAL, IDEA, SAFAR, RC5 and other block ciphers.

8 hours

Module-4

Public Key Encryption : Introduction, RSA Public Key Encryption, Rabin public-key encryption, ElGamal public key encryption, McEliece public key encryption, Knapsack public key encryption, Probabilistic public key encryption.

8 hours

Module-5

Identification and Entity Authentication: Introduction, Passwords, Challenge-response identification, Customized and zero-knowledge identification protocols, Customized and zero knowledge identification protocols.

Comparison: Fiat-Shamir, GQ, and Schnorr, Attacks on identification protocols.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the Security trends, cryptology, composition of ciphers, classes of attacks and security model.
CO2	Evaluate mathematical background on cryptographic functions.
CO3	Identify Stream cipher and block cipher algorithms.
CO4	Analyze the complexity of public key encryption methods.
CO5	Evaluate identification and Entity authentication schemes.

Reference Books:

1. Handbook of Applied Cryptography, Alfred J. Menezes, Paul C. van Oorschot, Scott A, ISBN-13: 978-0849385230.
2. Cryptography and Network Security, William Stallings, 6thEdition, ISBN-13: 978-0-13-335469-0.
3. Cryptography Engineering: Design Principles and Practical Applications, Niels Ferguson, Bruce Schneier, Tadayoshi Kohno, 2010, Wiley. ISBN: 978-0-470-47424-2.
4. Applied Cryptography: Protocols, Algorithms, and Source Code in C, Bruce Schneier, 2nd Edition, ISBN:0-471-22357-3.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – I

MACHINE LEARNING LABORATORY

Course Code	20MCSL17	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:4	SEE Marks	50
Credits	02	SEE Duration	03 Hours

1. Consider the dataset which has fewer samples for the training purpose. Apply different methods to increase the samples and also demonstrate how do you reduce the samples if more number of samples is available.
2. Write a program to solve L2-regularized least squares regression problem and design a model for the data.
3. Write a program for spectral clustering. Create a dataset using initials of your full name and graduation year. Using appropriate distance functions apply any of the spectral clustering methods.
4. Take the dataset of your own and apply different classification techniques. Compare the results and discuss which classifier is better and why?
5. Take the dataset of your own and apply different clustering techniques such as K-Means and Fuzzy means. Compare the results and discuss which clustering technique is better and why?
6. Write a program to demonstrate why a multi-layer neural network works better when compared to the single layer neural network.

Note :

The lab programs are not restricted to the above list. The students may be expected to execute the above programs as well as any other program related to Machine Learning domain.

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the implementation procedures for the machine learning algorithms.
CO2	Design Python programs for various Learning algorithms.
CO3	Apply appropriate data sets to the Machine Learning algorithms.
CO4	Identify and apply Machine Learning algorithms to solve real world problems.

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SEMESTER – II

DATA ANALYTICS USING R

Course Code	20MCS21	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Credits	04	SEE Duration	03 Hours

Module-1

Introduction to Data Science: Roles in a data science project, Stages of a Data Science Project, Determining upper and lower bounds on model performance.

Introduction to R Programming: Loading data into R: Working with data from files, Working with relational databases.

10 hours

Module-2

Exploration of Data: Using summary statistics to spot problems, Spotting problems by the usage of visualization and graphics for Single Variable and also case of two variables.

Management of Data: Cleaning data: Treating missing values (NAs), Data Transformation, Sampling for Modeling and Validation: Test and Training split, Creation of sample group column, Record Grouping, Data Provenance.

10 hours

Module-3

Modeling Methods: Choosing and Evaluating Models: Mapping problems to Machine Learning Tasks, Evaluating Models, Validating Models.

Memorization Methods: Building single variable models (categorical, numerical and cross validation methods), Building models using many variables (Decision Tree, Nearest Neighbour and Naïve Bayes methods).

10 hours

Module-4

Supervised Methods of Modeling: Usage of Linear and Non-Linear Regression to build model, make predictions, finding relations, reading model summary and characterizing coefficients.

Unsupervised Method of Modeling: Cluster Analysis: Hierarchical clustering using hclust(), k-means algorithm, Assigning new points to clusters, takeaway from clustering.

Association Rule: Overview of Association Rules, Mining association rules with a rules package, Takeaways from Association Rule.

10 hours

Module-5

Documentation and Deployment: Using of knitr package for milestone documentation, using of comments and version control for running documentation, deploying models as HTTP service, export feature.

Producing effective presentation: Presenting results to project sponsor, Presenting results to end users, Presenting work to other data scientists.

10 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the significance of Data Science and R Programming.
CO2	Illustrate the significance of exploration and management of data.
CO3	Explain modeling and memorization methods to analyze data.
CO4	Outline the various supervised and unsupervised methods of modelling.
CO5	Illustrate various documentation and deployment techniques for professional presentation.

Reference Books:

1. Zumel, N., & Mount, J. "Practical data science with R", Manning Publication, ISBN 9781617291562, 2014.
2. Hadley Wickham, Garrett Grolemund, "R for Data Science: Import, Tidy, Transform, Visualize and Model Data", O'Reilly Media, ISBN:978-1-4919-1039-9, 2017.
3. Robert I. Kabacoff, "R in Action", 2nd Edition, Manning Publication, ISBN 9781617291388, 2015.
4. Jared P Lander, R for Everyone: Advanced Analytics and Graphics, Addison-Wesley, ISBN: 9781449312084, 2013.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

MULTICORE ARCHITECTURE AND PROGRAMMING

Course Code	20MCS22	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Credits	04	SEE Duration	03 Hours

Module-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.

10 hours

Module-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.

10 hours

Module-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, Signaling, Compilation and Linking.

10 hours

Module-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.

10 hours

Module-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.

10 hours

Course Outcomes: At the end of the course the student will be able to:	
CO1	Identify performance related parameters in the field of multicore Architecture.
CO2	Explain fundamental concepts of parallel programming and its design issues.
CO3	Solve the issues related to multiprocessing and suggest solutions.
CO4	Understand the concept of multi-threading and OPENMP.
CO5	Illustrate OpenMP and programming concept.

Reference Books:

1. Shameem Akhter and Jason Roberts: Multicore Programming, Increased Performance through Software Multi-threading, Intel Press, ISBN 0-9764832-4-6, 2006.
2. Hennessey and Patterson: Computer Architecture A Quantitative Approach, 4th Edition, Elsevier, ISBN: 978-0-12-383872-8, 2012.
3. Calvin Lin, Lawrence Snyder: Principles of Parallel Programming, Pearson Education, ISBN-13: 978-0321487902, 2009.
4. Michael J. Quinn: Parallel Programming in C with MPI and OpenMP, Tata McGraw Hill, 2004.

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SEMESTER – II

NATURAL LANGUAGE PROCESSING

(Professional Elective –C)

Course Code	20MCS231	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Introduction: What is Natural Language Processing (NLP)x?, Origins of NLP, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications, Some Successful Early NLP Systems, Information Retrieval.

Language Modelling : Introduction, Various Grammar-based Language Models, Statistical Language Model.

8 hours

Module-2

Word Level Analysis: Introduction, Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part-of-Speech Tagging.

Syntactic Analysis: Context-Free Grammar, Constituency, Parsing, Probabilistic Parsing.

8 hours

Module-3

Hidden Markov and Maximum Entropy Models: Markov Chains, The Hidden Markov Model, and Computing Likelihood: The forward algorithm.

Decoding: The Viterbi algorithm, Training Hidden Markov models.

Speech Recognition: Speech Recognition Architecture, Applying Hidden Markov models to speech.

8 hours

Module-4

Machine Translation: Introduction, Problems in machine translation, Characteristics of Indian languages, machine Translation approaches, Direct machine translation, Rule based machine translation, corpus based machine translation.

NLP Applications: Information extraction, Machine Translation, Natural Language Generation, Discourse processing.

8 hours

Module-5

Information Retrieval and Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information.

Retrieval valuation Lexical Resources: WordNet, FrameNet, Stemmers, POS Tagger Case Study: Learning to classify text using NLTK- Supervised classification, Choosing the right features, Document classification, parts of speech tagging, Exploiting context, Evaluation, Accuracy, Precision and Recall, Confusion matrix, Cross- validation.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Comprehend the fundamentals of NLP and various NLP models.
CO2	Illustrate word level and syntactic analysis.
CO3	Comprehend the fundamentals of Markov models and apply Markov models to speech.
CO4	Outline challenges in machine translation and various machine translation approaches.
CO5	Comprehend and compare various information retrieval models.

Reference Books:

1. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, ISBN-13 : 978-0195692327, 2008.
2. Daniel Jurafsky and James H Martin, Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Prentice Hall, 2nd Edition, ISBN:978-0-13-187321-6, 2008.
3. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, Publisher: O'Reilly Media, June 2009, ISBN : 9780596516499.
4. Alexander Clark, Chris Fox, Shalom Lappin, The Handbook of computational linguistics and Natural Language processing, ISBN: 978-1-405-15581-6, Wiley Blackwell, 2010.

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SEMESTER – II

CLOUD SECURITY

(Professional Elective – C)

Course Code	20MCS232	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Introduction to cloud computing and security-A brief primer on security, architecture, defense in depth, cloud is driving broad changes. Securing the cloud: architecture-requirements, patterns and architectural elements, cloud security architecture, key strategies for secure operations.

8 hours

Module-2

Securing the cloud: data security-overview of data security in cloud computing, data encryption: applications and limits, sensitive data categorization, cloud storage, cloud lock-in Securing cloud: key strategies and best practices- Overall strategy, security controls.

8 hours

Module-3

Security criteria: Building an internal cloud, Security Criteria-private clouds: selecting an external cloud provide-Selecting CSP,-overview of assurance, over view of risks, security criteria, Evaluating clouds security: An information security framework- evaluation cloud security, checklist for evaluating cloud security.

8 hours

Module-4

Identity and access management Trust Boundaries, IAM Challenges, IAM Definitions, IAM Architecture and Practice , Getting Ready for the Cloud 80 Relevant IAM Standards and Protocols for Cloud Services , IAM Practices in the Cloud, Cloud Authorization Management, Security Management in the Cloud, Security Management Standards , Security Management in the Cloud.

8 hours

Module-5

Privacy: Privacy, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing , Legal and Regulatory Implications , U.S. Laws and Regulations , International Laws and Regulations, Audit and compliance, Internal Policy Compliance, Governance, Risk, and Compliance (GRC)Illustrative Control Objectives for Cloud Computing.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Explore compliance and security issues that arise from cloud computing architectures intended for delivering Cloud based enterprise IT services and business applications.
CO2	Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based IT services.
CO3	Illustrate the concepts and guiding principles for designing and implementing appropriate safeguards and countermeasures for Cloud based IT services.
CO4	Describe the Identity and Access Management challenges, practices and standards for cloud-based services.
CO5	Explain the risk and laws governing privacy management in cloud-based services.

Reference Books:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Media; 1st Edition, 2009, ISBN: 0596802765.
2. Vic (J.R.) Winkler, Securing the Cloud: Cloud Computer Security Techniques and Tactics, Imprint: Syngress, 1st Edition, 2011, ISBN: 9781597495929
3. Ronald L. Krutz, Russell Dean Vine, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 1st Edition, 2010, ISBN-13: 978-0470589878, 2010, ISBN-10: 0470589876
4. John Rittinghouse, James Ransome, Cloud Computing: Implementation, Management, and Security, 1st Edition, 2009, ISBN-13: 978-1439806807, ISBN-10: 1439806802.

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SEMESTER – II

COMPUTER SYSTEM PERFORMANCE ANALYSIS

(Professional Elective – C)

Course Code	20MCS233	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Introduction: The Art Of Performance Evaluation, Common Mistakes In Performance Evaluation, A Systematic Approach To Performance Evaluation, Selecting An Evaluation Technique, Selecting Performance Metrics, Commonly Used Performance Metrics, Utility Classification Of Performance Metrics, Setting Performance Requirements.

8 hours

Module-2

Workloads, Workload Selection and Characterization: Types of Work Loads, Addition Instructions, Instruction Mixes, Kernels; Synthetic Programs, Application Benchmarks, Popular Benchmarks. Work Load Selection: Services Exercised, Level Of Detail; Representativeness; Timeliness, Other Considerations In Workload Selection. Work Load Characterization Techniques: Terminology, Averaging, Specifying Dispersion, Single Parameter Histograms, Multi Parameter Histograms, Principle Component Analysis, Markov Models, Clustering.

8 hours

Module-3

Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification; Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.

8 hours

Module-4

Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote-Terminal Emulation; Components of an RTE; Limitations of RTEs, **Experimental Design and Analysis:** Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2k Factorial Designs, Concepts, Computation of effects, Sign table method for computing effects; Allocation of variance; General 2k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods.

8 hours

Module-5

Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little‟s Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little‟s Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis;

8 hours

Course Outcomes: At the end of the course the student will be able to:	
CO1	Understand the techniques to approach performance problem and Compare two systems and determine the optimal value of a parameter.
CO2	Identify performance bottlenecks and characterize the load on a system and Select the number and size of system components and predict the performance of future workloads.
CO3	Understand the use of different analysis strategies like measurement, simulation, analytical modeling and Implement different techniques in experimental design like factorial design techniques.
CO4	Understand how to use monitors and accounting logs of systems use to improve the performance of the system and Apply mathematical techniques with stress on learning the types of Queuing models.
CO5	Apply queuing models to solve problems in computer Networks, Operating system, etc.

Reference Books:

1. Raj Jain: The Art of Computer Systems Performance Analysis, 1st edition, John Wiley and Sons, ISBN-13 : 978-0471503361, 2012.
2. Paul J Fortier, Howard E Michel: Computer Systems Performance Evaluation and prediction, 1st Edition, Elsevier, Digital Press Publication, ISBN-13: 978-1555582609, 2009.
3. Trivedi K S: Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd Edition, Wiley Publication, ISBN-13: 978-0471333418, 2011.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

DEEP LEARNING

(Professional Elective – C)

Course Code	20MCS234	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Introduction: Introduction to deep learning and neural network, Advantages of deep learning, Difference between Shallow and Deep network, building block of Feed forward Neural networks, Gradient descent and the back propagation algorithm, Handling vanishing and exploding gradient problem, Global and Local minima, Activation Functions, approaches for avoiding bad local minima, Heuristics for faster training, Nesterov accelerated gradient descent, Regularization, Dropout.

8 hours

Module-2

Learning Process: Error-correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, credit assignment, learning with and without a teacher, learning tasks, memory, statistical learning theory, Backpropagation using MNSIT.

8 hours

Module-3

Modern practical deep neural networks: Training Deep feedforward networks, Hyperparameter tuning, regularization and optimization for training deep models, convolutional Neural Networks, Classification algorithm using Keras and TensorFlow.

8 hours

Module-4

Sequence Modelling: Recurrent and recursive nets, practical Methodology, RNN, LSTM and GRU models and applications.

8 hours

Module-5

Deep Learning Research: Linear factor models, auto encoders, variational auto encoders, restricted Boltzmann machine, generative adversarial networks, Transfer learning, Reinforcement learning.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Explain the concepts and applications of neural networks and deep learning.
CO2	Explain how various types of learning work and how they can be used.
CO3	Apply deep feedforward networks and convolutional to solve practical problems.
CO4	Demonstrate working of recurrent and recursive nets function and how practical problems can be solved using RNN, LSTM and GRUs.
CO5	Design end-to-end deep learning architectures involving various types of feedforward networks, auto encoders.

Reference Books:

1. Simon Haykin, Neural networks: A comprehensive foundation, Second Edition, Prentice Hall, New Delhi, 1999, ISBN-81-203-2373-4.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, ISBN: 0262035618, 2016.
3. Deep Learning with Keras, Antonio Gulli and Sujit Pal, Packt Publishing, 1st Edition, ISBN: 9781787128422, 2017.
4. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 1st Edition, ISBN 13: 9780387310732, 2011.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

DIGITAL FORENSIC AND CYBER CRIME

(Professional Elective – D)

Course Code	20MCS241	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Understanding Cyber Crime: Indian IT Act 2008 and amendments, Computer Forensic and Investigations as a Profession, Understanding Computer Forensics.

Understanding Computer Investigations: Preparing a Computer Investigation, Taking a Systematic Approach, Procedures for Corporate High-Tech Investigations, Understanding Data Recovery Workstations and Software.

8 hours

Module-2

Working with Windows and DOS Systems: Understanding File Systems, Exploring Microsoft File Structures, Examining NTFS Disks, Understanding Whole Disk Encryption, Understanding the Windows Registry, Understanding Microsoft Startup Tasks, Understanding MS-DOS Startup Tasks, and Understanding Virtual Machines.

8 hours

Module-3

Data Acquisition: Understanding Storage Formats for Digital Evidence, Determining the best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisitions, Using Remote Network Acquisition Tools. Computer Forensics Analysis and Validation: Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisitions.

8 hours

Module-4

Current Computer Forensics Tools: Evaluating Computer Forensic Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software. Recovering Graphics Files: Recognizing a Graphics File, Understanding Data Compression, Locating and Recovering Graphics Files, Identifying Unknown File Formats, Understanding Copyright Issues with Graphics.

8 hours

Module-5

Network Forensics: Network Forensic Overview, Performing Live Acquisitions, Developing Standard Procedures for Network Forensics, Using Network Tools. E-mail Investigations: Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools. Laboratory Lab exercises using forensic software and Case study data.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the Indian IT Act 2008 and its amendments.
CO2	Identify various types of computer crime.
CO3	Apply computer forensic techniques to identify the digital fingerprints associated with criminal activities.
CO4	Analyze hidden information from pictures and other files.
CO5	Apply network forensic tools for network forensic and live data forensic analysis.

Reference Books:

1. Nelson, Phillips, Frank, Enfinger and Steuart: Computer Forensics and Investigations, Cengage Learning, ISBN-13: 978-1-4180-6733-5, 2008.
2. Marjie T. Britz: Computer Forensics and Cyber Crime - An Introduction, 2nd Edition, Pearson Education, ISBN-13 : 978-8131764015, 2012.
3. Harish Chander: Cyber Laws and IT Protection, PHI, ISBN: 9788120345706, 2012.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

COMPUTER VISION

(Professional Elective – D)

Course Code	20MCS242	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-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.

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.

8 hours

Module-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.

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

8 hours

Module-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.

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.

8 hours

Module-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 hours

Module-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

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Develop a technical document for the designed vision-based system.
CO2	Determine 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.

CO4	Evaluate methods to use for solving a given problem and analyse the accuracy of the methods.
CO5	Understand the concepts of model-based vision.

Reference Books:

1. Computer Vision: A Modern Approach by David A. Forsyth, Jean Ponce, 2nd Edition, Pearson Education, ISBN-13 : 978-9332550117, 2015.
2. Computer Vision: Algorithms and Applications, by Richard Szeliski, Springer, ISBN: 978-1-84882-934-3, 2011.
3. Multiple View Geometry in Computer Vision by Richard Hartley and Andrew Zisserman, Second Edition, Cambridge University Press, ISBN: 0521540518, 2004.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

HUMAN COMPUTER INTERACTION

(Professional Elective – D)

Course Code	20MCS243	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-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.

8 hours

Module-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.

8 hours

Module-3

Design rules: principles, standards, guidelines, rules, Evaluation Techniques, Universal Design.

8 hours

Module-4

Cognitive models: Socio-Organizational issues and stake holder requirements, Communication and collaboration models-Hypertext, Multimedia and WWW.

8 hours

Module-5

Designing Web Interfaces: Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow.

8 hours

Course Outcomes:

At the end of the course the student 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.
CO3	Analyze the Organizational issues and stake holder requirements by using Cognitive models, communication and collaboration models.
CO4	Design and Develop Web Interfaces by using Direct Selection, Contextual Tools, Overlays.

Reference Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction, Pearson Education, 3rd Edition, ISBN-13: 978-0-13-046109-4, 2004.
2. Bill Scott and Theresa Neil, Designing Web Interfaces, OReilly, First Edition, ISBN: 9780596516253, 2008.
3. Jenny Preece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, 4th Edition, ISBN: 978-1-119-08879-0, 2015.
4. Jenifer Tidwell, Designing Interfaces: Patterns for Effective Interaction Design, O'Reilly, 2nd Edition, ISBN: 9781449379704, 2011.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

AGILE TECHNOLOGY

(Professional Elective – D)

Course Code	20MCS244	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-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.

8 hours

Module-2

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

8 hours

Module-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, Documentation.

8 hours

Module-4

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.

8 hours

Module-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.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Discuss different Agile methods.
CO2	Explain different adaptations of XP programming.
CO3	Discuss thinking, collaborating and releasing process of XP programming.
CO4	Explain planning and developing steps of XP programming.
CO5	Discuss Agility Principles, values and Eliminate Waste.

Reference Books:

1. James shore, Chromatic, The Art of Agile Development (Pragmatic guide to agile software development), O'Reilly Media, Shroff Publishers & Distributors, 2007.
2. Robert C. Martin-Agile Software Development, Principles, Patterns, and Practices, Prentice Hall; 1st Edition, 2002.
3. Craig Larman Pearson Education- Agile and Iterative Development A Manger‟s Guide, 1st Edition, India, 2004.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

INDUSTRY 4.0

(GLOBAL ELECTIVE)

Course Code	20GCS251	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Introduction: Industrial, Internet, Case studies, Cloud and Fog, M2M Learning and Artificial Intelligence, AR, Industrial Internet Architecture Framework (IIAF), Data Management.

8 hours

Module-2

The Concept of the IIoT: Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, TCP/IP, API: A Technical Perspective, Middleware Architecture.

8 hours

Module-3

Data Analytics in Manufacturing: Introduction, Power Consumption in manufacturing, Anomaly Detection in Air Conditioning, Smart Remote Machinery Maintenance Systems with Komatsu, Quality Prediction in Steel Manufacturing. Internet of Things and New Value Proposition, Introduction, Internet of Things Examples, IoTs Value Creation Barriers: Standards, Security and Privacy Concerns. Advances in Robotics in the Era of Industry 4.0, Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics.

8 hours

Module-4

Additive Manufacturing Technologies and Applications: Introduction, Additive Manufacturing (AM) Technologies, Stereo lithography, 3DP, Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing, Laser Engineered Net Shaping, Advantages of Additive Manufacturing, Disadvantages of Additive Manufacturing. Advances in Virtual Factory Research and Applications, The State of Art, The Virtual Factory Software, Limitations of the Commercial Software.

8 hours

Module-5

Augmented Reality: The Role of Augmented Reality in the Age of Industry 4.0, Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Maintenance, Assembly, Collaborative Operations, Training. Smart Factories: Introduction, Smart factories in action, Importance, Real world smart factories, The way forward. A Roadmap: Digital Transformation, Transforming Operational Processes, Business Models, Increase Operational Efficiency, Develop New Business Models.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals.
CO2	Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services.
CO3	Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits.
CO4	Understand the role of augmented reality in the age of industry.

Reference Books:

1. Alasdair Gilchrist, Industry 4.0 the Industrial Internet of Things, Apress Publisher, ISBN-13 : 978-1484220467, 2017.
2. Alp Ustundag, Emre Cevikcan, Industry 4.0: Managing The Digital Transformation, Springer, ISBN-13: 978-3319578699, 2018.
3. Ovidiu Vermesan and Peer Friessm, Designing the industry - Internet of things connecting the physical, digital and virtual worlds, Rivers Publishers, ISBN: 9788793379817, 2016.
4. Christoph Jan Bartodziej, The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Springer Gabler, ISBN 978-3-658-16502-4, 2017.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

PYTHON PROGRAMMING

(GLOBAL ELECTIVE)

Course Code	20GCS252	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Why should you learn to write programs, Variables, expressions and statements, Conditional execution, Functions.

8 hours

Module-2

Iteration, Strings, Files

8 hours

Module-3

Lists, Dictionaries, Tuples, Regular Expressions.

8 hours

Module-4

Classes and objects, Classes and functions, Classes and methods.

8 hours

Module-5

Networked programs, Using Web Services, Using databases and SQL.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.
CO2	Demonstrate proficiency in handling Strings and File Systems.
CO3	Implement Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
CO4	Interpret the concepts of Object-Oriented Programming as used in Python.
CO5	Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

Reference Books:

1. Charles R. Severance, Python for Everybody: Exploring Data Using Python 3, 1st Edition, CreateSpace Independent Publishing Platform, 2016.
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, Green Tea Press, 2015.
3. Charles Dierbach, Introduction to Computer Science Using Python, 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.
4. Mark Lutz, Programming Python, 4th Edition, O'Reilly Media, ISBN-13: 978-9350232873, 2011.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

BUSINESS ANALYTICS

(GLOBAL ELECTIVE)

Course Code	20GCS253	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Business analytics Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling.

8 hours

Module-2

Trendiness and Regression Analysis Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

8 hours

Module-3

Organization Structures of Business analytics Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, Predictive Analytics, Predicative Modelling, Predictive analytics analysis.

8 hours

Module-4

Forecasting Techniques Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

8 hours

Module-5

Decision Analysis Formulating Decision Problems, Decision Strategies with and without Outcome, Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Explore the concepts of Business Analytics.
CO2	Understand modeling and prediction in Business Analytics.
CO3	Understand the Organization Structures of Business Analytics.
CO4	Summarize Forecasting Techniques.
CO5	Understand the importance of decision making.

Reference Books:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business Analytics Principles, Concepts, and Applications, FT Press Analytics, 1st Edition, 2014, ISBN-13: 978-0133989403.
2. Evan Stubs, The Value of Business Analytics: Identifying the Path to Profitability, John Wiley & Sons, 1st Edition, ISBN: 978-1-118-01239-0, 2014.
3. James Evans, Business Analytics, Pearsons Education, ISBN-13: 9780134576794, 2nd Edition.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

DATA MINING AND DATA WAREHOUSING

(GLOBAL ELECTIVE)

Course Code	20GCS254	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Data Warehousing & modeling: Basic Concepts: Data Warehousing: A multitier Architecture, Data warehouse models: Enterprise warehouse, Data mart and virtual warehouse, Extraction, Transformation and loading, Data Cube: A multidimensional data model, Stars, Snowflakes and Fact constellations: Schemas for multidimensional Data models, Dimensions: The role of concept Hierarchies, Measures: Their Categorization and computation, Typical OLAP Operations.

8 hours

Module-2

Data warehouse implementation& Data mining: Efficient Data Cube computation: An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAP Queries, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP. **:** Introduction: What is data mining, Challenges, Data Mining Tasks, Data: Types of Data, Data Quality, Data Preprocessing, Measures of Similarity and Dissimilarity.

8 hours

Module-3

Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FP-Growth Algorithm.

8 hours

Module-4

Classification: Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers.

8 hours

Module-5

Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph-Based Clustering.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understands data mining problems and implement the data warehouse.
CO2	Demonstrate the association rules for a given data pattern.
CO3	Discuss between classification algorithms.
CO4	Demonstrate the various Clustering algorithm.

Reference Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First Impression, ISBN 13: 978-1-292-02615-2, 2014.
2. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining-Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, ISBN-13 : 978-9380931913, 2012.
3. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression, ISBN-13 : 978-0201175196, 2012.
4. Michael.J.Berry, Gordon.S.Linoff, Mastering Data Mining, Wiley Edition, 2nd Edition, ISBN: 0-471-47064-3, 2012.

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SEMESTER – II

SOFTWARE ORIENTED ARCHITECTURE

(GLOBAL ELECTIVE)

Course Code	20GCS255	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

SOA Basics: Software Architecture, Types of IT Architecture, SOA Evolution, Key components, perspective of SOA, Enterprise-wide SOA, Architecture, Enterprise Applications, Solution Architecture for enterprise application, Software platforms for enterprise Applications, Patterns for SOA, SOA programming models.

8 hours

Module-2

SOA Analysis and Design: Service-oriented Analysis and Design, Design of Activity, Data, Client and business process services, Technologies of SOA, SOAP, WSDL, JAX, WS, XML WS for .NET, Service integration with ESB, Scenario, Business case for SOA, stakeholder OBJECTIVES, benefits of SPA, Cost Savings.

8 hours

Module-3

SOA Governance: SOA implementation and Governance, strategy, SOA development, SOA governance, trends in SOA, event-driven architecture, SOA technologies, proof-of concept, process orchestration, SOA best practices.

8 hours

Module-4

SOA Implementation: SOA based integration, integrating existing application, development of web services, Integration, SOA using REST, RESTful services, RESTful services with and without JWS, Role of WSDL,SOAP and Java/XML mapping in SOA, JAXB Data binding.

8 hours

Module-5

Application Integration: JAX, WS 2.0 client side/serverside development, Packaging and Deployment of SOA component, SOA shopper case study, WSDL centric java WS with SOA-J, related software, integration through service composition (BPEL), case study - current trends.

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Understand the different IT architectures and SOA basics.
CO2	Explain SOA based applications and Technologies.
CO3	Learn SOA Governance and its technologies.
CO4	Discuss SOA based integration and RESTful services.
CO5	Understand JAX and WS 2.0 SOA Applications with case studies.

Reference Books:

1. Shankar Kambhampaly, Service–Oriented Architecture for Enterprise Applications, ISBN: 9788126516384, Wiley 2008.
2. Mark D. Hansen, SOA using Java Web Services, Practice Hall, ISBN-13 : 978-0130449689, 2007.
3. Waseem Roshen, SOA-Based Enterprise Integration, Tata McGraw-HILL, ISBN-13: 9780070677265, 2009.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

LINEAR PROGRAMMING

(GLOBAL ELECTIVE)

Course Code	20GCS256	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	SEE Duration	03 Hours

Module-1

Linear Programming: Introduction to Linear Programming problem. Graphical method of solution. Simplex methods**,** special cases in Simplex method**.**

8 hours

Module-2

Artificial variable techniques: The Big-M method**,** Two-Phase simplex techniques, Revised simplex method.

8 hours

Module-3

Duality: Primal-Dual relationships, Conversion to Primal to dual and vice-versa. The dual simplex method, The Bounded Variables Problem, Sensitivity Analysis.

8 hours

Module-4

Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems.

8 hours

Module-5

Assignment Problem: Formulation of the Assignment problem, solution method of Assignment problem-Hungarian Method, Variants in Assignment problem, Travelling Salesman Problem (TSP).

8 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Apply Graphical and Simplex methods to solve Linear Programming Problems.
CO2	Apply advanced simplex methods to solve Linear Programming Problems.
CO3	Solve the Transportation problems to obtain optimal solution.
CO4	Solve specialized Linear Programming Problems called Assignment problems.

Reference Books:

1. D.S. Hira and P.K. Gupta, Operations Research, (Revised Edition), Published by S. Chand & Company Ltd, ISBN : 81-219-0281-9, 2014.
2. Taha H A, Operation Research, an Introduction, PHI, 8th Edition, 2009, ISBN: 0130488089.
3. Hiller, Liberman, Nag, Basu, Introduction to Operation Research, Tata McGraw Hill, 9th Edition, 2012, ISBN 13: 978-0-07-133346-7.
4. S.D.Sharma, Operations Research-Theory, Methods and Applications, Kedar Nath publications, 15th Edition, ISBN-13: 978-9380803388.

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SEMESTER – II

SOFTWARE DEVELOPMENT FOR PORTABLE DEVICES LABORATORY

Course Code	20MCSL26	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:4	SEE Marks	50
Credits	02	SEE Duration	03 Hours

1. Introducing different Android development tools and developing Hello World application.
2. Develop an android application to investigate the activity life cycle.
3. Develop an android application to investigate the fragments.
4. Develop an android application to create user interfaces with different layouts and views.
5. Develop an android application to create a Registration form using appropriate widgets.
6. Develop an android application to embed PickerViews in an activity.
7. Develop an android application on using implicit & explicit Intents.
8. Develop an android application to utilize Toasts and Notifications.
9. Develop an android application to work SQLite data storage and perform various operations on the table.
10. Develop an android application for creating location-based service.

Course Outcomes:

At the end of the course the student will be able to:

CO1	Identify the various aspects of android platform and different android developer tools.
CO2	Recognize the activity life cycle and fragment life cycle.
CO3	Demonstrate the usage of different Views and ViewGroups.
CO4	Understand the usage of SQLite to create and perform operations on table.
CO5	Demonstrate the knowledge of location-based services.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

MINI PROJECT

Course Code	20MCSMP27	CIE Marks	100
Teaching Hours/Week(L:T:P)	0:0:4	SEE Marks	-
Credits	03	SEE Duration	-

Guidelines

1. Each student must select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey.
2. The mini project would be performed in-house.
3. The implementation of the project must be preferably carried out using the resources available in the department/college.
4. Execution of mini project should be carried out by students only under guidance of allotted.
5. 15-20 pages report to be submitted by students in prescribed guidelines. Presentation is for 10 minutes.
6. A demonstration and internal oral examination on the mini project should be done at the end of the semester.
7. Department may arrange demonstration with poster presentation of all mini projects.

Course Outcomes:

At the end of the course the student will be able to:

CO1	Describe the problem and review and summarize the literature for the topic of the identified problem.
CO2	Illustrate the suitable design of experiments including experimental plan.
CO3	Explain the concepts of design, development, construction, and fabrication of innovative product for the project title.
CO4	Use various tools of testing and statistical analysis for the data in order to draw relevant conclusions.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – II

RESEARCH METHODOLOGY AND IPR

Course Code	20MCS28	CIE Marks	50
Teaching Hours/Week (L:T:P)	1:2:0	SEE Marks	50
Credits	02	SEE Duration	03 Hours

Module-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 hours

Module-2

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

5 hours

Module-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 hours

Module-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 hours

Module-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 hours

Course Outcomes:

At the end of the course the student will be able to:

CO1	Write and present a substantial technical report.
CO2	Demonstrate a degree of mastery over the area of specialization.

Reference Books:

1. Bhanwar Lal Garg, Renu Kavdia, Sulochana Agarwal, Umesh Kumar Agarwal, Introduction To Research Methodology, ISBN-13: 978-8176111652, RBSA Publishers; Reprint 2019 Edition.
2. Kothari, C.R., 1990. Research Methodology: An introduction to Research, U.K., ISBN: 9788122424881, 2002.