BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(Autonomous institution affiliated to VTU, Belagavi)
Doddaballapur Road, Avalahalli, Yelahanka, Bengaluru 560064

M.Tech Computer Science and Engineering
Scheme and Syllabus

2021 Scheme

Institute Vision

To emerge as one of the finest technical institutions of higher learning, to develop engineering professionals who are technically competent, ethical and environment friendly for betterment of the society.

Institute Mission

Accomplish stimulating learning environment through high quality academic instruction, innovation and industry-institute interface.

Department of Computer Science and Engineering

VISION

To develop technical professionals acquainted with recent trends and technologies of computer science to serve as valuable resource for the nation/society.

MISSION

Facilitating and exposing the students to various learning opportunities through dedicated academic teaching, guidance and monitoring.

M.Tech in Computer Science and Engineering

Program Educational Objectives (PEOs)

PEO1 Apply analytical thinking to solve problems through research in the areas of Computer Science and Engineering.

PEO2 Adapt to changing technological trends through life-long learning by exhibiting professional ethics, integrity and career growth.

PEO3 Develop skills to facilitate in providing sustainable solutions by addressing the ever-growing challenges of the society.

Program Outcomes (POs)

PO1 Independently carry out research and development work to solve practical problems related to Computer Science and Engineering domain.

PO2 Write and present a substantial technical report/document.

PO3 Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4 Analyze the acquired domain knowledge for providing feasible solution(s).

PO5 Relate the learning outcomes to build requisite competency in professional environment.

PO6 Appraise the need for engaging in lifelong learning.

About the Department

The Department of Computer Science & Engineering was started in the year 2002 – 2003 with an intake of 60, the Year 2010 with an intake of 90 and currently it is 180. The Department is highly progressive and has a team of well qualified, experienced and dedicated faculty. 16 faculty members hold Doctoral degrees, and 18 Faculty members are currently pursuing their Doctorate degrees. The Department of Computer Science & Engineering continues to recruit faculty members with high experience in academics, industry, and research.

The Department has well-equipped computer laboratories for course work, teaching and to carry out projects. The servers and nodes are all connected in the network with all necessary licensed software. Exposure to cutting edge technologies is provided by means of Industrial Projects and technical talks from domain experts of reputed research organizations. The students are encouraged to involve themselves in creative, technical and research activities. Students have been performing well in the university examination.

The Department maintains a wireless network (Wi-Fi) with unlimited Internet access for use by staff and students. Our graduates are working in leading IT industries and many students have secured admissions to prestigious universities in India and abroad. The Department has an R&D Center as well as an Incubation Center which is facilitating the students to acquire practical knowledge. The Department also offers an M.Tech. Program (post-graduation) in Computer Science & Engineering, which was introduced in the year 2014 with an approved intake of 18.

About M.Tech in Computer Science and Engineering

M.Tech (Computer Science and Engineering) commenced in the year 2014 with an intake of 18 students. The Post Graduate Program in Computer Science & Engineering is an affiliated program offered by Visvesvaraya

Technological University (VTU), Belagavi. The curriculum is designed by the university and has been common across all the institutions affiliated to it. Highly experienced faculty members with doctoral degrees handle the courses for this program.

Students and faculty members are proactively involved in high end research activities and have published impetus research publications in domains of Computer Network, Network Security, AI and Data Science. Students undergo 8 weeks industrial internship in many reputed companies like Nokia, Siemens, Robert Bosch, Phillips and many more. Many students are aspirant of the higher studies (Ph.D.) in various domains

PREAMBLE

In keeping abreast with India's recent National Education Policy (NEP 2020), the Indian Institute of Science, Bengaluru, has designed the Master of Technology (Online) degree program, for practicing engineers and scientists. Towards the attainment of such a holistic and multidisciplinary education, the flexible and innovative curriculum has been provided at BMSIT&M with credit-based courses and projects/internships/special courses in the areas of community engagement and public service, environmental education, and value-based education.

The emphasis is more on the core competency in the curriculum of the program to enhance opportunities for placement through industry relevant courses as program core and program electives. This is effectively attained with proper design, operation and improvement in academic components in the system with inclusive focus on Modern teaching methods, advanced curricula, innovative assessment methods, research temperament, industry associated curriculum. Implementation of academic autonomy can is with supportive governance and administrative structure is properly planned and put in place.

Curricular inputs for the framework are from all the stakeholders involved in

the academic process and referring curriculum from standard and well-known universities/colleges. Input for the framework is also from professional bodies like IEEE and CSI which recommends the advanced courses for the PG program of 2 years. The expected learning outcomes of autonomous curriculum of BMSIT&M caters to the aspiration of learner in-terms of higher education, research, industry requirements. Develop learner's inquisitiveness and focus on research and development of disruptive technologies. Incorporation of ICT tools imperatively blended in the autonomous curricula reaching all class of learners.

With this preamble, the curricula for the autonomous BMSIT&M has been designed to meet the contemporary needs (aspirations) of primary stake holders (students) with the following.

Salient features

1. **Inclusion of NEP 2020:** The aspiration of NEP 2020 and various levels has been incorporated in the M.Tech Computer Science Engineering (Autonomous) with inclusive focus on practical work, industrial internship, emphasis on research to solve the societal issues and latest trends as courses.
2. **Induction Programme:** There will be a week-long induction program for the PG students entering the institution. The incumbents learn about the institutional policies, processes, practices, culture and values.
3. **Post Graduate Program Outcomes (PO) Based Curriculum:** The curricula for the program is designed to meet the post graduate attributes (Program Outcomes) defined by National Board of Accreditation which are based on the knowledge, research, skill, ethics and higher learning.
4. **Emphasis on Research Project Based Learning:** To impart the skills to the prospective researcher, the emphasis on practical sessions is extended in the curricula for all the programs. At each semester, the

adequate amount of practical/laboratory courses are included. Further, some of the theory courses are blended with practical as integrated course.

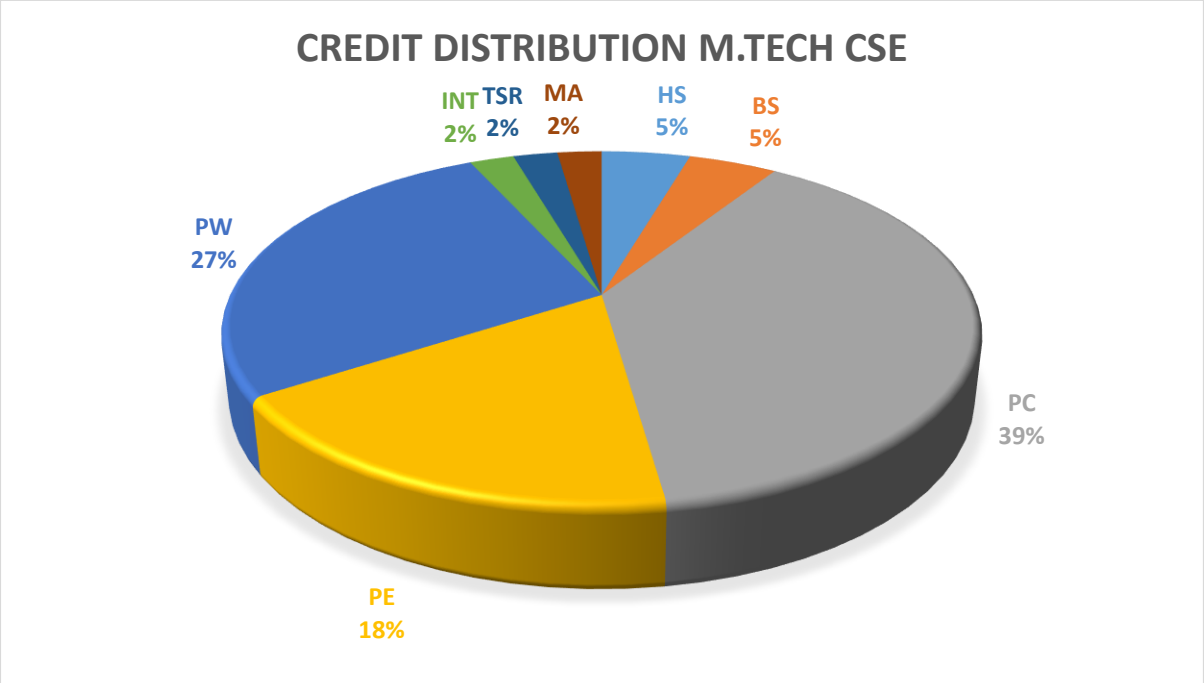
5. **Industry exposure through Mini projects and Internships:** The curricula includes industry internships and mini projects for the students to expose them to the real-world experience at industrial environment. Mini projects expose to better technical articulation and project cycles.
6. **Self-Learning:** The curriculum provides with an opportunity for the students to take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, and evaluating learning outcomes.
7. **Multiple avenues based on aspirations of the students**: The students will study the program specific courses for two years. There are three major avenues for the aspiring students to pursue:
    - **Industry/Placement:** The students who are aspiring to work as professional engineers in their core industrial domain have the option of studying the courses in the curriculum which are aligned towards the placement opportunities.
    - **Research:** The curriculum provides an opportunity for the students to pursue the courses which are in support of higher learning enabling the learner to do research work in the desired domain of interest.
    - **Presentation and Articulation:** The curriculum provides opportunities to present flexible assessment method for the course which improves communication and expect document this as report

Credit Distribution of M.Tech Computer Science and Engineering (Autonomous)

SEM	HS	BS	PC	PE	PW	INT	TSR	MA	Total Credits
I		4	16				2	RMIPR (2)	24
II			14	8	2				24
III			4	8	6	2			20
IV	4				16				20
Total	4	4	34	16	24	2	2	2	88

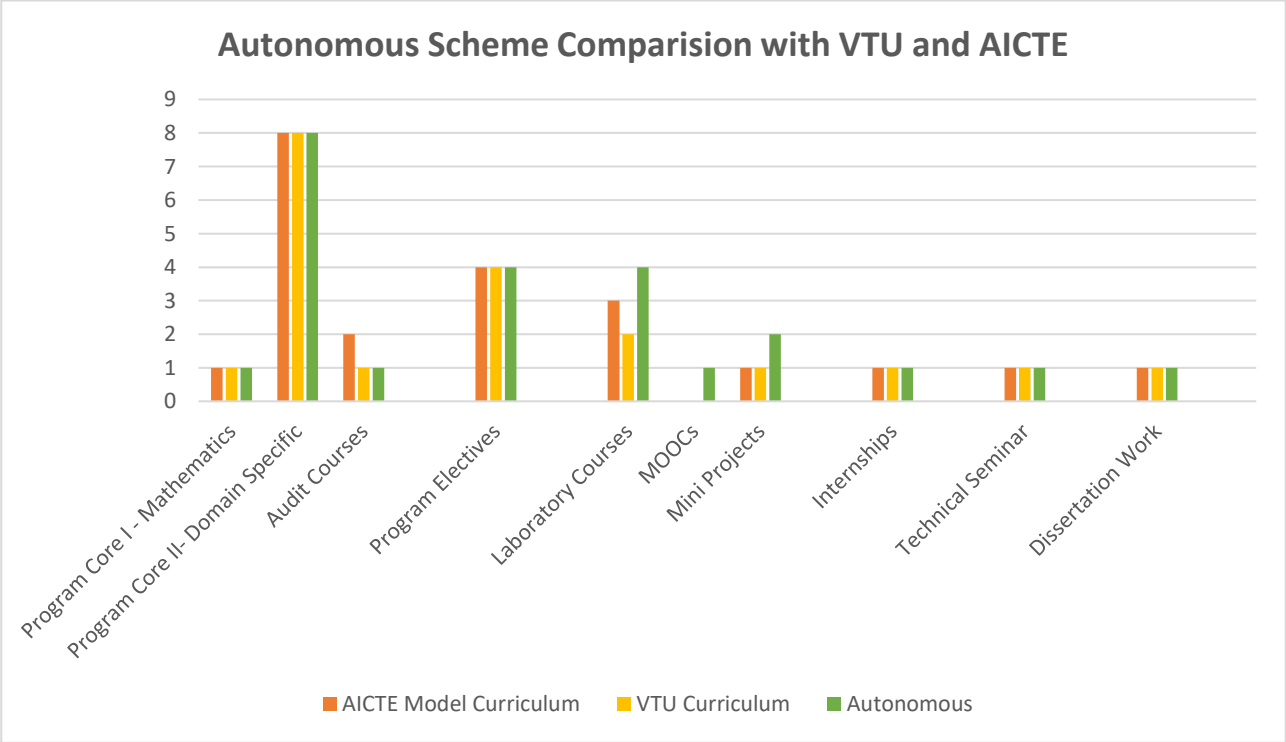
Legend

HS	Humanities and Social Science Course	**BS**	Basic Science Course
PC	Professional Core	**PE**	Professional Elective
INT	Internship	**TSR**	Technical Seminar
AEC	Ability Enhancement Course	**PW**	Project Work
MA	Mandatory Non-credit course		



Statistical Comparison Curriculum Components with AICTE and VTU

Sl. No	Type of Course	AICTE Model Curriculum	VTU Curriculum	Autonomous
1.	Program Core I - Mathematics	1	1	1
2.	Program Core II- Domain Specific	8	8	8
3.	Audit Courses	2	1	1
4.	Program Electives	4	4	4
6.	Laboratory Courses	4	2	4
7.	MOOCs	-	-	1
8.	Mini Projects	1	1	2
9.	Internships	1	1	1
10.	Technical Seminar	1	1	1
11.	Dissertation Work	1	1	1



Inclusion the autonomous curriculum is at par and above the standard prescribed

BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

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Scheme of Teaching and Examination: Effective from AY 2021-22

Choice Based Credit System (CBCS)

PG PROGRAM: COMPUTER SCIENCE AND ENGINEERING (CSE) | **Semester: I**

Sl. No	Course Category	Course Code	Course Title	Teaching Dept.	Teaching Hours /Week			Credits	Examination			
					L	T	P		Duration	CIE Marks	SEE Marks	Total Marks
1	BS	21MCS11	Applied Mathematics	Maths	4	0	0	4	3	50	50	100
2	MA	21MA12	Research Methodology and IPR	CSE	2	0	0	2	3	50	50	100
3	PC	21MCS13	Artificial Intelligence	CSE	3	0	0	3	3	50	50	100
4	PC	21MCS14	Internet of Things and Applications	CSE	4	0	0	4	3	50	50	100
5	PC	21MCS15	Advanced Data Structures and Algorithms	CSE	3	0	2	4	3	50	50	100
6	PC	21MCS16	Advanced Computer Networks	CSE	4	0	0	4	3	50	50	100
7	PC	21MCSL17	Internet of Things and Applications Laboratory	CSE	0	0	2	1	3	50	50	100
8	PC	21MCS18	Technical Seminar	CSE	0	4	0	2	3	50	50	100
				TOTAL	**21**	**4**	**4**	**24**		400	400	800

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Scheme of Teaching and Examination: Effective from AY 2021– 22

Choice Based Credit System (CBCS)

PG PROGRAM: COMPUTER SCIENCE AND ENGINEERING (CSE) | **Semester: II**

Sl. No	Course Category	Course Code	Course Title	Teaching Dept.	Teaching Hours /Week			Credits	Examination			
					L	T	P		Duration	CIE Marks	SEE Marks	Total Marks
1	PC	21MCS21	Data Science and Machine Learning	CSE	4	0	0	4	3	50	50	100
2	PC	21MCS22	Software Project Management and Agile Technologies	CSE	4	0	0	4	3	50	50	100
3	PC	21MCS23	Managing Big Data	CSE	4	0	0	4	3	50	50	100
4	PE	21MCS24AX	Professional Elective-A	CSE	4	0	0	4	3	50	50	100
5	PE	21MCS25BX	Professional Elective-B	CSE	4	0	0	4	3	50	50	100
6	PC	21MCSL26	Managing Big Data Laboratory	CSE	0	0	2	1	3	50	50	100
7	PC	21MCSL27	Data Science and Machine Learning with R Laboratory	CSE	0	0	2	1	3	50	50	100
8	PC	21MCS28	Mini Project	CSE	0	0	4	2	3	50	-	50
				TOTAL	**21**	**0**	**8**	**24**		**400**	**350**	**750**

Professional Elective - Group A	
Course Code	**Course Title**
21MCS24A1	Probability, Statistics and Queuing theory
21MCS24A2	Advanced Cryptography
21MCS24A3	Wireless and Adhoc Networks
21MCS24A4	Cloud Computing

Professional Elective - Group B	
Course Code	**Course Title**
21MCS25B1	Automation Testing
21MCS25B2	Block Chain and Ethical Hacking
21MCS25B3	Computer Vision
21MCS25B4	Mobile Application Development

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Choice Based Credit System (CBCS)

PG PROGRAM: COMPUTER SCIENCE AND ENGINEERING (CSE) — **Semester: III**

Sl. No	Course Category	Course Code	Course Title	Teaching Dept.	Teaching Hours /Week				Credits	Examination			
					L	T	P	PW		Duration	CIE Marks	SEE Marks	Total Marks
1	PC	21MCS31	Cyber Security and Forensics	CSE	4	0	0	0	4	3	50	50	100
2	PE	21MCS32CX	Professional Elective-C	CSE	4	0	0	0	4	3	50	50	100
3	PE	21MCS33DX	Professional Elective-D	CSE	4	0	0	0	4	3	50	50	100
4	PW	21MCS34	Mini Project	CSE	0	0	0	4	2	3	50	50	100
5	PW	21MCS35	Project Phase - 1	CSE	0	0	0	4	4	3	50	-	50
6	IN	21MCSI36	Internship	CSE	0	0	0	4	2	3	50	50	100
				TOTAL	**12**	**0**	**0**	**12**	**20**		**300**	**250**	**550**

Professional Elective - Group C	
Course Code	**Course Title**
21MCS32C1	Game Programming
21MCS32C2	Bitcoin and Cryptocurrenics
21MCS32C3	Augmented and Virtual Reality
21MCS32C4	Software Defined Networks

Professional Elective - Group D	
Course Code	**Course Title**
21MCS33D1	Object Oriented Modelling and Design
21MCS33D2	Robotic Process Automation
21MCS33D3	Deep Learning
21MCS33D4	High Performance Computing

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Choice Based Credit System (CBCS)

PG PROGRAM: COMPUTER SCIENCE AND ENGINEERING (CSE) — **Semester: IV**

Sl. No	Course Category	Course Code	Course Title	Teaching Dept.	Teaching Hours /Week				Self-Study	Credits	Examination			
					L	T	P	PW			Duration	CIE Marks	SEE Marks	Total Marks
1	PC	21MCS41	MOOC on Project Work	CSE	0	0	0	0	4	4				
2	PW	21MCS42	Project Phase - 2	CSE	0	0	0	16	0	16	3	50	50	100
				TOTAL	**0**	**0**	**0**	**16**	**4**	**20**		**50**	**50**	**100**

SEMESTER – I

M.TECH COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - I

Applied Mathematics (4:0:0) 4

(Effective from the academic year 2021-22)

Course Code	21MCS11	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3 Hours

Course Objectives:

This course will enable students to:

1. Have an insight into statistical methods.
2. Apply the concept of probability distribution of discrete and continuous random variables.
3. Apply the concept of various graphs and Vector Spaces.
4. Analyze the statistical data for testing of hypothesis and to draw the conclusions.

Module – 1

Introduction: Understanding of Vector spaces, graph theory, Statistical models & their applications in Engineering, Economics and Statistics.

Linear Algebra-I

Vector Spaces: Vector spaces; subspaces Linearly independent and dependent vectors, Basis and dimension, coordinate vectors-Illustrative examples. Linear transformations, Representation of transformations by matrices.

(10 hours)

Module – 2

Linear Algebra-II

Computation of Eigen values and Eigen vectors of real symmetric matrices-Jacobi and Given's method. Orthogonal vectors and orthogonal basis. Gram-Schmidt orthogonalization process. QR decomposition, singular value decomposition.

(10 hours)

Module – 3

Statistical Inference: Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non linear).

(10 hours)

Module – 4

Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycle. Specialized techniques to solve combinatorial enumeration problems.

(10 hours)

Module – 5

Probability Theory: Random variable (discrete and continuous), Probability mass function (pmf), Probability density function (pdf), Mathematical expectation, Sampling theory: testing of hypothesis by ***t***-test, z- test.

Summary of the Course

(10 hours)

Course outcomes:

The students will be able to

CO1: Apply probability formulations for new predictions with discrete and continuous RV's.

CO2: Solve the vector spaces and related topics arising in magnification and rotation of images.

CO3: Examine various graphs in different geometries related to edges.

CO4: Apply the statistical tools in multi variable distributions.

CO5: Summarize the Numerical and Statistical tools using programming

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three test will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks:

1. David C.Lay, Steven R.Lay and J.J.McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education Ltd., 2015.
2. T.Veerarajan, "Probability, Statistics and Random Process", 3rdEdition,Tata Mc-Graw Hill Co., 2016.
3. Norman L.Biggs, "Discrete Mathematics", 2nd Edition, Oxford University Press, 2017.

References:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. John Vince, "Foundation Mathematics for Computer Science", Springer International Publishing, Switzerland, 2015.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – I

Research Methodology and Intellectual Property Rights (2:0:0) 2

(Effective from the academic year 2020 -2021)

Course Code	21MAI12	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:0:0	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Give an overview of the research methodology and explain the technique of defining a research problem.
2. Explain the functions of the literature review in research and carry out a literature search, its review and develop theoretical and conceptual frameworks.
3. Explain various research designs, sampling designs, and also different methods of data collections.
4. Understand hypothesis and chi- square test.
5. Develop the art of interpretation and the art of writing different research reports.
6. Explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective.

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

(5 Hours)

Module – 2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

(5 Hours)

Module – 3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method (6 Hours)

Module – 4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics an Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, and Cautions in Using Chi Square Tests.

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports

(6 Hours)

Module – 5

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading

International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property.

Recap / Summary of the Course (4 Hours)

Course Outcomes: The student will be able to:

CO1: Understand the concepts of research methodology, research problem and literature review.
CO2: Understand various forms of the intellectual property rights, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.
CO3: Analyze various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
CO4: Apply several parametric tests of hypotheses.
CO5: Develop the art of interpretation and writing research reports.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks :

1. C.R. Kothari, Gaurav Garg, "Research methodology: Methods and Techniques", New Age International, 4th Edition, 2018.
2. Ranjit Kumar, "Research Methodology a step-by-step guide for beginners", SAGE Publications Ltd., 4th Edition, 2014.
3. The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice, September 2013.

References:

1. Trochim , Research Methods: the concise knowledge base , Atomic Dog Publishing, 2005.
2. Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
3. Panneerselvam R, Research Methodology, Prentice Hall of India, New Delhi, 2004.

M.Tech COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – I

Machine Learning -1 (3:0:0) 3

(Effective from the academic year 2021 -2022)

Course Code	21MCS13	CIE Marks	50
Teaching Hours/Week (L: T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Apply the basic principles, models, and algorithms of AI
2. Recognize, model, and solve problems in the analysis and design of information systems.
3. Analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective**.**

Intelligent agents: Reactive, Deliberative, Goal-driven, Utility-driven, and Learning agents Artificial Intelligence programming techniques

(9 Hours)

Module – 2

Problem-solving through Search: Forward and backward, State-space, Bind, heuristic, Problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms.

(8 Hours)

Module – 3

Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge.

(7 Hours)

Module – 4

Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference. **Decision-Making:** basics of utility theory, decision theory, sequential decision problems, elementary game theory.

(7 Hours)

Module – 5

Machine Learning and Knowledge Acquisition: Learning from memorization, examples, explanation, and exploration. Learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.

Recap/Summary: In this course students will study about Introduction to Artificial Intelligence, Problem solving through many search techniques Knowledge representation and reasoning.

(9 Hours)

Course Outcomes: The students will be able to:

CO1: Illustrate basic principles and applications of Artificial Intelligence.
CO2: Apply the different search algorithms for problem solving.
CO3: Analyse the knowledge representation and reasoning with different decision making theory.
CO4: Appraise the Machine Learning and Artificial Intelligence techniques for real solving Real world problems.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Kevin Knight, Elaine Rich and B. Nair, Artificial Intelligence, Third Edition, 2017.
2. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Fourth Edition, 2020.

References:

1. FLASINSKI M, Introduction to Artificial Intelligence, SPRINGER 2017.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, 2003.

M.Tech Computer Science and engineering

Choice Based Credit System (CBCS)

Semester – I

Internet Of Things and Applications (4:0:0) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS14	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Lecture Hours	50	Exam Hours	3

Course objectives:

This course will enable students to:

1. Understand the fundamentals of Internet of Things.
2. Learn about the basics of IOT protocols.
3. Apply the concept of Internet of Things in the real world scenario.
4. Build a small low cost embedded system using Raspberry Pi.

Module – 1

Preamble: Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT . The Internet of Things (IoT) is a course about the new paradigm of objects interacting with people, with information systems, and with other objects. Important to learn the fundamentals of this emerging technology.

INTRODUCTION TO IoT : What is The Internet of Things? Overview and Motivations, Examples of Apllications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Apjplication Examples-Overview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.

(10 Hours)

Module – 2

Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards-Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC,IETF IPv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO

(10 Hours)

Module – 3

Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M. Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.

(10 Hours)

Module – 4

Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Realtime Data Analysis, Structural Health Monitoring Case Study.

(10 Hours)

Module – 5

BUILDING IoT WITH RASPBERRY PI & ARDUINO: IoT Physical Devices & Endpoints – What is IoT Device –Exemplary devices :Raspberry Pi –About the Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms .

Recap: Summary of the Course (10 Hours)

Course Outcomes: The students will be able to

CO1: Understand the concepts of Internet of Things.
CO2: Illustrate basic framework used in IoT architecture .
CO3: Identify functionality and usage of various protocols in IoT architecture .
CO4: Analyze applications of IoT in real time scenario.
CO5: Design a portable IoT using Rasperry Pi.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks:

1.Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press,2015.
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2MCommunications", Wiley, 2013.

References:

1. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle ,From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence,Elsevier,2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi,The Internet of Things – Key applications and Protocols,Wiley,2012.

M.Tech COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – I

Advanced Data structures and Algorithms (3:0:2) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS15	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	50
Total Number of Contact Hours	40+26	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Explain principles of algorithms analysis approaches
2. Compare and contrast number theoretic based strategies.
3. Describe data flow in networks using graph algorithms.
4. Design and implement optimization algorithms in specific applications.

Module – 1

Preamble:

Advanced Algorithms introduces a collection of algorithms for complex programming challenges in data analysis. Advanced Algorithms teaches you powerful approaches to a wide range of tricky coding challenges that you can adapt and apply to your own applications.

Review of Elementary Structures, Search Trees, Balanced Search Trees.

(9 Hours)

Lab Programs:

1. Programs to implement various data structures.

Module – 2

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

(7 Hours)

Module – 3

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.

(7 Hours)

Lab Programs:

1. Program to implement Ford-Fulkerson method.
2. Program to implement Johnson's Algorithm.

Module – 4

Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization (8 Hours)

Lab Programs:

1.Program to implement RSA algorithm.

Module – 5

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

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

Lab Programs:

1.Program to implement Naive algorithm.
2.Program to implement Rabin - Karp algorithm.
3.Program to implement Boyer – Moore algorithm.
4. Program to implement Monte Carlo algorithm.

Summary: Overview of various techniques / algorithms that can be adopted to any application. (9 Hours)

Course Outcomes: The students will be able to:

CO1: Describe efficient algorithms for a range of computational problems, along with their computational complexity.
CO2: Choose the suitable algorithm for any given task.
CO3: Analyze a variety of algorithms with application to real-world problems.
CO4: Identify an appropriate way of dealing with challenging computational problems.
CO5: Interpret the working of algorithms various algorithms using a suitable programming language

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks:

1. Thomas H. Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2009
2. Kenneth A. Berman, Algorithms, Cengage Learning, 2002.
3. Peter Brass, Advanced Data Structures, CAMBRIDGE University Press, 2008.

References:

1. E. Horowitz, S. Sahni and S. Rajasekaran, Fundamentals of Computer Algorithms, University Press, Second edition, 2007.

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SEMESTER – I

Advanced Computer Networks and Security (4:0:0)4

(Effective from the academic year 2021 -2022)

Course Code	21MCS16	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Gain knowledge of the various aspects of network architecture and protocols, Network performance
2. Understand effective communication mechanisms
3. Students will learn about the issues in 802.11 LANs
4. Learn various congestion control algorithms.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective.

Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait ,Sliding Window, Concurrent Logical Channels.

(10 Hours)

Module – 2

Internetworking I: Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, subnetting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels. Internetworking- II: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP.

(10 Hours)

Module – 3

WiFi: 802.11, Wireless LANs, The 802.11 Architecture, The 802.11 MAC Protocol, The IEEE 802.11 Frame, Mobility in the Same IP Subnet, Advanced Features in 802.11, Personal Area Networks: Bluetooth and Zigbee, Cellular Internet Access, An Overview of Cellular Network Architecture, 3G Cellular Data Networks: Extending the Internet to Cellular Subscribers, On to 4G: LTE, Mobility Management: Principles, Addressing, Routing to a Mobile Node, Mobile IP ,Managing Mobility in Cellular Networks, Routing Calls to a Mobile User, Handoffs in GSM, Wireless and Mobility Impact on Higher-Layer Protocols

(10 Hours)

Module – 4

End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), Endto-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery

(10 Hours)

Module – 5

Overview of Network Security: Elements of Network Security , Classification of Network Attacks ,Security Methods ,Symmetric-Key Cryptography :Data Encryption Standard (DES),Advanced Encryption Standard (AES) , Public-Key Cryptography :RSA Algorithm ,Diffie-Hellman Key-Exchange Protocol , Authentication :Hash Function , Secure Hash Algorithm (SHA) , Digital Signatures , Firewalls and Packet Filtering ,Packet Filtering , Proxy Server .

Recap/Summary of the course.

(10 Hours)

Course Outcomes:

The student will be able to

CO1: Apply various protocols to develop applications using the sockets API.

CO2: Demonstrate effective communication mechanisms in computer networks

CO3: Analyze the concepts and issues in Mobile and Wireless Networks.

CO4: Examine possible research opportunities and challenges within the network application and security.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks

1. Larry Peterson and Bruce S Davis "Computer Networks: A System Approach", 5 Edition, Elsevier 2014.
2. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e, Pearson Education, 2012.
3. William Stallings, Cryptography and Network Security, 6th Edition.

References:

1. Uyless Black, "Computer Networks, Protocols , Standards and Interfaces" 2 nd Edition PHI.
2. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture", 6th Edition, PHI – 2014.
3. Behrouz A Forouzan, "TCP /IP Protocol Suite" 4 th Edition – Tata McGraw-Hill

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SEMESTER – I

INTERNET OF THINGS Laboratory (0:0:2) 1

(Effective from the academic year 2021 -2022)

Course Code	21MCSL17	CIE Marks	50
Teaching Hours/Week (L: T:P)	0:0:2	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	3

Course Objectives:

This course will enable students to:

1. To provide skills for designing and analyzing IOT Concepts.
2. To enable students to work on various IOT sensor.
3. To provide skills to work towards solution of real-life problems

List of Experiments-PART A

1. Transmit a string using UART.
2. Point-to-Point communication of two Motes over the radio frequency.
3. Multi-point to single point communication of Motes over the radio frequency. LAN (Subnetting).
4. I2C protocol study: Reading Temperature and Relative Humidity value from the sensor.

PART-B:Mini Project

- For any problem selected in domain of IOT.
- Make sure that the application should use at least 3 or more sensor.
- Indicative areas like health care can be included.

Course Outcomes: The students will be able to:

CO1: Demonstrate how communication happens between two objects within a LAN .

CO2: Examine how an IoT solution can be used to control an object through Internet.

CO3: Develop programming solutions for given problem scenario.

SEMESTER – II

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Choice Based Credit System (CBCS)

SEMESTER – II

Machine Learning -2 (4:0:0) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS21	CIE Marks	50
Teaching Hours/Week (L: T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Discuss the concepts of statistical learning
2. summarize Linear regression and Classification techniques and outline Tree based methods
3. Explain unsupervised learning with statistical learning.
4. Learning about a set of tools for modelling and understanding complex datasets.

Module – 1

Preamble: Significance and Scope of the course: Data Science helps with creating insights from data that deals with real world complexities and Machine Learning helps in accurately predicting or classifying outcomes for new data points by learning patterns from historical data. Data scientists can work with machine learning with equal ease. Data science allows data collected for other purposes to be applied to model problems related to various domains. The most popular programming languages among data scientists are open source tools that include or support pre-built statistical and machine learning capabilities. Machine learning is expanding across all fields such as banking and finance, information technology, media entertainment, gaming etc.

Statistical Learning: What Is Statistical Learning, Assessing Model Accuracy, Assessing Model Accuracy

(10 Hours)

Module – 2

Linear Regression: Simple Linear Regression, Multiple Linear Regression, Other Considerations in the Regression Model: Potential Problems, Comparison of Linear Regression with *K*-Nearest

(10 Hours)

Module – 3

Classification: An Overview of Classification, Why Not Linear Regression? Logistic Regression, Linear Discriminant Analysis

Tree-Based Methods: The Basics of Decision Trees. Bagging, Random Forests, Boosting

(10 Hours)

Module – 4

Unsupervised Learning: The Challenge of Unsupervised Learning, Principal Components Analysis, Clustering Methods

(10 Hours)

Module – 5

Support Vector Machines: Maximal marginal classifier, Support Vector Classifier.

Resampling Methods: Cross Validation- The validation set approach, Leave one out cross validation, K fold cross validation. The Bootstrap.

Self-Study Topics:

- Reinforcement learning
- Convolutional Neural Network.
- Deep Learning algorithms

Recap/ Summary of the Course

(10 Hours)

Course Outcomes: The students will be able to:

CO1: Discuss the concepts of statistical learning
CO2: Illustrate Supervised learning methods
CO3: Interpret various Unsupervised learning methods
CO4: Analyze statistical learning methods for various areas.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani. "Introduction to Statistical Learning (with Applications in R)", Springer, 2017.

References:

1. Simon Rogers, Mark Girolami, A First Course in Machine Learning (Chapman& Hall/Crc Machine Learning & Pattern Recognition), CRC Press, 2011.

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SEMESTER – II

Software Project Management and Agile Technologies (4:0:0) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS22	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Identify the range, scope, and complexity of modern projects.
2. Understand and be able to integrate both the customer and the quality tools into project management.
3. Learn techniques and tools for improving team collaboration and software quality.
4. To develop an understanding on agile software development.

Module – 1

Preamble: This course is designed to demonstrate the value of project management as an aid to business in general, reflecting both the purpose of projects and the way that they are managed. Further this course focuses on the software development process by using various Agile practices such as Scrum, Extreme Programming, Lean, and Kanban.

Project Evaluation and Project Planning: Importance of Software Project Management, Activities Methodologies, Categorization of Software Projects, Setting objectives, Management Principles, Management Control, Project portfolio Management, Cost-benefit evaluation technology, Risk evaluation, Strategic program Management, Stepwise Project Planning.

(10 Hours)

Module – 2

Project Life Cycle and Effort Estimation: Software process and Process Models, Choice of Process models, mental delivery, Rapid Application development, Agile methods, Extreme Programming, SCRUM, Managing interactive processes, Basics of Software estimation, Effort and Cost estimation techniques, COSMIC Full function points, COCOMO II A Parametric Productivity Model, Staffing Pattern.

(10 Hours)

Module – 3

Introduction Extreme Programming and Agile Development: Why Agile, Understanding Success, Beyond Deadlines, Importance of Organizational Success, Introduction to Agility How to Be Agile, Agile methods, Don't make your own method, Road to mastery

Understanding XP (Extreme Programming) - XP life cycle, XP team, XP Concepts Adopting XP - Knowing whether XP is suitable, Implementing XP, assessing Agility, Practicing XP, Thinking - Pair Programming, Energized work, Informative Workspace, Root cause Analysis, Retrospectives.

(10 Hours)

Module – 4

Collaborating: Trust, Sit together, Real customer involvement, Ubiquitous language, meetings, coding standards, Iteration demo, Reporting.

Releasing: Bug free Release, Version Control, fast build, continuous integration, Collective ownership, Documentation.

(10 Hours)

Module – 5

Activity Planning and Risk Management: Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Network Planning models, Forward Pass & Backward Pass techniques, Critical path (CRM) method, Risk identification, Assessment, Monitoring, PERT technique, Monte Carlo simulation, Resource Allocation, Creation of critical patterns, Cost schedules.

Recap/ Summary of the Course

(10 Hours)

Course Outcomes:

The students will be able to:

- **CO1:** Prepare design document and compute effort estimates for a software project.
- **CO2:** Analyze factors involved in implementation of software projects.
- **CO3:** Design and provide measurement, metrics necessary for problems involving agile software development.
- **CO4:** Integrate best practices of traditional and agile software development and use in real-time software projects.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
2. James Shore and Shane Warden: The art of Agile Development, 11th Indian Reprint, O'Reilly, 2018.

References:

1. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication, 2011.
2. Pankaj Jalote, Software Project Management in Practice, Pearson Education Inc.

Delhi, 2002.
3. Andrew Stellman and Jennifer Greene, Learning Agile, O'Reilly, 4th Indian Reprint, 2018.
4. Venkat Subramaniam and Andy Hunt, Practices of an Agile Developer, SPD, 5th Indian Reprint, 2015.

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SEMESTER – II

Advanced DBMS (4:0:0) 4

(Effective from the academic year 2021-22)

Course Code	21MCS23	CIE Marks	50
Teaching Hours/Week (L: T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Develop map-reduce analytics using Hadoop and related tools
2. Define big data for business intelligence
3. Analyse business case studies for big data analytics
4. Explain managing of Big data without SQL

Module – 1

Preamble: The industry is a data driven with billion worth of business data with high impact on Engineering, Economics and Statistics. Most scientific, research and e commerce industries are highly data drive and oriented for economic success.

UNDERSTANDING BIG DATA: What is big data – why big data –. Data!, Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System , Grid Computing, Volunteer Computing, convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics..

(10 Hours)

Module – 2

NOSQL DATA MANAGEMENT: Introduction to NoSQL – aggregate data models –

aggregates – key-value and document data models –relationships–graph databases– schema less databases – materialized views – distribution models – shading –– version – map reduce – partitioning and combining – composing map-reduce calculations..

(10 Hours)

Module – 3

BASICS OF HADOOP: Data format – analysing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system(HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures.

(10 Hours)

Module – 4

MAPREDUCE APPLICATIONS: MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats

(10 hours)

Module – 5

HADOOP RELATED TOOLS: Hbase – data model and implementations – Hbase clients – Hbase examples –praxis. Cassandra – Cassandra data model – Cassandra examples – Cassandra clients –Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

Recap/ Summary of the Course

(10 hours)

Course Outcomes: The students will be able to:

CO1: Summarize the fundamentals and concepts of Big Data.

CO2: Apply non-relational databases (NoSQL) techniques for storing and processing large volumes of structured and unstructured data.

CO3: Analyse methods and algorithms, to compare them to solve problems.

CO4: Evaluate efficient big data solutions for various application using novel platform architectures of Hadoop and Map-Reduce.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics:
2. Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.

References:

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
4. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
5. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
6. Alan Gates, "Programming Pig", O'Reilley, 2011.

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SEMESTER – II

Probability, Statistics and Queuing theory (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS24A1	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives: This course will enable students to:

1. Develop analytical capability and to impart knowledge of Probability, Statistics and Queuing.
2. Apply above concepts in Engineering and Technology.
3. Acquire knowledge of Hypothesis testing and Queuing methods and their applications so as to enable them to apply them for solving real world problems

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective

Introduction: Axioms of probability, Conditional probability, Total probability, Baye's theorem, Discrete Random variable, Probability mass function, Continuous Random variable. Probability density function, Cumulative Distribution Function, and its properties, Two-dimensional Random variables, Joint pdf / cdf and their properties.

(10 Hours)

Module – 2

Probability Distributions / Discrete distributions: Binomial, Poisson Geometric and Hyper-geometric distributions and their properties. Continuous distributions: Uniform, Normal, exponential distributions and their properties.

(10 Hours)

Module – 3

Random Processes: Classification, Methods of description, Special classes, Average values of Random Processes, Analytical representation of Random Process, Autocorrelation Function, Cross-correlation function and their properties, Ergodicity, Poisson process, Markov Process, Markov chain.

(10 Hours)

Module – 4

Testing Hypothesis: Testing of Hypothesis: Formulation of Null hypothesis, critical region, level of significance, errors in testing, Tests of significance for Large and Small Samples, t-distribution, its properties and uses, F-distribution, its properties and uses, Chi-square distribution, its properties and uses, $\chi 2$ – test for goodness of fit, $\chi 2$ test for Independence. (10 Hours)

Module – 5

Symbolic Representation: Symbolic Representation of a Queuing Model, Poisson Queue system, Little Law, Types of Stochastic Processes, Birth-Death Process, The M/M/1 Queuing System, The M/M/s Queuing System, The M/M/s Queuing with Finite buffers.

Recap/ Summary of the course.

(10 Hours)

Course Outcomes: The students should be able to:

CO1: Demonstrate use of probability and characterize probability models using probability mass (density) functions & cumulative distribution functions.
CO2: Illustrate the discrete & continuous probability distributions techniques and its and its applications.
CO3: Interpret mean and correlation functions for a given random process.
CO4: Use methods of Hypothesis testing for goodness of fit.
CO5: Apply queuing theory techniques for the given problems.
CO6: Utilize a random process in terms of its mean and correlation functions.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbook:

1. Probability, Statistics and Queuing Theory, V. Sundarapandian, Eastern Economy Edition, PHI Learning Pvt. Ltd, 2009.

References:

1. Probability & Statistics with Reliability, Queuing and Computer Applications, 2nd Edition by Kishor. S. Trivedi, Prentice Hall of India ,2004.
2. Probability, Statistics and Random Processes, 1st Edition by P Kausalya, Pearson Education, 2013.

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Choice Based Credit System (CBCS)

SEMESTER – II

Advanced Cryptography (4:0:0) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS24A2	CIE Marks	50
Teaching Hours/Week (L: T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Explain standard algorithms used to provide confidentiality, integrity and authenticity.
2. Distinguish key distribution and management schemes.
3. Deploy encryption techniques to secure data in transit across data networks
4. Implement security applications in the field of Information technology.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political, and economic growth of the nation. Impact of the course on societal and ethical issues and career perspective.

Overview of Cryptography: Introduction, Information security and cryptography, Basic terminology and concepts, Symmetric key encryption, Digital signatures, Public-key cryptography, Hash functions, Protocols and mechanisms, Key establishment, management, and certification, Pseudorandom numbers and sequences, Classes of attacks and security models.

(10 Hours)

Module – 2

Symmetric & Asymmetric Cryptography: Classical encryption techniques, Block cipher design principles and modes of operation, Data encryption standard, Evaluation criteria for AES, AES cipher, Principles of public key cryptosystems, The RSA algorithm, Key management – Diffie Hellman Key exchange, Elliptic curve arithmetic-Elliptic curve cryptography.

(10 Hours)

Module – 3

Mathematical Background: Probability theory, Information theory, Complexity theory, Number theory, Abstract algebra, Finite fields, The integer factorization problem, The RSA problem, The Diffie-Hellman problem, Composite moduli.

Number Theory: Introduction to number theory, Overview of modular arithmetic, discrete logarithms, and primality/factoring, Euclid's algorithm, Finite fields, Prime numbers, Fermat's and Euler's theorem- Testing for primality, A quick introduction to groups, rings, integral domain and fields.

(10 Hours)

Module – 4

Geometric Extensions: Fields, Characteristic of a field, prime fields, Arithmetic of polynomials over fields. Field extensions, Galois group of a field extensions, Fixed field and Galois extensions. Minimum polynomial, Construction of fields with the help of an irreducible polynomial. Splitting field of a polynomial, Separable polynomial and Separable extensions. Construction of finite fields and their structure. Enumeration of irreducible

polynomials over finite fields. Fundamental theorem of Galois Theory. Cyclotomic extensions, Geometric constructions and Galois theory of Equations (Statement only of Abel Ruffini), Solving Cubic and Bi-quadratic polynomials using radicals.

(10 Hours)

Module – 5

Quantum Cryptography and Quantum Teleportation: Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, local vs. nonlocal interactions, entanglements, EPR paradox, Bell's theorem, Bell basis, teleportation of a single qubit theory and experiments.

Recap/Summary of the course.

(10 Hours)

Course Outcomes: The students will be able to:

CO5: Apply the OSI security architecture and classical encryption techniques for simple applications.
CO6: Compare various cryptographic techniques.
CO7: Analyze the vulnerabilities in any computing system and hence be able to design a cryptographic solution.
CO8: Evaluate security mechanisms using rigorous approaches, including theoretical.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, "Handbook of Applied Cryptography" CRC Press.
2. Neal Koblitz, A Course in Number Theory and Cryptology, Springer 1987.
3. William Stallings, Cryptography and Network Security Principles And Practice, 6th edition, 2019.

References:

1. Damien Vergnaud and Michel Abdalla, Applied Cryptography and Network Security, 7th International Conference, ACNS 2009, Paris-Rocquencourt, France, June 2-5, 2009, Proceedings.
2. B. Schneier, "Applied Cryptography: Protocols, Algorithms, and Source Code in C", 2nd Edition, John Wiley & Sons, 1995.
3. Mihir Bellare and Phillip Rogaway, "Introduction to Modern Cryptography", 2005.

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Choice Based Credit System (CBCS)

SEMESTER – II

Wireless Adhoc Networks (4:0:0) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS24A3	CIE Marks	50
Teaching Hours/Week (L: T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Comprehend the fundamental principles of Ad-hoc Networks
2. Discuss a comprehensive understanding of Ad-hoc network protocols
3. Outline current and emerging trends in Ad-hoc Wireless Networks.
4. Analyze energy management in ad-hoc wireless networks.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political, and economic growth of the nation. Impact of the course on societal and ethical issues and career perspective.

Ad-hoc Wireless Networks Introduction: Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas.

(10 Hours)

Module – 2

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols

(10 Hours)

Module – 3

Multicast Routing: Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols.

(10 Hours)

Module – 4

Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure Touting Ad-hoc Wireless Networks.

(10 Hours)

Module – 5

Quality of Service and Energy Management: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of

Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes.

Recap/Summary of the course.

(10 Hours)

Course Outcomes: The students will be able to:

CO1: Apply the OSI architecture for simple applications of adhoc networks.
CO2: Compare various routing protocols.
CO3: Analyze energy consumption and management.
CO4: Evaluate the existing network and improve its quality of service.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbook:

1. C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011.

References:

1. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
3. 3. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

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Choice Based Credit System (CBCS)

SEMESTER – II

Cloud Computing (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS24A4	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	52	Exam Hours	3

Course Objectives: This course will enable students to,

- The student will learn how to apply trust-based security model to real-world security problems.
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models.
- Develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.
- Security Issues in Cloud Computing Infrastructure Security.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective

Introduction: Introduction to Cloud Computing Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing. Characteristics of Cloud Computing, Benefits and advantages of Cloud Computing. Cloud computing platforms: Infrastructure as service: Amazon EC2, Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing.

(11 Hours)

Module – 2

Cloud Computing Architecture Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise.

(10 Hours)

Module – 3

Security Issues in Cloud Computing Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management .

(10 Hours)

Module – 4

Security Management in the Cloud Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues Privacy Issues, 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

(10 Hours)

Module – 5

Audit and Compliance Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud. ADVANCED TOPICS Recent developments in hybrid cloud and cloud security. Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs; Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting

Recap/Summary: of the course.

(11 Hours)

Course Outcomes: The student will be able to,

CO1: Identify security aspects of each cloud model

CO2: Apply trust-based security model to different layer

CO3: Develop a risk-management strategy for moving to the Cloud.

CO4: Implement a public cloud instance using a public cloud service provider.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009.
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765, O'Reilly Media, September 2009.

References:

1. Cloud Computing Bible by B. Sosinsky, Wiley India
2. Building applications in cloud: Concept, Patterns and Projects by Moyer, Pearson.

M.Tech Computer Science and Engineering

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Semester – II

Automation Testing (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS25B1	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Lecture Hours	50	Exam Hours	3

Course objectives:

This course will enable students to:

1. Understand the fundamental criteria for test cases.
2. Learn about the test management and test automation techniques.
3. Apply test metrics and measurements in the real world scenario.
4. Design of test cases.

Module – 1

Preamble: Automation Testing is presently a important technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with **Automation Testing** . The **Automation Testing** is a course about the new paradigm of software testing, with software testing tool, and with other objects. Important to learn the fundamentals of this emerging technology.

The Value of Test Automation: Why Do We Need Test Automation? From Waterfall to Agile Software Development The Cost of Software Complexity Refactoring Continuous **Improvement From Manual to Automated Testing:** First Attempt: Record and Playback Getting the Most Out of Test Automation Differences Between Manual and Automated Tests

People and Tools: Choosing the Right Tools Who Should Write the Tests? The Variety of Tools (11 Hours)

Module – 2

Reaching Full Coverage : How Do You Measure Coverage?Gaining Value Before Reaching Full CoverageWhat Do We Do When We Have Full Coverage?How Do We Get to 100% Coverage?Reversing the Wheel My Road Map to Successful Automation Project

Business Processes: Running the Tests on a Regular BasisHandling Bugs That Are Found by the Automation Continuous Integration Acceptance Test Driven Development (ATDD)Continuous Delivery and Continuous Deployment

(9 Hours)

Module – 3

Preparing for the Tutorial: Prerequisites and Presumptions Applicability of the Process or Existing Test Automation Systems Overview of the Process Getting to Know the SUT Preparing the Environment for the Tutorial Using Git Through Visual Studio

Test Automation and Architecture: Test Architecture Considerations Understanding the SUT Architecture Alternatives and Considerations in a Layered Architecture Real-World Architecture

Isolation and Test Environments: Isolation Problems and Solutions Isolation Techniques

The Big Picture: The Relationships Between Software Architecture and Business Structure The Relationships Between Software Architecture and Organizational Structure with Test Automation

(9 Hours)

Module – 4

Designing the First Test Case : Choosing the First Test to Automate The Scientific Method for Designing a Test Case

Start Coding the First Test: Creating the Project Write the Pseudo-code Getting the Code to Compile Model Code Review

Completing the First Test: Running the Test to Find What to Implement FirstAdding Selenium to the Project Implementing the MVCForumClient Constructor Implementing RegisterNewUserAndLogin Hitting the Isolation Problem Implementing CreateDiscussion and Analyzing the Failure Completing the Test

Investigating Failures: Integrating with Latest Version of MVCForum Improving the Error Reporting Logging and Other Evidence Collection Adding Nested Visual Logger to MVCForum Tests Investigating Challenging Failures

(10 Hours)

Module – 5

Adding More Tests: Writing the Next Tests Making Additional Improvements Supporting Multiple Users and Browsers Additional Improvement Opportunities Adding More Tests

Continuous Integration: Is It Really Necessary?Creating the Test Build Process Changing the Development Processes and Culture Decreasing the Test Run Duration Covering a Broader Matrix

Acceptance Test Driven Development: Overview on ATDD Being More Agile

The Process Using the Acceptance Tests as Documentation Introducing ATDD in an Existing Project

Recap: Summary of the Course (11 Hours)

Course Outcomes: The students will be able to

CO1: Understand the concepts of software testing.
CO2: Illustrate basic framework used in automation testing .
CO3: Identify functionality and usage of various tools in automation testing .
CO4: Analyze applications of automation testing in real time scenario.
CO5: Design a use case in automation testing using Selenium .

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Arnon Axelrod, "Complete Guide to Test Automation: Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects", APress,2018.

References:

1. Mark Fewster, Dorothy Graham,"Software Test Automation: Software Test Automation", Addison-Wesley, 1999.
2. Bruce A. Posey and Daniel Mosley ,"Just Enough Software Test Automation", Prentice Hall PTR, 2002.

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SEMESTER – II

Block Chain Technology (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS25B2	CIE Marks	50
Teaching Hours/Week (L: T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	52	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Explain Intrusion Detection, Policy Creation, Social Engineering, DDoS Attacks, Buffer Overflows and Virus Creation.
2. Compare different types of hacking tools
3. Design system into block chain systems.
4. Test blocks chain system for any vulnerability.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective.

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

(11 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.

(10 Hours)

Module – 3

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models

(10 Hours)

Module – 4

Wireless Hacking: Wireless Foot printing, Wireless Scanning and Enumeration, Gaining Access, Tools that exploiting WEP Weakness, Denial of Services Attacks, Firewalls: Firewalls landscape, Firewall Identification-Scanning Through firewalls, packet Filtering, Application Proxy Vulnerabilities, Denial of Service Attacks, Motivation of Dos Attackers, Types of DoS attacks, Generic Dos Attacks, UNIX and Windows DoS

(10 Hours)

Module – 5

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

Summary: Overview of various techniques under hacking and application of blockchain.

(11 Hours)

Course Outcomes: The students will be able to:

CO1: Identify major research challenges and technical gaps existing between theory and practice in blockchain.
CO2: Differences between proof-of-work and proof-of-stake consensus.
CO3: Demonstrate how intruders escalate privileges.
CO4: Design, build, and deploy a distributed application.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, First Edition, Princeton University Press, 2016.
2. Stuart McClure, Joel Scambray and Goerge Kurtz, Hacking Exposed 7: Network Security Secrets & Solutions, Tata Mc Graw Hill, 2010.

References:

1. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gray Hat, Hacking The Ethical Hackers Handbook, 3rd Edition, Tata Mc Graw Hill, 2011.

M.TECH COMPUTER SCIENCE AND ENGINEERING

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SEMESTER – II

Computer Vision (4:0:0) 4

(Effective from the academic year 2020-21)

Course Code	21MCS25B3	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. To review image processing techniques for computer vision.
2. To understand shape and region analysis.
3. To understand three-dimensional image analysis techniques.
4. To understand motion analysis.
5. To study some applications of computer vision algorithms.

Module – 1

Introduction and Fundamentals: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective

Introduction: Origins of Digital Image Processing, examples, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Digital Image Fundamentals: A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Basic relationship between pixels, Zooming and Shrinking. Image Processing Prototyping Tool: Overview, Image processing toolbox, working environment and editor, Reading, loading and displaying images, Saving Image and simple image manipulations.

(10 Hours)

Module – 2

Image Enhancement : Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Image Enhancement in the Frequency Domain: Background, Image Enhancement in the Frequency Domain, Introduction to the Fourier Transform and the Frequency, Domain, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering.

(10 Hours)

Module – 3

Image Segmentation: Detection of Discontinuities, line and spot detection, Edge detection, gradient operators, compass operators, Laplace operator, stochastic gradients,

Edge Linking and Boundary Detection: Thresholding- local and adaptive, Region-Based Segmentation, Region Growing and Linking, Splitting and Merging.

Hough Transform: Principle, Line detection and Linking, Peak Detection, Circle detection.

(10 Hours)

Module – 4

Shapes And Regions: N-Ary shape analysis – connectedness – object labelling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape

recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

(10 hours)

Module – 5

3D Vision And Motion : Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

Recap/Summary: Application of various image processing Techniques

(10 hours)

Course Outcomes: The students will be able to:

CO1: Explain the fundamentals of image processing
CO2: Apply 3D vision techniques.
CO3: Implement motion related techniques.
CO4: Develop applications using computer vision techniques.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Rafael C G., Woods R E. and Eddins S L, Digital Image Processing, Prentice Hall, 3rd edition, 2008.

References:

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.
2. E. R. Davies, ―Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.B Kosko. “Neural Networks and Fuzzy systems: A Dynamical System approach PHI, 1991.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – II

Mobile Applications Development (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS25B4	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	52	Exam Hours	3

Course Objectives:

This course will enable students to:

1. To understand the working of the android and windows life cycle of the application.
2. To write a simple and complex program for android and windows OS.
3. To present different Google Map API.
4. To establish adequate research interest in topics Device driver and developing the emulator
5. Implement the design using specific mobile development frameworks

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective.

An Overview of Android: Introducing Android, The Open Handset Alliance, Android Platform differences, Android Platform. Configuring Your Development environment, Exploring Android software development Kit, Writing first android application.

Understand the Anatomy of an android application: The life Cycle of android application, manifest file, defining android application using the manifest file, Creating First android application, Type of Android application.

(11 Hours)

Module – 2

Managing Application Resources: Resources, Working with resources. Refercing the system resources, Managing multiple Application Configuration, Configurations.

Exploring User Interface Screen Elements: Introducing Android view ,Widgets and Layouts, Displaying Text to user, Getting the text from the user, Using Buttons, checkbox and Radio groups, Getting Dates and times user, Indicating the information to the user.

(10 Hours)

Module – 3

Working in the Background: Introducing Services, Creating and Controlling Services, Using background thread, introducing loaders, Manual thread creation and thread synchronization.

Using Android Data and Storage API: Working with application Prefernces, Working with files and Directories, Storing the Structured data using SQLlite Databases, Implementing query(),insert(),update() and getType (), Updating the Manifest file, Working with Live Folder.maps

(10 Hours)

Module – 4

Smartphone Application Development: Developing Your First Smartphone Application, UI Design with Forms and Controls , Smartphone UI Design, Keyboard Input and Input Mode.
Data Access with SQL Server Mobile : Microsoft SQL Server 2005 Mobile Edition, Writing SQL Server Mobile Applications, Setting Up the SQL Server Mobile Server Environment .

(10 Hours)

Module – 5

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.
Recap / Summary of the course

(11 Hours)

Course Outcomes: The students will be able to:

CO1: Understand the fundamentals of mobile architecture, lifecycle of android, resources ,maps, graphics, hardware sensors ,wireless devices
CO2: Analyse the application based on the maps, openGL, hardware sensors, Communication API's
CO3: Design the windows application framework using the available Windows system level API's
CO4: Implement the design using Objective C and iOS

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Reto Meier, Professional Android 4 Application Development, Wrox Publication,2012,
2. Baijian Yang, Pei Zheng, Lionel M. Ni, Professional Microsoft Smartphone Programming, Wrox Publication,2007.
3. James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012
4. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.

References:

1. Shane Conder, Lauren Darcey, Android Wireless Application Development,3rd Edition, Addison Wesley,2009.
2. Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, Programming Android,2nd Edition ,O'Reilly Publication ,2012.
3. Satya Komatineni , Dave MacLean , Sayed Hashimi, Pro Android 3, Apress publication ,2011.

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Choice Based Credit System (CBCS)

SEMESTER – II

Advanced DBMS Laboratory (0:0:2) 1

(Effective from the academic year 2021-22)

Course Code	21MCSL26	CIE Marks	50
Teaching Hours/Week (L: T:P)	0:0:2	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	3

Course Objectives:

This course enables students to:

1. Optimize business decisions and create competitive advantage with Big Data analytics
2. Imparting the architectural concepts of Hadoop and introducing map reduce Paradigm
3. Introducing Java concepts required for developing map reduce programs
4. Introduce programming tools PIG & HIVE in Hadoop echo system.
5. Developing Big Data applications for streaming data using Apache Spark

List of Experiments

Experiment 1

Start by reviewing HDFS. It found that the composition of HDFS is like your local Linux file system. Use the ***hadoop fs*** command while interacting with HDFS.

1. Review the commands available for the Hadoop Distributed File System:
2. Copy file foo.txt from local disk to the user's directory in HDFS
3. Get a directory listing of the user's home directory in HDFS
4. Get a directory listing of the HDFS root directory
5. Display the contents of the HDFS file user/fred/bar.txt
6. Move that file to the local disk, named as baz.txt
7. Create a directory called input under the user's home directory
8. Delete the directory input old and all its contents.
9. Verify the copy by listing the directory contents in HDFS:

Experiment 2

Using the HDFS, learn the control of map/reduce jobs.

1. Create a JOB and submit to cluster
2. Track the job information
3. Terminate the job
4. Counters in MR Jobs with example
5. Map only Jobs and generic map examples
6. Distributed cache example
7. Combiners, Secondary sorting and Job chain examples

Experiment 3

Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record oriented.

Experiment 4

Using the Movie Lens data at the URL http://grouplens.org/datasets/movielens/ develop map/reduce program to perform basic operations on the data set.

1. List all the movies and the number of ratings
2. List all the users and the number of ratings they have done for a movie
3. List all the Movie IDs which have been rated (Movie Id with at least one user rating it)

4. List all the Users who have rated the movies (Users who have rated at least one movie)
5. List of all the User with the max, min, average ratings they have given against any movie
6. List all the Movies with the max, min, average ratings given by any user

Experiment 5

Use HiveQL to filter and aggregate "click data" to build facts about user's movie preferences. The query results should be saved in a staging table and must be used to populate the database.

1. Write a query to select only those clicks which correspond to starting, browsing, completing, or purchasing movies. Use a CASE statement to transform the RECOMMENDED column into integers where 'Y' is 1 and 'N' is 0. Also, ensure GENREID is not null. Only include the first 25 rows.
2. Write a query to select the customer ID, movie ID, recommended state and most recent rating for each movie.
3. Load the results of the previous two queries into a staging table.
4. Load the results of the queries into the staging table.

Experiment 6

Learn basic Pig Latin semantics and the fundamental types in Pig Latin, Data Bags and Tuples.

1. Start the Grunt shell and execute the following statements to set up a dataflow with the click stream data.
2. Group the log sample by movie and dump the resulting bag.
3. Add a GROUP BY statement to the sessionize.pig script to process the click stream data into user sessions.

Course Outcomes: The students will be able to:

CO1: Preparing for data summarization, query, and analysis.
CO2: Applying data modelling techniques to large data sets
CO3: Creating applications for Big Data analytics
CO4: Building a complete business data analytic solution

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SEMESTER – II

Machine Learning Lab (0:0:2) 1

(Effective from the academic year 2021 -2021)

Course Code	21MCSL27	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Learn basics of R.
2. Implement various machine learning techniques.

Write the R programming for the following Questions.

Q1.

a) Load Auto. Data file.
b) View the data in a spread sheet using fix () function.
c) Handle the missing element of the data matrix.
d) Check for dimension and Variable names.

Q2.

a) Plot the scatterplots of the quantitative scatterplot variables.
b) Produce a numerical summary of each variable in Auto. Data file.

Q3.

a) Fit a Simple Linear Regression model using least square.
b) Produce confidence intervals and prediction intervals.
c) Analyse detailed information using summary function.

Q4.

a) Fit a multiple linear regression model using least squares.
b) Analyse detailed information using summary function.
c) Include interaction terms in a linear model using the lm() function.
d) Analyse detailed information using summary function.

Q5.

a) Fit a logistic regression model. Use the functions to access coefficients and particular aspects of the fitted model.
b) Compute the confusion matrix in order to determine how many observations were correctly or incorrectly classified.
c) Fit a linear discriminant analysis model.

Q6.

a) knn() function to predict the market's movement, for K=1
b) Compare the result with K=3.
c) Fit a QDA model to the Smarket data.

Q7.

a) Fit a classification tree in order to predict target variable

b) Lists the variables that are used as internal nodes in the tree, the number of terminal nodes, and the (training) error rate.
c) Plot the tree Structure, display the node labels.
d) Evaluate its performance on the test data.
e) Find the number of terminal nodes of each tree considered (size) as well as the corresponding error rate and the value of the cost-complexity parameter used.

Q8.

a) Perform PCA on the USArrests data set.
b) Plot the first two principal components.
c) Output the standard deviation of each principal component.
d) Compute the proportion of variance explained by each principal component.
e) Plot the PVE explained by each component and cumulative PVE,

Q9

a) Performs K-means clustering.
b) Plot the data, with each observation coloured according to its cluster assignment.
c) Implements hierarchical clustering.
d) Compute the 50 × 50 inter-observation Euclidean distance matrix.
e) Plot the dendrograms.

Q10.

a) Use the svm() function to fit the support vector classifier for given value of the cost parameter.
b) Analyze basic information about the support vector classifier fit using the summary function.
c) Compare SVMs with a linear kernel, using a range of values of the cost parameter.
d) Access the cross-validation errors for each of these models using the summary function.
e) Generate the test data and predict the class labels of the test observations.

Course Outcomes: The students will be able to:

CO1: Interpret various Supervised and Unsupervised learning methods.
CO2: Analyse statistical learning methods for various data set.

SEMESTER – III

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SEMESTER – III

Cyber Security and Forensics (4:0:0) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS31	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

5. To summarize the concepts of cyber forensics and its applications in different context.
6. To investigate incident and areas affected due to cybercrime.
7. To illustrate tools used in cyber forensic
8. To infer legal perspectives in cyber security
9. To apply the policies, security standards, and IPR issues on a cybercrime incident.

Module – 1

Preamble: The course aims to provide an overview of cyber law, security, tools, and approaches to secure resources and manage intellectual property for enhancing the competitiveness for organizations. Upon completion of this course, students should be able to accomplish the course outcomes defined. The cyber security and forensics has direct impact on the security systems, society, financial models and affecting the GDP.

Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyber offenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector.

(10 Hours)

Module – 2

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

(10 Hours)

Module – 3

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

(10 Hours)

Module – 4

Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of

Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.

(10 Hours)

Module – 5

Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards – Iso, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of 20082020 / 23 Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.

Recap: This course highlights the significance of cyber security, the need for mitigating the cybercrimes, tools used, role of forensics, IT Act and IPR issues, policy and standards. The course facilitates the learning at higher cognitive levels to gain deeper understanding of the subject.

(10 Hours)

Course Outcomes:

The students will be able to:

4. Apply the relevant sections of the IT Act to the given problem.
5. Analyze the influence cyber-forensics in investigating the given cybercrime.
6. Infer legal issues and socio economic impact due to cybercrime.
7. Examine relevant network defense / web application tool to solve given cyber security problem justify its suitability.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks:

3. Sunit Belapure, Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives Wiley India Pvt Ltd 2013
4. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, Introduction to information security and cyber laws, Dreamtech Press 2015

References:

1. Thomas J. Mowbray, Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions John Wiley & Sons 2013
2. James Graham, Ryan Olson, Rick Howard , Cyber Security Essentials CRC Press 2010

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SEMESTER – III

Game Programming (4:0:0) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS32C1	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Understand the concepts of Game design and development.
2. Learn the processes, mechanics and issues in Game Design.
3. Be exposed to the Core architectures of Game Programming.
4. Know about Game programming platforms, frame works and engines.
5. Learn to develop games.

Module – 1

Preamble: HTML5 and modern JavaScript game engines have helped revolutionized web based games. Though the world of HTML game development continues to grow and evolve, An Introduction to HTML5 Game Development with Phaser.js, provides a grounded resource and vital learning tool to anyone looking to optimize web game development process.

Introduction: State of HTML5 Games, A Simple Game.

(10 Hours)

Module – 2

Workspace Setup, Phaser Project Setup

(10 Hours)

Module – 3

Phaser Principles: Game Loop, States, Display List, The World, Camera, Loading and the Asset Cache, Images, Sprites, Texture Atlases, Tile Sprites, Input, Sound

(10 Hours)

Module – 4

Phaser Principles contd: Maps, Tweens, Physics Primer, Phases of a Physics System, Bodies, Arcade Physics

(10 Hours)

Module – 5

Game Examples: Shoot 'em Up, Game Prefabs

Recap: This course enables new and upcoming features of JavaScript and another execution environment of Node and NPM, which are robust tools that just about any modern web developer will have on their computer. The course facilitates the learning at higher cognitive levels to gain deeper understanding of the subject.

(10 Hours)

Course Outcomes:

The students will be able to:

CO1: Apply the concepts of Game design and development.
CO2: Analyze the Core architectures of Game Programming.
CO3: Infer processes and use mechanics for game development.
CO4: Examine Game programming platforms, frame works and engines.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbook:

1. Travis Faas, "An Introduction to HTML5 Game Development with Phaser.js", CRC Press, Taylor & Francis Group; 1st edition

References:

1. Mike Mc Shaffrfy and David Graham, "Game Coding Complete", Fourth Edition, Cengage Learning, PTR, 2012
2. Jason Gregory, "Game Engine Architecture", CRC Press / A K Peters, 2009.

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SEMESTER – III

Cryptocurrencies (4:0:0) 4

(Effective from the academic year 2021 -2022)

Course Code	21MCS32C2	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

6. Apply features of Block chain to the given crypto currency.
7. Demonstrates the working of block chain application involving cryptocurrencies.
8. Compare various protocols and consensus algorithms for a given application.
9. Select appropriate regulation framework for legal use of cryptocurrencies.

Module – 1

Preamble: Block chain technology has the potential to revolutionize interactions between governments, businesses and citizens. Blockchain and Cryptocurrency are vastly discussed in all research domains to bring the decentralization. The bit coin has revolutionised the working financial models and has global impact on financial transactions leading to boost GDP over next decade.

Introduction: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

(10 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.

Block chain Use cases: Blockchain in trade/supply chain: Provenance of goods, visibility, trade/supply chain finance, invoice management/discounting, Internet of Things, Government, Health, Finance, Media, Alternative to Blockchain.

(10 Hours)

Module – 3

Requirements for the consensus protocols-Proof of Work (PoW)-Scalability aspects of Blockchain consensus protocols: Permissioned Blockchains-Design goals-Consensus protocols for Permissioned Blockchains.

Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts.

Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.

(10 Hours)

Module – 4

BitCoin: Introduction to Bitcoin, key concepts of Bitcoin, Merits and De Merits Fork and Segwits, Sending and Receiving bitcoins, choosing bitcoin wallet, Converting Bitcoins to Fiat Currency.

(10 Hours)

Module – 5

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

Sidechain, Namecoin,
Cryptocurrency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects – Cryto-currency Exchange, Black Market and Global Economy.

Recap: Concepts related to block chain and consensus algorithm, bit coin, crypto currency regulation

(10 Hours)

Course Outcomes: The students will be able to:

8. Demonstrate the basics of the Block Chain concepts using modern tools and technologies.
9. Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain.
10. Apply consensus algorithm platform to implement the Block chain Application.
11. Analyse the security and efficiency of a given cryptocurrenices. .

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks:

2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, First Edition, Princeton University Press, 2016.
3. Mark Gates, ―Blockchain: Ultimate guide to understanding blockchain, bitcoin, crypto currencies, smart contracts and the future of money‖, Wise Fox Publishing and Mark Gates, 2017.

References:

1. Arshdeep Bahga, Vijay Madisetti, ―Blockchain Applications: A Hands-On Approach, Arshdeep Bahga, Vijay Madisetti publishers 2017.
2. NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/#
3. Udemy: https://www.udemy.com/course/build-your-blockchain-az/
4. EDUXLABS Online training :https://eduxlabs.com/courses/blockchain-technologytraining/?tab=tab-curriculum
5. Ebook: Blockchain Applications- https://www.blockchain-books.com
6. https://onlinecourses.nptel.ac.in/noc18_cs47/unit?unit=45&lesson=68
7. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017.

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SEMESTER – III

Augment and Virtual Reality (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS32C3	CIE Marks	50
Teaching Hours/Week (L: T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	52	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Understand the basics of virtual reality
2. Understand geometric modeling and Virtual environment.
3. Study about Virtual Hardware and Software
4. Develop Virtual Reality applications

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective.

Introduction to virtual reality

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics –Flight Simulation – Virtual environments –requirement – benefits of virtual reality- Historical development of VR : Introduction – Scientific Landmark -3D **Computer Graphics:** Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms- Radiosity – Hidden Surface Removal – Realism- Stereographic image.

(11 Hours)

Module – 2

Virtual environment:

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and non- linear translation - shape & object in between – free from deformation – particle system- Physical Simulation : Introduction – Objects falling in a gravitational field – Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft.

(10 Hours)

Module – 3

Geometric modeling

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances –Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual environment – the Computer environment – VR Technology – Model of interaction – VR Systems.

(10 Hours)

Module – 4

Introduction to Augmented Reality:
Definition, scope, brief history, Examples, Related Fields

(10 Hours)

Module – 5

Designing And Developing 3d User Interfaces: Strategies for Designing and Developing Guidelines and Evaluation. (2)

Advances In 3d User Interfaces: 3D User Interfaces for the Real World, AR Interfaces as 3D Data Browsers, 3D Augmented
Reality Interfaces, Augmented Surfaces and Tangible Interfaces, Agents in AR, Transitional AR-VR Interfaces - The future of 3D User
Interfaces, Questions of 3D UI Technology, 3D Interaction Techniques, 3D UI Design and Development, 3D UI Evaluation and Other Issues.

Summary: Various perceptron models with spatial and visual characteristics modeled under architectural purview.

(11 Hours)

Course Outcomes: The students will be able to:

CO1: Adapt various principles and concepts of virtual reality and its application.

CO2: Apply different geometric modeling

CO3: Develop virtual model for different problems

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. John Vince "Virtual Reality Systems Pearson Education Asia, 2007.
2. Dieter Schmalstieg, Tobias Hollerer, "Principles and Practices Augmented Reality Principles and Practices, Addisen Wesley Ebook.
3. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design",
   Morgan Kaufmann, 2009

References:

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005

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SEMESTER – III

Software Defined Networks (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS32C4	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Lecture Hours	50	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Understand the basic knowledge of software defined networks.
2. Learn about the basics of Open flow protocols.
3. Apply the concept of software defined network in the advance trends.

Module – 1

Introduction: Implication and Scope of Software defined networking in connecting device and how it is changing the way communications networks are managed, maintained, and secured. Impact of the course on current Innovations and Research trends.

Basic Packet-Switching Terminology- The Modern Data Center- Traditional Switch Architecture- Autonomous and Dynamic Forwarding Tables- Evolution of Switches and Control Planes- Cost- SDN Implications for Research and Innovation- Data Center Innovation.

(11 Hours)

Module – 2

The Evolution of Networking Technology- Forerunners of SDN - Software Defined Net working OpenFlow- Sustaining SDN Interoperability- Network Virtualization- Fundamental Characteristics of SDN- SDN Operation- SDN Devices- SDN Controller- SDN Applications- Alternate SDN Methods.

(10 Hours)

Module – 3

OpenFlow Overview- OpenFlow 1.0 and OpenFlow Basics-OpenFlow 1.1 Additions- OpenFlow 1.2 Additions- OpenFlow 1.3 Additions- OpenFlow Limitations- Potential Drawbacks of Open SDN- SDN via APIs- DN via Hypervisor-Based Overlays- SDN via Opening Up the Device- Network Functions Virtualization- Alternatives Overlap and Ranking.

SDN in the Data Center- Data Center Demands- Tunneling Technologies for the Dat a Center- Path Technologies in the Data Center- Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center.

(10 Hours)

Module – 4

Open SDN versus Overlays in the Data Center- Real-World Data Center- SDN in Other Environments- Wide Area Networks- Service Provider and Carrier Networks- Campus Networks- Hospitality Networks- Mobile Networks- Optical Networks

(9 Hours)

Module – 5

Software Defined Networking For Internet-Of-Things: Why SDN for the IoT? –SDN Simplicity for the IoT-SDN architecture for IoT - SDN—Scalability for the IoT-SDN Traffic Flow Optimization for the IoT-Security and Connectivity- The Telco Role Amazon Web Services for IoT.

Recap: Summary of the Course

(11 Hours)

Course Outcomes: The students will be able to:

CO1: Summarize the simple switching architecture and components.
CO2: Illustrate basic framework used in open flow switch .
CO3: Identify functionality and usage of various protocols in open flow architecture.
CO4: Analyse applications of SDN in data centre.
CO5: Infer architecture of SDN that will be used in IOT.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Paul Göransson, Chuck Black, Software Defined Networks A comprehensive Approach, Elsevier,2014.
2. By Perry Lea, Internet of Things for Architects: Architecting IoT solutions , Packt publishing 2018.
3. William Stallings ,Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, Publisher: Addison-Wesley 2015 ISBN: 9780134175393.

References:

1. Paul Goransson, Chuck Black, Software Defined Networks: A Comprehensive Approach, 1st Edition, MK
2. Thomas D. Nadeau, SDN: Software Defined Networks, 1st Edition, Oreilly.

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SEMESTER – III

Object Oriented Modelling and Design (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS33D1	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	52	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Understand what software life cycle is, how software projects are planned and managed, types of resources involved in software development projects, risks are identified and assessed, predictions and assessments are made.
2. Identify software engineering problems, including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements.
3. Analyse and specify software requirements through a productive working relationship with various stakeholders of the project.

Module – 1

Introduction: Implication and Scope of Object Oriented Modelling and Design in specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements. Impact of the course on current Innovations and Research trends.

Introduction to Software Engineering: Software, Software Crisis, Software Engineering definition, Evolution of Software Engineering Methodologies, Software Engineering Challenges. Software Processes: Software Process, Process Classification, Phased development life cycle, Software Development Process Models, Process, use, applicability and Advantages/limitations.

(11 Hours)

Module – 2

Object oriented Paradigm: Object oriented Concepts, Classes, Objects, Attributes, Methods and services, Messages, Encapsulation, Inheritance, Polymorphism, Identifying the elements of object model, management of object oriented Software projects, Object Oriented Analysis, Domain Analysis, Generic Components of OOA model, OOA Process, Object Relationship model, Object Behavior Model.

(10 Hours)

Module – 3

Object Oriented Design: Design for Object- Oriented systems, The Generic components of the OO design model, The System design process, The Object design process, Design Patterns, Object Oriented Programming.

(10 Hours)

Module – 4

Object Oriented testing: Broadening the view of Testing, Testing of OOA and OOD models, Object-Oriented testing strategies, Test case design for OO software, testing methods applicable at the class level, Interclass test case design.

(10 Hours)

Module – 5

Technical Metrics for Object Oriented Systems: The Intent of Object-Oriented metrics, The distinguishing Characteristics, Metrics for the OO Design model, Class-Oriented

metrics, Operation-Oriented Metrics, Metrics foe Object Oriented testing, Metrics for Object Oriented projects. CASE Tools

Recap: Summary of the Course

(11 Hours)

Course Outcomes: The students will be able to:

CO1: Summarize the Model the object-oriented software systems using Unified Modelling Language (UML).

CO2: Identify cost of constructing object-oriented software.

CO3: Apply the Object-Oriented Software-Development Process to design software.

CO4: Analyse and Specify software requirements through a SRS documents.

CO5: Design and Plan software solutions to problems using an object-oriented strategy.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Stephen R. Schach, Object oriented and Classical Software Engineering, 7/e, Tata McGraw Hill Edition.
2. Timothy Lethbridge, Robert Laganiere, Object oriented and Classical Software Engineering, Tata McGraw Hill Edition.
3. Roger S Pressman, Software Engineering, Tata McGraw Hill Edition.

References:

1. Component based software engineering: 7th International symposim vica Crnkovic, Springer, CBSE 2004

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SEMESTER – III

CUDA Architecture (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS33D2	CIE Marks	50
Teaching Hours/Week (L: T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	52	Exam Hours	3

Course Objectives:

This course enables students to:

1. To understand the basics of GPU architectures.
2. To write programs for massively parallel processors.
3. To illustrate different GPU programming models
4. To study about the various applications using mapping algorithms.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective.

Von Newman Architecture: Multi-node Computing, NVidia and CUDA, GPU hardware, Parallelism in GPU, Types of Parallelism, Flynn Classification, Common Parallel Patterns, CPUs and GPUs, Compute Levels.

Using CUDA – Multi GPU: Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, and Resource Contentions.

(11 Hours)

Module – 2

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

(10 Hours)

Module – 3

Memory handling with CUDA: Caches, Registers, Shared Memory, Global Memory, Texture Memory, Serial Vs Parallel Code, Locality, Algorithms on Multiple GPUs.

(10 Hours)

Module – 4

Multi-CPU and Multi-GPU Solutions: Introduction, Locality, Multi-CPU systems,Multi-GPU Systems, Algorithms on Multiple GPUs, Which GPU?, Single-Node Systems, Streams Multiple-Node Systems.

(10 Hours)

Module – 5

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

Self-Study Topics:

- Application coding using GPUs

Recap/ Summary: Overview of various techniques under parallel techniques with focus on each algorithm analysis.

(11 Hours)

Course Outcomes: The students will be able to:

CO1: Study the overview of the GPU architecture.

CO2: Identify efficient parallel programming patterns to solve problems.

CO3: Write simple programs using OpenCL.

CO4: Implement efficient algorithms in GPUs for common application kernels.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Shane Cook, CUDA Programming: A Developers Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.

References:

1. Nicholas Wilt, CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison -Wesley, 2013.
2. Jason Sanders, Edward Kandrot, CUDA by Example: An Introduction to General Purpose GPU Programming, Addison – Wesley, 2010.
3. http://www.nvidia.com/object/cuda_home_new.html
4. http://www.openCL.org

M.TECH COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – III

Data Warehousing and Mining (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS33D3	CIE Marks	50
Teaching Hours/Week (L:T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	52	Exam Hours	3

Course objectives:

This course will enable students to:

1. Be familiar with mathematical foundations of data mining tools.
2. Understand and implement classical models and algorithms in data warehouses and data mining
3. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering
4. Develop skills in selecting the appropriate data mining algorithms for solving practical problems. Optimize a query and basic concepts on transaction processing, concurrency control and recovery.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective

Data warehouse: Introduction to data ware house, difference between operational data base system and data warehouse, data ware house characteristics, DW architecture and its components, Data modelling, schema design, OLAP operations, OLAP server architecture.

(11 Hours)

Module – 2

Introduction to Data Mining: Introduction to data mining, KDD challenges , DM tasks, data pre-processing , data cleaning, dimensionality reduction, feature subset selection, data transformation.

(10 Hours)

Module – 3

Association rules: Problem definition, frequent item set generation, The Apriori principle, support and confidence measures, Association rule generation, the partition algorithms, FP-growth algorithms.

(10 Hours)

Module – 4

Classification: General approach to solving a classification problem, Evaluation of classifiers, Classification techniques, decision tree construction, Naïve-Bayes classifier, Bayesian belief networks, KNN classification algorithms and characteristics.

(10 Hours)

Module – 5

Clustering: Clustering overview, evaluation of clustering algorithms, partitioning clustering K-means algorithms, Hierarchical clustering algorithm, Key issues in hierarchical clustering strength and weakness, outlier detection.

Recap/Summary: Introduction to Data warehouse with different operational database systems, Introduction to Data Mining with Clustering, Classification and Association rule mining.

(11 Hours)

Course Outcomes: The students will be able to:

CO1: Understand the functionality of the various datamining and data warehousing component.
CO2: Appreciate the strengths and limitations of various data mining and data warehousing models.
CO3: Explain the analyzing techniques of various data.
CO4: Describe different methodologies used in datamining and data ware housing.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. Jiawei Han, Micheline Kamber, Morgan Kaufmann, Data Mining-concepts and Techniques, Elsevier Publishers, 2017.
2. Paulraj Ponniah, Data Warehousing Fundamentals For It Professionals, 2Nd Ed, Willy, 2014.

References:

1. Arun K Pujari, Data Mining Techniques 3rd Edition, Universities press, 2015.
2. Berson, Data Warehousing, Data Mining, & Olap, McGraw Hill Education, 2014.

M.TECH COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – II

High Performance Computing (4:0:0) 4

(Effective from the academic year 2020 -2021)

Course Code	21MCS33D4	CIE Marks	50
Teaching Hours/Week (L: T:P)	4:0:0	SEE Marks	50
Total Number of Contact Hours	52	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Review of the trends in computers and parallelism in computer architecture
2. Familiarize the basic ideas of vector processing, multiprocessing and parallel operations
3. Focus on performance of different processor architectures
4. Review the advantages of thread level parallelism
5. Expose to basics of Parallel programming.

Module – 1

Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective.

Fundamentals of computer design

Introduction; Classes computers; Defining computer architecture; Trends in Technology. Trends in power in Integrated Circuits; Trends in cost; Dependability, Measuring, reporting and summarizing Performance attributes; Quantitative Principles of computer design.

Pipelining

Introduction, pipeline hazards, implementation of pipeline, what makes pipelining hard to implement.

(11 Hours)

Module – 2

Instruction level parallelism (ILP)

ILP basic concepts and challenges, basic complier techniques for exposing ILP, reducing branch costs with prediction, overcoming data hazards with dynamic scheduling, hardware based speculation. Exploiting ILP using multiple issues and static scheduling, Exploring ILP using dynamic scheduling, multiple issue and speculation.

Multiprocessors and Thread level parallelism:

Introduction, Symmetric shared memory architectures; Performance of symmetric shared-memory multiprocessors, Distributed shared memory and directory-based coherence, Basics of synchronization, Models of memory consistency.

(10 Hours)

Module – 3

Memory hierarchy Design:

Eleven advanced optimizations of cache performance, memory technology and optimizations, Protection: virtual memory and virtual machines.

Speed up performance laws: Amdhal's laws, Gustafson's laws, Memory Bound Speed up model

(10 Hours)

Module – 4

Data-Level Parallelism in Vector, SIMD, and GPU Architectures: Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units,

Detecting and Enhancing Loop-Level Parallelism, Mobile versus Server GPUs and Tesla versus Core i7.

(10 Hours)

Module – 5

Warehouse-Scale Computers to Exploit Request-Level and Data-Level Parallelism: Introduction, Programming Models and Workloads for Warehouse-Scale Computers, Computer Architecture of Warehouse-Scale Computers, Physical Infrastructure and Costs of Warehouse-Scale Computers, Cloud Computing: The Return of Utility Computing, Crosscutting Issues, Putting It All Together: A Google Warehouse-Scale Computer, Fallacies and Pitfalls

Recap/ Summary: Overview of the various levels of the parallelism in tightly coupled systems with focus on memory design and computing architectures.

(11 Hours)

Course Outcomes: The students will be able to:

CO2: Summarize the fundamentals of high-performance computing.

CO3: Demonstrate high performance computing concepts.

CO4: Design and apply parallel computing constructs.

CO5: Analyze the performance of different CPU architectures.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Flexible Assessment Method.

Textbooks:

1. John L Hennessy, David A Patterson." Computer Architecture: A Quantitative Approach". Elsevier, 5th Edition, 2011.
2. Kai Hwang. "Advanced Computer Architecture: Parallelism, Scalability, Programmability ", McGraw-Hill, 2008.

References:

1. Dezso Sima, Terence Fountain, Peter Kacsuk. "Advanced Computer Architectures - A design space approach". Pearson Education 2005. ISBN-13: 978-81-317-0208-6.