RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)
RV Vidyaniketan Post, MysuruRoad
Bengaluru – 560 059

Scheme and Syllabus of I to IV Semesters

(Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)

in

SOFTWAREENGINEERING

DEPARTMENT OF

INFORMATION SCIENCE & ENGINEERING

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

1. To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
2. To create a conducive environment for interdisciplinary research and innovation.
3. To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
4. To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
5. To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work and Innovation

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DEPARTMENT OF

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DEPARTMENT OF
INFORMATION SCIENCE & ENGINEERING

Vision

To be the hub for innovation in Information Science & Engineering through Teaching, Research, Development and Consultancy; thus make the department a global resource center in advanced, sustainable and inclusive technology.

Mission

1. To enable students to become responsible professionals, strong in fundamentals of information science and engineering through experiential learning
2. To bring research and entrepreneurship into class rooms by continuous design of innovative solutions through research publications and dynamic development oriented curriculum.
3. To facilitate continuous interaction with the outside world through student internship, faculty consultancy, workshops, faculty development program, industry collaboration and association with the professional societies.
4. To create a new generation of entrepreneurial problem solvers for a sustainable future through green technology with an emphasis on ethical practices, inclusive societal concerns and environment
5. To promote team work through inter-disciplinary projects, co-curricular and social activities.

PROGRAMME OUTCOMES (PO)

M. Tech. in Software Engineering graduates will be able to:

PO1: An ability to **independently carry out research /investigation** and development work to solve practical problems.

PO2: An ability to **write and present** a substantial technical report/document.

PO3: An ability to develop softwares in various domains in a systematic way by applying**Analytical** and **Programming skills** leading to practical solutions.

PO4: Design, develop and deliver complex, scalable and **cost effective** software systems by applying Software Engineering principles, tools and processes.

PO5: Demonstrate with responsibilities and capabilities of professional software engineer with importance to quality and management issues involved in **software construction.**

PO6: Demonstrated capability to take up higher studies, Entrepreneurships and self-driven career development in the chosen area of interest.

Program Specific Criteria (PSC)

The curriculum includes Advanced Data Structures, Software design and construction, requirements analysis, security, verification, and validation; software engineering processes and tools appropriate for the development of complex software systems, IT applications, mathematical foundations with machine learning and Advanced Database Engineering including big data analytics with applications appropriate to software engineering domain. Project work focuses on software engineering principles, structure and development methodologies of software systems and logical and analytical skills in solving real world engineering problems.

PROFESSIONAL SOCIETY

Software Engineering Body of Knowledge (*SWEBOK)* - IEEE Computer Society

ABBREVIATIONS

Sl. No.	Abbreviation	Acronym
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	CE	Professional Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics
23.	MCA	Master of Computer Applications
24.	MST	Structural Engineering
25.	MHT	Highway Technology
26.	MPD	Product Design & Manufacturing
27.	MCM	Computer Integrated & Manufacturing
28.	MMD	Machine Design
29.	MPE	Power Electronics
30.	MVE	VLSI Design & Embedded Systems
31.	MCS	Communication Systems
32.	MBS	Bio Medical Signal Processing &Instrumentation
33.	MCH	Chemical Engineering
34.	MCE	Computer Science & Engineering
35.	MCN	Computer Network Engineering
36.	MDC	Digital Communication
37.	MRM	Radio Frequency and Microwave Engineering
38.	MSE	Software Engineering
39.	MIT	Information Technology
40.	MBT	Biotechnology
41.	MBI	Bioinformatics

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DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

M.Tech Program in SOFTWARE ENGINEERING

FIRST SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18MAT11B	Probability Theory and Linear Algebra	MAT	3	1	0	**4**
2	18MSE12	Advanced Data Structures & Algorithms	IS	4	0	1	**5**
3	18MSE13	Advanced Software Quality & Testing	IS	4	0	1	**5**
4	18HSS14	Professional Skills Development	HSS	0	0	0	**0**
5	18MSE1AX	Elective – A	IS	3	1	0	**4**
6	18MSE1BX	Elective – B	IS	4	0	0	**4**
Total number of Credits				**18**	**02**	**02**	**22**
Total Number of Hours / Week				**18**	**04**	**04**	**26**

SECOND SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18MSE 21	Cyber Security & Digital Forensics	IS	4	0	1	**5**
2	18MSE 22	Human Computer Interaction	IS	3	1	0	**4**
3	18 IM 23	Research Methodology	HSS	3	0	0	**3**
4	18 MSE 24	Minor Project	IS	0	0	2	**2**
5	18MSE 2CX	Elective – C	IS	4	0	0	**4**
6	18MSE2DX	Elective – D	IS	4	0	0	**4**
7	18 XX 2GX	Global Elective	Respective BoS	3	0	0	**3**
Total number of Credits				**21**	**01**	**03**	**25**
Total Number of Hours / Week				**21**	**02**	**06**	**29**

SEMESTER : I		
GROUP A: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	18 MSE 1A1	Service Oriented Architecture
2.	18 MIT 1A2	Information Retrieval
3.	18 MSE 1A3	Software Architecture
GROUP B: PROFESSIONAL ELECTIVES		
1.	18 MSE 1B1	Fault Tolerant System
2.	18 MIT 1B2	Enterprise Application Development
3.	18 MSE 1B3	Artificial Neural Networks
SEMESTER : II		
GROUP C: PROFESSIONAL ELECTIVES		
1.	18 MSE 2C1	Metrics And Models For Software Engineering
2.	18MCS2C2	Machine Learning
3.	18 MIT 2C3	Computer System Performance & Analysis
GROUP D: PROFESSIONAL ELECTIVES		
1.	18 MSE 2D1	Data Engineering
2.	18 MSE 2D2	Agile Technologies
3.	18 MSE 2D3	Software Project Management

GROUP G: GLOBAL ELECTIVES				
Sl. No.	**Host Dept**	**Course Code**	**Course Title**	**Credits**
1.	CS	18CS2G01	Business Analytics	3
2.	CV	18CV2G02	Industrial & Occupational Health and Safety	3
3.	IM	18IM2G03	Modelling using Linear Programming	3
4.	IM	18IM2G04	Project Management	3
5.	CH	18CH2G05	Energy Management	3
6.	ME	18ME2G06	Industry 4.0	3
7.	ME	18ME2G07	Advanced Materials	3
8.	CY	18CHY2G08	Composite Materials Science and Engineering	3
9.	PY	18PHY2G09	Physics of Materials	3
10.	MA	18MAT2G10	Advanced Statistical Methods	3

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THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18 MSE 31	Social Network Analysis	IS	4	1	0	**5**
2	18 MSE 32	Internship	IS	0	0	5	**5**
3	18 MSE 33	Major Project: Phase-I	IS	0	0	5	**5**
4	18MSE3EX	Professional Elective –E	IS	4	0	0	**4**
Total number of Credits				**8**	**1**	**10**	**19**
Total Number of Hours/Week				**8**	**2**	**20**	**30**

SEMESTER:III		
GROUP E: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
4.	18 MIT 3E1	Mobile Application Development
5.	18 MSE 3E2	Web Intelligence
6.	18 MSE 3E3	Natural Language Processing

FOURTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18 MSE 41	Major Project: Phase- II	IS	0	0	20	20
2	18 MSE 42	Technical Seminar	IS	0	0	2	2
Total number of Credits				**0**	**0**	**22**	**22**
Total Number of Hours / Week				**0**	**0**	**44**	**44**

SEMESTER : I						
PROBABILITY THEORY AND LINEAR ALGEBRA (Common to MCN, MCE, MCS, MIT, MSE, MRM, MDC)						
Course Code	**:**	**18MAT11B**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**10 Hrs**

Matrices and Vector spaces:
Geometry of system of linear equations, vector spaces and subspaces, linear independence, basis and dimension, four fundamental subspaces, Rank-Nullity theorem(without proof), linear transformations.

Unit – II	**10 Hrs**

Orthogonality and Projections of vectors:

Orthogonal Vectors and subspaces, projections and least squares, orthogonal bases and Gram- Schmidt orthogonalization, Computation of Eigen values and Eigen vectors, diagonalization of a matrix, Singular Value Decomposition.

Unit – III	**11 Hrs**

Random Variables:

Definition of random variables, continuous and discrete random variables, Cumulative distribution Function, probability density and mass functions, properties, Expectation, Moments, Central moments, Characteristic functions.

Unit – IV	**11 Hrs**

Discrete and Continuous Distributions:
Binomial, Poisson, Exponential, Gaussian distributions.

Multiple Random variables:

Joint PMFs and PDFs, Marginal density function, Statistical Independence, Correlation and Covariance functions, Transformation of random variables, Central limit theorem (statement only).

Unit – V	**10 Hrs**

Random Processes:

Introduction, Classification of Random Processes, Stationary and Independence, Auto correlation function and properties, Cross correlation, Cross covariance functions. Markov processes, Calculating transition and state probability in Markov chain.

Course Outcomes
After going through this course the student will be able to:

CO1	Demonstrate the understanding of fundamentals of matrix theory, probability theory and random process.
CO2	Analyze and solve problems on matrix analysis, probability distributions and joint distributions.
CO3	Apply the properties of auto correlation function, rank, diagonalization of matrix, verify Rank - Nullity theorem and moments.
CO4	Estimate Orthogonality of vector spaces, Cumulative distribution function and characteristic function. Recognize problems which involve these concepts in Engineering applications.

Reference Books	
1	Probability, Statistics and Random Processes, T. Veerarajan, 3rd Edition, 2008, Tata McGraw Hill Education Private Limited, ISBN:978-0-07-066925-3.
2	Probability and Random Processes With Applications to Signal Processing and Communications, Scott. L. Miller and Donald. G. Childers, 2nd Edition, 2012, Elsevier Academic Press, ISBN 9780121726515.
3	Linear Algebra and its Applications, GilbertStrang, 4th Edition, 2006, Cengage Learning, ISBN 97809802327.
4	Schaum's Outline of Linear Algebra, Seymour Lipschutz and Marc Lipson, 5th Edition, 2012, McGraw Hill Education, ISBN-9780071794565.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : I						
ADVANCED DATA STRUCTURES AND ALGORITHMS (Theory and Practice)						
Course Code	**:**	**18MSE12**		**CIE Marks**	**:**	**100 + 50**
Credits L:T:P	**:**	**3:1:1**		**SEE Marks**	**:**	**100 + 50**
Hours	**:**	**39L+26T+26P**		**SEE Duration**	**:**	**3 +3 Hrs**

Unit-I	**08 Hrs**
Analysis Techniques: Growth of Functions: Asymptotic notations, Recurrences relations and solutions Amortized Analysis: Aggregate, Accounting and Potential Methods. **Advanced Data structures**: Abstract data types (ADTs), Graph, Directed Acyclic Graph, Trees: Preliminaries, Binary tree, The search tree ADT: Binary search tree, 2-3-4 tree, Red Black tree.	
Unit – II	**08 Hrs**
Priority Queues and Disjoint Sets, **Heaps**: Binary, Binomial, Fibonacci, leftist, Skew. **Graph Algorithms**: Bellman - Ford Algorithm, Single source shortest paths in a DAG, Dijkstra's algorithm, Johnson's Algorithm for sparse graphs, Flow networks and Ford- Fulkerson method, Maximum bipartite matching.	
Unit –III	**08 Hrs**
Tries: Ctrie, Radix, Suffix, Ternary search. **String-Matching Algorithms**: Naïve string Matching, Rabin - Karp algorithm, String matching with finite automata, **Algorithm Design Techniques:**Dynamic Programming: Matrix-Chain Multiplication ,Elements of Dynamic Programming ,Longest Common Subsequence.	
Unit –IV	**08Hrs**
Spatial data partitioning tree: K-d tree, segment tree, Range tree, Interval tree, Priority search tree. **Computational Geometry**: Line segment properties, determining whether any pair of segments intersects, Finding the convex hull, finding the closet pair of points.	
Unit –V	**07 Hrs**
Probabilistic and Randomized Algorithms: Probabilistic algorithms, Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms, Probabilistic numeric algorithms.	
Laboratory Component:	**2 Hrs/Week**

The following programs will be executed on Java/C/C++/C# any equivalent tool/language by adapting exception handling technique wherever it is suitable.

1.	Write a program to implement a dictionary using Binary Search Tree(BST) ADTs. Assume all the entries in the dictionary to be distinct integers. Each ADT should support five operations, void Insert (val),boolean Delete(val),boolean Search(val),void ClearADT() and void DisplayADT(). Both search and delete operations should respond with a boolean value indicating whether the search/delete was successful or not.
2	Design, develop, and write a program to implement insertion and search operation in a 2-3-4 tree. Determine its complexity.
3	Design, develop, and write a program to implement the Dijkstra's algorithm using Binary heap. Determine its complexity
4	Design, develop, and write a program to implement a spell checker using any Trie variant. Determine its complexity.
5	Design, develop, and write a program to implement segment tree and determine its complexity.
6	Design, develop, and write a program to implement Jhonson algorithm and determine its complexity

7.	Design, develop, and write a program to implement to solve string matching problem using naive approach and the Rabin Karp algorithm and compare their complexity.
8.	Design, develop, and write a program to implement to solve matrix chain multiplication problem.
9.	Design, develop, and write a program to implement a Monte Carlo-Rabin Miller algorithm to test the primality of a given integer.
10.	Design, develop, and write a program to implement Graham's Scan algorithm to solve convex-hull problem.

Course Outcomes

After going through this course, the students will be able to:

CO1	Apply data structure techniques for various programming aspects.
CO2	Evaluate advanced data structures and algorithms with an emphasis on persistence.
CO3	Analyze data structure impact on algorithms, program design and program performance.
CO4	Design and implement efficient solutions to real world problems.

Reference Books

1	Data Structures and Algorithms Analysis in C++, Mark Allan Weiss, 4th Edition, 2014, Pearson, ISBN-13: 9780132847377 Java, 3rd Edition, 2012, ISBN:0-132-57627-9 / 9780132576277.
2	Data structures and algorithms, Aho, Hopcroft and Ullman, 1st Edition, Pearson Education India, 2002, ISBN: 8177588265, 9788177588262.
3	The Algorithm Design Manual, Steven S Skiena, Springer, 2008, ISBN: 9781848000704, 9781848000698.
4	Introduction to algorithms, Cormen, Thomas H., Leiserson, Charles E., Rivest, Ronald L. and Clifford Stein – 3rd Edition, MIT Press, 2009, ISBN-13: 978-0262033848.

Scheme of Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Scheme of Continuous Internal Evaluation (CIE): Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Continuous Internal Evaluation (CIE): Practical (50 Marks)

The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are rewarded for 10 marks. Total marks for the laboratory is 50.

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Scheme of Semester End Examination (SEE): Practical (50 Marks)

SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

Semester End Evaluation (SEE): Total marks: 100+50=150

Theory (100 Marks) + Practical (50 Marks) =Total Marks (150

SEMESTER : I						
ADVANCED SOFTWARE QUALITY AND TESTING (Theory & Practice)						
Course Code	**:**	**18MSE13**		**CIE Marks**	**:**	**100 + 50**
Credits L:T:P	**:**	**4:0:1**		**SEE Marks**	**:**	**100 + 50**
Hours	**:**	**52L+ 26P**		**SEE Duration**	**:**	**3 +3 Hrs**

Unit-I	**12 Hrs**
Software Quality : Five Views of Software Quality, McCall's Quality Factors and Criteria, Quality Factors, Quality Criteria, Relationship between Quality Factors and Criteria, Quality Metrics, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard, ISO 9000:2000 Fundamentals, ISO 9001:2000 Requirements **Software Reliability:** What is Reliability?, Fault and Failure, Time, Time Interval between Failures, Counting Failures in Periodic Intervals, Failure Intensity, Definitions of Software Reliability, First Definition of Software Reliability, Second Definition of Software Reliability, Comparing the Definitions of Software Reliability, Factors Influencing Software Reliability, Applications of Software Reliability, Comparison of Software Engineering Technologies, Measuring the Progress of System Testing, Controlling the System in Operation, Better Insight into Software Development Process, Operational Profiles, Operation, Representation of Operational Profile.	
Unit – II	**10 Hrs**
A Perspective on Testing: Basic Definitions , Test Cases, Insights from a Venn Diagram, Identifying Test Cases , Errors and Fault Taxonomies , Levels of Testing, **Generalized Pseudocode**, The Triangle Problem , The NextDate Function, The Commission Problem , The SATM System, The Currency Converter, Saturn Windshield Wiper Controller Boundary Value Testing, Equivalence Class Testing, Decision Table based Testing.	
Unit -III	**10 Hrs**
Path Testing , Program Graphs, DD-Paths, Test Coverage Metrics, Basis Path Testing, Guidelines and Observations, Data Flow Testing, Define/Use Testing, Slice-Based Testing, Program Slicing Tools Retrospective on Unit testing, The Test Method Pendulum, Traversing the Pendulum, valuating Test Methods, Insurance Premium Case Study Guidelines.	
Unit –IV	**10 Hrs**
Life Cycle Based Traditional Waterfall Testing, Testing in Iterative Life Cycles, Agile Testing, Agile Model–Driven Development Model-Based testing, Testing Based on Models, Appropriate Models, Commercial Tool Support for Model-Based Testing Integration Testing, Decomposition-Based Integration, Call Graph–Based Integration, Path-Based Integration, Example: integrationNextDate, Conclusions and Recommendations System Testing, Threads, Basis Concepts for Requirements Specification, Model-Based Threads Use Case–Based Threads, Long versus Short Use Cases, How Many Use Cases?, Coverage Metrics for System Testing, Supplemental Approaches to System Testing, Nonfunctional System Testing Atomic System Function Testing Example.	
Unit –V	**10 Hrs**
Object-Oriented Testing: Issues in Testing Object-Oriented Software, Example: ooNextDate Object-Oriented Unit Testing, Object-Oriented Integration Testing, Object-Oriented System Testing, Software Complexity : Unit-Level Complexity, Integration-Level Complexity, Software Complexity Example, Object-Oriented Complexity, System-Level Complexity Model-Based Testing for Systems of Systems: Characteristics of Systems of Systems Sample Systems of Systems, Software Engineering for Systems of Systems, Communication Primitives for Systems of Systems, Effect of Systems of Systems Levels on Prompts.	

Course Outcomes **After completing the course, the students will be able to:**	
CO1	Analyze the importance of software quality assurance & testing in software development.
CO2	Evaluate the concepts of software quality assurance techniques and find their relevance of use.
CO3	Implement the concepts of software testing and appraise the most appropriate testing approaches for a given situation.
CO4	Use the principles of testing and develop the necessary test cases in problem solution.
Reference Books	
1	Software Testing, A Craftsman's Approach, Paul C. Jorgensen: 4th Edition, 2016,Auerbach Publications.
2	Software Testing and Quality Assurance: Theory and Practice, KsheerasagarNaik and PriyadarshiTripathy, Wiley International, 2010 Edition, ISBN 978-81-265-2593-5.
3	Introduction To Software Testing, Paul Ammann, Jeff Offutt George, Cambridge University Press;2nd Edition, ISBN 978-1107172012.
4	Software Testing: Principles and Practices, by Srinivasan Desikan Paperback, 2nd Edition, Pearson.co.in, ISBN-978-81-775-8121-8.

Laboratory Component: From Ref Book #2	**2 Hrs/Week**

Students are expected to analyze the following problems with respect to software testing and identify all necessary test cases.

1. Design, develop, code and run the program in any suitable language to solve the **commission problem**. Analyze it from the perspective of dataflow testing, derive at least 10 different test cases, execute these test cases and discuss the test results.
2. Design, develop, code and run the program in any suitable language to solve the **NextDate problem**. Analyze it from the perspective of decision table-based testing, derive at least 10 different test cases, execute these test cases and discuss the test results.
3. Design, develop, code and run the program in any suitable object-oriented language to solve the **calendar problem**. Analyze it from the perspective of OO testing, derive test cases to test the method that increment the date and the method that increments the month., execute these test cases and discuss the test results.
4. Design, develop, code and run the program in any suitable object-oriented language to solve the **currency converter problem**. Analyze it from the perspective of use case-based system testing, derive appropriate system test cases., execute these test cases and discuss the test results.
5. Study of any web testing tool (e.g. Selenium) A report of these problem solutions need to be prepared for realizing the importance of software testing.

Scheme of Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Scheme of Continuous Internal Evaluation (CIE): Theory (100 Marks)

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Scheme of Semester End Examination (SEE) for 100 marks
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Scheme of Semester End Examination (SEE): Practical (50 Marks)
SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

Semester End Evaluation (SEE): Total marks: 100+50=150

Theory (100 Marks) + Practical (50 Marks) =Total Marks (150)

SEMESTER : I						
PROFESSIONAL SKILL DEVELOPMENT (Common to all Programs)						
Course Code	**:**	**18HSS14**		**CIE Marks**	**:**	**50**
CreditsL: T: P	**:**	**0:0:0**		**SEE Marks**	**:**	**Audit Course**
Hours	**:**	**24 L**				

Unit – I	**03 Hrs**
Communication Skills: Basics of Communication, Personal Skills & Presentation Skills – Introduction, Application, Simulation, Attitudinal Development, Self Confidence, SWOC analysis. **Resume Writing:** Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts. Theory and Applications.	
Unit – II	**08 Hrs**
Quantitative Aptitude and Data Analysis: Number Systems, Math Vocabulary, fraction decimals, digit places etc. Simple equations – Linear equations, Elimination Method, Substitution Method, Inequalities. **Reasoning** – a. **Verbal** - Blood Relation, Sense of Direction, Arithmetic & Alphabet. b. **Non- Verbal reasoning** - Visual Sequence, Visual analogy and classification. **Analytical Reasoning** - Single & Multiple comparisons, Linear Sequencing. **Logical Aptitude** - Syllogism, Venn-diagram method, Three statement syllogism, Deductive and inductive reasoning. Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. **Verbal Analogies/Aptitude** – introduction to different question types – analogies, Grammar review, sentence completions, sentence corrections, antonyms/synonyms, vocabulary building etc. Reading Comprehension, Problem Solving	
Unit – III	**03 Hrs**
Interview Skills: Questions asked & how to handle them, Body language in interview, and Etiquette – Conversational and Professional, Dress code in interview, Professional attire and Grooming, Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on Stress Interviews, Technical Interviews, and General HR interviews	
Unit – IV	**03 Hrs**
Interpersonal and Managerial Skills:Optimal co-existence, cultural sensitivity, gender sensitivity; capability and maturity model, decision making ability and analysis for brain storming; Group discussion(Assertiveness) and presentation skills	
Unit – V	**07 Hrs**
Motivation: Self-motivation, group motivation, Behavioral Management, Inspirational and motivational speech with conclusion. (Examples to be cited). **Leadership Skills:** Ethics and Integrity, Goal Setting, leadership ability.	

Course Outcomes **After going through this course the student will be able to:**	
CO1	Develop professional skill to suit the industry requirement.
CO2	Analyze problems using quantitative and reasoning skills
CO3	Develop leadership and interpersonal working skills.
CO4	Demonstrate verbal communication skills with appropriate body language.

Reference Books	
1	The 7 Habits of Highly Effective People, Stephen R Covey, 2004 Edition, Free Press, ISBN: 0743272455
2	How to win friends and influence people, Dale Carnegie, 1st Edition, 2016, General Press, ISBN: 9789380914787
3	Crucial Conversation: Tools for Talking When Stakes are High, Kerry Patterson, Joseph Grenny, Ron Mcmillan 2012 Edition, McGraw-Hill Publication ISBN: 9780071772204
4	Ethnus, Aptimithra: Best Aptitude Book, 2014 Edition, Tata McGraw Hill ISBN: 9781259058738

Phase	Activity
I	After the completion of Unit 1 and Unit 2, students are required to undergo a test set for a total of 50 marks. The structure of the test will have two parts. Part A will be quiz based, evaluated for 15 marks and Part B will be of descriptive type, set for 50 Marks and reduced to 35 marks. The total marks for this phase will be 50 (15 + 35).
II	Students will have to take up second test after the completion Unit 3, Unit 4 and Unit 5.The structure of the test will have two parts. Part A will be quiz based evaluated for 15 marks and Part B will be of descriptive type, set for 50 Marks and reduced to 35 marks. The total marks for this phase will be 50 (15 + 35).
FINAL CIE COMPUTATION	
Continuous Internal Evaluation for this course will be based on the average of the score attained through the two tests. The CIE score in this course, which is a mandatory requirement for the award of degree, must be greater than 50%.The attendance will be same as other courses.	

SEMESTER : I						
SERVICE ORIENTED ARCHITECTURE (Professional Elective-A1)						
Course Code	**:**	**I8MSE1A1**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**3:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L+26T**		**SEE Duration**	**:**	**3 Hrs**

Unit-I — **08 Hrs**

Introduction:
SOA and MSA Basics: Service Orientation in Daily Life, Evolution of SOA and MSA. Service-oriented Architecture and Microservices architecture – Drivers for SOA, Dimensions of SOA, Conceptual Model of SOA, Standards and Guidelines for SOA, Emergence of MSA.

Enterprise-Wide SOA:
Considerations for Enterprise-wide SOA, Strawman Architecture for Enterprise-wide SOA, Enterprise SOA Reference Architecture, Object-oriented Analysis and Design (OOAD) Process, Service-oriented Analysis and Design (SOAD) Process, SOA Methodology for Enterprise.

Unit – II — **08 Hrs**

Service-Oriented Applications:
Considerations for Service-oriented Applications, Patterns for SOA, Pattern-based Architecture for Service-oriented Applications, Composite Applications, Composite Application Programming Model.

Service-Oriented Analysis and Design:
Need for Models, Principles of Service Design, Non-functional Properties for Services, Design of Activity Services (or Business Services), Design of Data Services, Design of Client Services, Design of Business Process Services.

Unit -III — **08 Hrs**

Technologies for SOA:
Technologies for Service Enablement, Technologies for Service Integration, Technologies for Service Orchestration.

SOA Governance and Implementation:
Strategic Architecture Governance, Service Design-time Governance, Service Run-time Governance, Approach for Enterprise-wide SOA Implementation.

Unit –IV — **08 Hrs**

Big Data and SOA: Concepts, Big Data and its characteristics, Technologies for Big Data, Service-orientation for Big Data Solutions.

Business Case for SOA: Stakeholder Objectives, Benefits of SOA, Cost Savings, Return on Investment (ROI), Build a Case for SOA.

Unit –V — **07 Hrs**

SOA Best Practices: SOA Strategy – Best Practices, SOA Development – Best Practices, SOA Governance – Best Practices.

EA and SOA for Business and IT Alignment: Enterprise Architecture, Need for Business and It Alignment, EA and SOA for Business and It Alignment.

Course Outcomes
After completing the course, the students will be able to:

CO1	Comprehend the need for SOA and its systematic evolution.
CO2	Apply SOA technologies to enterprise domain
CO3	Design and analyse various SOA patterns and techniques.
CO4	Compare and evaluate best strategies and practices of SOA.

Reference Books	
1	Service - Oriented Architecture & Microservices Architecture: For Enterprise, Cloud, Big Data and Mobile; Shankar Kambhampaty, 3rd Edition, Wiley, 2018, ISBN: 9788126564064.
2	Icon Group International; The 2018-2023 World Outlook for Service-Oriented Architecture (SOA) Software and Services; ICON Group International; 1st Edition, 2017, ASIN: B06WGPN8YD.
3	Thomas Erl; Service Oriented Architecture Concepts Technology & Design, Pearson Education Limited; 2015, ISBN-13: 9788131714904.
4	Guido Schmutz, Peter Welkenbach, Daniel Liebhart; Service Oriented Architecture An Integration Blueprint; Shroff Publishers & Distributors; 2010, ISBN-13: 9789350231081

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : I						
INFORMATION RETRIEVAL (Professional Elective-A2)						
Course Code	**:**	**18MIT1A2**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**3:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L+26T**		**SEE Duration**	**:**	**3 Hrs**

Unit-I — **08 Hrs**

Boolean Retrieval

An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval.

The term Vocabulary and Postings Lists

Document delineation and character sequence decoding, Obtaining the character sequence in a document, Choosing a document unit, Determining the vocabulary of terms, Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, Faster postings list intersection via skip pointers, Positional postings and phrase queries, Bi-word indexes, Positional indexes, Combination schemes.

Unit – II — **08 Hrs**

Dictionaries and tolerant retrieval

Search structures for dictionaries, Wildcard queries, General wildcard queries, k-gram indexes for wildcard queries, Spelling correction, Implementing spelling correction, Forms of spelling correction, Edit distance, k-gram indexes for spelling correction, Context sensitive spelling correction, Phonetic correction

Index Construction*:*Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing and Other types of indexes.

Unit -III — **08 Hrs**

Index compression

Statistical properties of terms in information retrieval, Heaps' law: Estimating the number of terms, Zipf's law: Modeling the distribution of terms, Dictionary compression, Dictionary as a string, Blocked storage.

Scoring, term weighting and the vector space model

Parametric and zone indexes, Weighted zone scoring, Learning weights, The optimal weight *g*, Term frequency and weighting, Inverse document frequency, TF-IDF weighting, The vector space model for scoring, Dot products, Queries as vectors, Computing vector scores.

Unit –IV — **08 Hrs**

Computing scores in a complete search system

Efficient scoring and ranking, Inexact top *K* document retrieval, Index elimination, Champion lists, Static quality scores and ordering, Impact ordering, Cluster pruning, Components of an information retrieval system, Tiered indexes, Query-term proximity, Designing parsing and scoring functions. Putting it all together**.**

Evaluation in information retrieval

Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results.

Unit –V — **07 Hrs**

XML retrieval: Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Probabilistic information retrieval

Review of basic probability theory, The Probability Ranking Principle, The Binary Independence Model.

Course Outcomes **After going through this course, the students will be able to:**	
CO1	Analyze and implement algorithms to extract relevant information from unstructured data using Information retrieval techniques.
CO2	Evaluate information retrieval algorithms for document indexing, relevance ranking, web search, query processing, recommender systems, etc.
CO3	Apply various information retrieval techniques to retrieve information.
CO4	Create information retrieval applications based on various ranking principles and retrieval methods.
Reference Books	
1	An Introduction to Information Retrieval, Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze:, Cambridge University Press, England, 2008, ISBN 13: 9780521865715.
2	Statistical Language Models for Information Retrieval, ChengXiangZhai, , Morgan & Claypool Publishers, 2009, ISBN: 9781598295900
3	Modern Information Retrieval, Ricardo Baeza-Yates, Berthier Ribeiro-Neto, Addison Wesley Longman Publishing Co. Inc, 2009, ISBN-10: 0321416910.
4	Information Retrieval Data Structures and Algorithms,William B. Frakes, Ricardo Baeza-Yates,FirstEdition,Pearson Education Limited,2012, ISBN-9788131716922.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : I						
SOFTWAREARCHITECTURE (Professional Elective-A3)						
Course Code	**:**	**18MSE1A3**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**3:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L+26T**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**08 Hrs**
Introduction andarchitecturaldrivers: Introduction–What issoftwarearchitecture?– Standard Definitions – Architecturalstructures –Influenceof softwarearchitectureonorganization-both businessandtechnical– ArchitectureBusinessCycle- Introduction –Functionalrequirements–Technicalconstraints –Quality Attributes	
Unit – II	**08 Hrs**
Qualityattribute workshop: Quality AttributeWorkshop–Documenting Quality Attributes– Sixpartscenarios– Case studies.	
Unit -III	**08 Hrs**
Architecturalviews: Introduction– Standard Definitionsforviews–Structures and views-Representingviews-available notations –Standard views–4+1viewofRUP, Siemens4views,SEI'sperspectivesand views–Casestudies	
Unit –IV	**08 Hrs**
Architecturalstyles: Introduction– Dataflowstyles–Call-returnstyles–SharedInformationstyles-Eventstyles–Case studies foreach style	
Unit –V	**07 Hrs**
Documentingthearchitecture: Good practices – Documenting theViewsusingUML–Meritsand Demeritsofusingvisual languages–Need forformal languages- Architectural DescriptionLanguages–ACME– Casestudies.Specialtopics:SOA and Webservices–Cloud Computing– Adaptive structures	

Course Outcomes
After going through this course, the students will be able to:

CO1	Abilitytounderstandthe softwarearchitecturalrequirements,driversandtoexplain abouttheinfluenceofsoftwarearchitectureonbusinessandtechnicalactivities.
CO2	Abletoanalyzethequalityattributeworkshopandto applythe concepttopreparethe documentationonqualityattribute.
CO3	Abilitytounderstand,identifythekeyarchitecturalstructuresandtousetheviewsto specifyarchitecture.
CO4	Abilitytouse & evaluatethestylestospecifyarchitecture.

Reference Books

1	Software Architectures Principles and Practices", Len Bass, Paul Clements, and Rick Kazman, 2nd Edition, ,Addison-Wesley, 2003, ISBN : 0321154959
2	Architecting Software Intensive System. A Practitioner's Guide", Anthony J Lattanze, Auerbach Publications, 2010, ISBN: 978-4020-7883-5.
3	Documenting Software Architectures. Views and Beyond", Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, 2nd Edition, Addison- Wesley, 2010. ISBN: 0321552687.
4	Cloud Computing. Principles and Paradigms, RajkumarBuyya, James Broberg, and Andrzej Goscinski, John Wiley & Sons, 2011,ISBN 978-0-470-88799-8.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : I						
FAULT TOLERANT SYETEMS (Professional Elective-B1)						
Course Code	**:**	**18MSE1B1**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**12 Hrs**
Fault Classification, Types of Redundancy, Basic Measures of Fault Tolerance: Traditional and Network ; Failure Rate, Reliability, and Mean Time to Failure, Canonical and Resilient Structures, Reliability Evaluation Techniques, Fault-Tolerance Processor-Level Techniques, Byzantine Failures.	
Unit – II	**10 Hrs**
Fault Tolerant Design: Basic concepts ,static,(NMR,use of error correcting codes), dynamic, hybrid and self purging redundancy, Sift-out Modular Redundancy (SMR), triple modular redundancy, SMR reconfiguration.	
Unit -III	**10 Hrs**
Information Redundancy Coding, Resilient Disk Systems, Data Replication, Algorithm-Based Fault Tolerance. Fault-Tolerant Networks Measures of Resilience, Common Network Topologies and their Resilience, Fault-Tolerant Routing.	
Unit –IV	**10 Hrs**
Software Fault Tolerance Acceptance Tests, Single-Version Fault Tolerance, N-Version Programming, Recovery Block Approach, Preconditions, Postconditions, and Assertions, Exception-Handling, Software Reliability Models, Fault-Tolerance Remote Procedure Call.	
Unit –V	**10 Hrs**
Checkpointing: What is Checkpointing?, Checkpoint Level, Optimal Checkpointing – An Analytical Model, Cache-Aided Rollback Error Recovery (CARER), Checkpointing in Distributed Systems, Checkpointing in Shared-Memory Systems, Check pointing in Real-Time Systems, Other. Uses of Checkpointing . Fault Detection in Cryptographic Systems Overview of Ciphers, Security Attacks Through Fault Injection, Countermeasures.	

Course Outcome
After going through this course, the students will be able to:

CO1	Discuss the main concepts and the relationship between defect, fault and error and the main issues of fault modelling and simulation.
CO2	Analyze and design fault tolerant system and fault tolerant schemes/ architectures in hardware and software.
CO3	Demonstrate the operation of the most popular fault tolerant approaches used in digital systems and computer networks.
CO4	Apply the concepts of availability, dependability and reliability in the design of software.

Reference Books

1	Israel Koren, C. Mani Krishna, Elsevier/Morgan Kaufmann, 2007, ISBN: 9780120885251
2	System Software Reliability, Hoang Pham, Spirnger, 2006, ISBN : 978-1-85233-950-0
3	Fault tolerant Control Systems: Design and Practical Applications, Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart, Abbas Chamseddine ,Spirnger, 2009, ISBN : 978-184882-653
4	Analysis and Synthesis of Fault-Tolerant Control Systems, Magdi S. Mahmoud, YuanqingXiajohnwiley& sons, 2014,ISBN : 978-1-118-54133-3.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : I						
ENTERPRISE APPLICATION DEVELOPMENT (Professional Elective-B2)						
Course Code	**:**	**18MIT1B2**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**12 Hrs**
Overview of Enterprise Applications Introduction, Architecture, Enterprise Applications, Kinds of Enterprise Application, Thinking About Performance , Patterns ,The Structure of the Patterns, Limitations of Patterns, Layering , The Evolution of Layers in Enterprise Applications, The Three Principal Layers , Choosing Where to Run Layers , Organizing Domain Logic, Making a Choice,Service Layer.	
Unit – II	**10 Hrs**
Mapping to Relational Databases: Architectural Patterns ,The Behavioral Problem , Reading in Data , Structural Mapping Patterns , Mapping , Inheritance , Building the Mapping, Double Mapping , Using Metadata , Database Connections, Web Presentation: View Patterns, Input control patterns.	
Unit -III	**10 Hrs**
Concurrency and Session State: Concurrency, Concurrency Problems , Execution Contexts , Isolation and Immutability, Optimistic and Pessimistic Concurrency Control . Preventing Inconsistent Reads, Deadlocks, Transactions ACID, Transactional Resources, Reducing Transaction Isolation for Liveness, Business and System Transactions , Patterns for Offline Concurrency Control, Application Server Concurrency. Session state: Value of statelessness, Session state, Ways to store session state.	
Unit –IV	**10 Hrs**
Distributed Objects: The Allure of Distributed Objects , Remote and Local Interfaces , Where You Have to Distribute, Working with the Distribution Boundary, Interfaces for Distribution, Layers all together: Domain Layer, Data Source Layer, Data Source for Transaction Script , Data Source Table Module, Data Source for Domain Model, The Presentation Layer, Other Layering schemes	
Unit –V	**10 Hrs**
Constructing Enterprise Applications Construction Readiness: Defining construction plan, package structure, Setting up Configuration plan, Development environment Defining software construction Map, Constructing Solution layers: Infrastructure services layer, Presentation layer, Business layer, Data access layer, Integration layer component.	

Course Outcome
After going through this course, the students will be able to:

CO1	Comprehend the concepts of prime layers in Enterprise application development to solve real world problems.
CO2	Design the architecture of EA through mapping of patterns to database and implementing concurrency.
CO3	Develop Enterprise Application with appropriate Web presentation techniques and Session state attributes.
CO4	Plan and define software construction map for building layers for enterprise applications.

Reference Books	
1.	Patterns of Enterprise Application Architecture, Martin Fowler, With Contributions from David Rice, Matthew Foemmel, Edward Hieatt, Robert Mee and Randy Stafford, Reprint Version – 2016,Addison-Wesley Publication, ISBN 0-321-12742-0.
2.	Raising Enterprise Applications: A Software Engineering Perspective, by Satheesha B. Nanjappa, Senthil K. Nallasamy, VeerakumarEsakimuthuAnubhav Pradhan, Wiley-India Publication, ISBN: 9788126519460.
3	Service-Oriented Architecture: A Planning and Implementation Guide for Business and Technology by Eric A. Marks, Michael Bell, 2006, ISBN: 978-0-471-76894-4,
4.	A systematic perspective to managing complexity with enterprise architecture by PallabSaha, 2013, ISBN:9781466645189,

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : I						
ARTIFICAL NEURAL NETWORKS (Professional Elective-B3)						
Course Code	**:**	**18 MSE 1B3**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**12 Hrs**
Introduction : Fundamental Theory, Biological Neuron, Performance Parameters **Artificial Neural Network Architectures and Training Processes** : Main Architectures of Artificial, Neural Networks, Training Processes and Properties of Learning, **The Perceptron Network, The ADALINE Network and Delta Rule**	
Unit – II	**10 Hrs**
Multilayer Perceptron Networks : Operating Principle of the Multilayer Perceptron Training Process of the Multilayer Perceptron, Multilayer Perceptron Applications, Aspects of Topological Specifications for MLP Networks, Implementation Aspects of Multilayer Perceptron Networks	
Unit -III	**10 Hrs**
Radial Basis Function Networks : Training Process of the RBF Network, Applications of RBF Networks, **Recurrent Hopfield Networks**, **Self-Organizing Kohonen Networks**	
Unit –IV	**10 Hrs**
Radial Basis Function Networks : Training Process of the RBF Network, Applications of RBF Networks**, Recurrent Hopfield Networks, Self-Organizing Kohonen Networks**	
Unit –V	**10 Hrs**
Application of Artificial Neural Networks in Engineering and Applied Science Problems: Coffee Global Quality Estimation Using Multilayer Perceptron ,Computer Network Traffic Analysis Using SNMP Protocol and LVQ Networks, Forecast of Stock Market Trends Using Recurrent Networks, Disease Diagnostic System Using ART Networks, Recognition of Disturbances Related to Electric Power Quality Using MLP Networks, Method for Classifying Tomatoes Using Computer Vision and MLP Networks, Performance Analysis of RBF and MLP Networks in Pattern Classification	

Course Outcome

After going through this course, the students will be able to:

CO1	Describe the structure and function of the most common artificial neural network (ANN) types.
CO2	Learn training, verification and validation of neural network models.
CO3	Quantitatively analyse the process and outcomes of learning in ANNs, and account for their shortcomings, limitations.

Reference Books

1	Artificial Neural Networks - A Practical Course, Ivan Nunes Da Silva, Springer, 2017, ISBN:978-3-319-43162-8.
2	Principles of Artificial Neural Networks, Daniel Graupe, 3rd Edition, 2013, ISBN: 978-981-4522-74-8.

3	A Brief Introduction to Neural Networks, David Kriesel, 2007.
4	Artificial Neural Networks, B. Yognanarayana, Prentice Hall, 2006, ISBN: 978-981-4522-74-8.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : I						
CYBER SECURITY AND DIGITAL FORENSICS (Theory & Practice)						
Course Code	**:**	**18MSE21**		**CIE Marks**	**:**	**100 + 50**
Credits L:T:P	**:**	**3:1:1**		**SEE Marks**	**:**	**100 + 50**
Hours	**:**	**39L+26T+26P**		**SEE Duration**	**:**	**3 +3 Hrs**

Unit-I	**08 Hrs**

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, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Unit – II	**08 Hrs**

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.

Unit –III	**08 Hrs**

Understanding the Digital Forensics Profession and Investigations:
An Overview of Digital Forensics, Preparing for Digital Investigations, Maintaining Professional Conduct, Preparing a Digital Forensics Investigation, Procedures for Private-Sector High-Tech Investigations, Understanding Data Recovery Workstations and Software, Conducting an Investigation.

Current Digital Forensics Tools:
Evaluating Digital Forensics Tool Needs, Digital Forensics Software Tools, Digital Forensics Hardware Tools, Validating and Testing Forensics Software.

Unit –IV	**08 Hrs**

Mobile Device Forensics:
Understanding Mobile Device Forensics, Understanding Acquisition Procedures for Mobile Devices.

Cloud Forensics:
An Overview of Cloud Computing, Legal Challenges in Cloud Forensics, Technical Challenges in Cloud Forensics, Acquisitions in the Cloud, Conducting a Cloud Investigation, Tools for Cloud Forensics.

Unit –V	**07 Hrs**

Digital Forensics Analysis and Validation:
Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques

Virtual Machine Forensics, Live Acquisitions, and Network Forensics:
An Overview of Virtual Machine Forensics, Performing Live Acquisitions, Network Forensics Overview

Lab Component	**2 Hrs/Week**

Demonstrate the application of the following tools using Kali Linux.

Kali Linux

1. **Information Gathering Tools**
   Dnmap, Sparta, Hping3, Netdiscover , Recon-ng
2. **Web Application Analysis Tools**
   Webscarab, HTTrack, Owasp-Zap
3. **Password Attack Tools**
   John The Ripper, Crunch, Ncrack, Wordlist, Rainbowcrack
4. **Sniffing And Snooping Tools**
   MACchanger, Responder, Wireshark, Hamster
5. **Port Exploitation Tools**
   Exe2hex, Weevely, Proxychains

6.Forensics Tools
Foremost, Binwalk, Autopsy

7. **Reporting Tools**

Pipal, Casefile, Cutycapt, Faraday-Ide, .Magictree

Course Outcome
After going through this course, the students will be able to:

CO1	Interpret the basic concepts of cyber security and digital forensics.
CO2	Compare different software and hardware tools used in validating forensic data.
CO3	Discuss tool support for detection of various attacks.
CO4	Demonstrate through use of proper tools knowledge on the cyber security, Cybercrime and forensics.

Reference Books

1	Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives, SunitBelapure and Nina Godbole, Wiley India Pvt Ltd, 2013, ISBN: 978-81-265-21791,
2	Guide to Computer Forensics and Investigations, Bill Nelson, Amelia Phillips, Chris Steuart, fifth edition, ISBN: 978-1-285-06003-3.
3	Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions, Thomas J. Mowbray, Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 84965 -1.
4	I. A. Dhotre , Cyber Forensics , Technical Publications, 1st Edition,2016, ISBN-13: 978-9333211475.

Scheme of Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Scheme of Continuous Internal Evaluation (CIE): Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Continuous Internal Evaluation (CIE): Practical (50 Marks)
The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are rewarded for 10 marks. Total marks for the laboratory is 50.

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Scheme of Semester End Examination (SEE): Practical (50 Marks)
SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

Semester End Evaluation (SEE): Total marks: 100+50=150

Theory (100 Marks) + Practical (50 Marks) =Total Marks (150)

SEMESTER : II						
HUMAN COMPUTER INTERACTION (Theory)						
Course Code	**:**	**18MSE22**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**3:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L+26T**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**08 Hrs**

Usability of Interactive Systems:
Introduction, Usability goals and Measures, Usability Motivations, Universal Usability, Goals for Our Profession; **Guidelines, Principles, and Theories**: Introduction, Guidelines, Principles, Theories.

Unit – II	**08 Hrs**

Managing Design Processes:
Introduction, Organizational Design to Support Usability, The Four Pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Social Impact Statement for Early Design Review, Legal Issues. **Evaluating Interface Designs**: Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance Tests, Evaluation During Active Use Controlled Psychologically Oriented Experiments.

Unit -III	**08 Hrs**

Direct Manipulation and Virtual Environment :
Introduction Examples of Direct Manipulation, Discussion of Direct Manipulation, 3D Interfaces Teleoperation, Virtual and Augmented Reality. **Menu Selection, Form Fill-in, and Dialog Boxes :**Introduction, Task-Related Menu Organization, Single Menus, Combinations of Multiple Menus, Content Organization Fast Movement through Menus, Data Entry with Menus: Form Fill-in, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays.

Unit –IV	**08 Hrs**

Collaboration and Social Media Participation:
Introduction, Goals of Collaboration and Participation, Asynchronous Distributed Interfaces: Different Place, Different TimeSynchronous Distributed Interfaces: Different Place, Same Time, Face-to-Face Interfaces: Same Place, Same Time. **Quality of Service:** Introduction, Models of Response Time Impacts Expectations and Attitudes, User Productivity, Variability in Response Time, Frustrating Experiences.

Unit –V	**07 Hrs**

Balancing Function and Fashion:
Introduction, Error Messages, Non anthropomorphic Design, Display Design, Web Page Design, Window Design, Color. **User Documentation and Online Help:** Introduction, Online versus Paper, Documentation, Reading from Paper versus from Displays, Shaping the Content of the Documentation, Accessing the Documentation, Online Tutorials and Animated Demonstrations, Online Communities for User Assistance, The Development Process. **Information Search:** Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Search Interface.

Course Outcome
After going through this course, the students will be able to:

CO1	Demonstrate Understanding of Interaction between the human and computer components.
CO2	Apply and analyse HCI design principles and guidelines in the software process.
CO3	Compare and Implement Interaction design rules.
CO4	Design prototypes and come up with methods and criteria for evaluation of the design.

Reference Books

1.	Designing the User Interface: Techniques for Effective Human-Computer Interaction, Ben Shneiderman and Catherine Plaisant, 6th Edition, Pearson Publications, 2016, ISBN: 9780123822291.
2.	The essential guide to user interface design, Wilbert O Galitz, 3rd Edition , Wiley, 2007, ISBN: 978-0-471-27139-0.
3	Human – Computer Interaction, Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg, Pearson 3rd Edition,2004, ISBN 0-13-046109-1.
4.	Interaction Design, Prece, Rogers, Sharps, 3rd Edition, Wiley, 2011, ISBN: 978-1-119-02075-2.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
RESEARCH METHODOLOGY (Common to all programs)						
Course Code	**:**	**18IM23**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**08 Hrs**

Overview of Research
Research and its types, identifying and defining research problem and introduction to different research designs. Essential constituents of Literature Review. Basic principles of experimental design, completely randomized, randomized block, Latin Square, Factorial.

Unit – II	**08 Hrs**

Data and data collection
Overview of probability and data typesPrimary data and Secondary Data, methods of primary data collection, classification of secondary data, designing questionnaires and schedules.
Sampling Methods: Probability sampling and Non-probability sampling

Unit – III	**08 Hrs**

Processing and analysis of Data
Statistical measures of location, spread and shape, Correlation and regression, Hypothesis Testing and ANOVA. Interpretation of output from statistical software tools

Unit – IV	**08 Hrs**

Advanced statistical analyses
Non parametric tests, Introduction to multiple regression, factor analysis, cluster analysis, principal component analysis. Usage and interpretation of output from statistical analysis software tools.

Unit-V	**07 Hrs**

Essentials of Report writing and Ethical issues
Significance of Report Writing ,Different Steps in Writing Report,Layout of the Research Report , Ethical issues related to Research, Publishing, Plagiarism
Case studies: Discussion of case studies specific to the domain area of specialization

Course Outcomes
After going through this course the student will be able to:

CO1	Explain the principles and concepts of research types, data types and analysis procedures.
CO2	Apply appropriate method for data collection and analyze the data using statistical principles.
CO3	Present research output in a structured report as per the technical and ethical standards.
CO4	Create research design for a given engineering and management problem situation.

Reference Books:

1	Research Methodology Methods and techniques by, Kothari C.R., New Age International Publishers, 4th edition, ISBN: 978-93-86649-22-5
2	Management Research Methodology, Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., Pearson Education: New Delhi, 2006. ISBN: 978-81-77585-63-6
3	The Research Methods Knowledge Base, William M. K. Trochim, James P. Donnelly, 3rd Edition, Atomic Dog Publishing, 2006. ISBN: 978-1592602919
4	Statistics for Management, Levin, R.I. and Rubin, D.S., 7th Edition, Pearson Education: New Delhi.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
MINOR PROJECT						
Course Code	**:**	**18MCE24**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**0:0:2**		**SEE Marks**	**:**	**100**
Hours/Week	**:**	**4**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

1. Each project group will consist of maximum of two students.
2. Each student / group has to select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The number of projects that a faculty can guide would be limited to four.
5. The minor project would be performed in-house.
6. The implementation of the project must be preferably carried out using the resources available in the department/college.

Course Outcome
After going through this course, the students will be able to:

CO1	Conceptualize, design and implement solutions for specific problems.
CO2	Communicate the solutions through presentations and technical reports.
CO3	Apply resource managements skills for projects.
CO4	Synthesize self-learning, team work and ethics.

Scheme of Continuous Internal Examination
Evaluation will be carried out in 3 phases. The evaluation committee will comprise of 4 members: Guide,
Two Senior Faculty Members and Head of the Department.

Phase	Activity	Weightage
I	Synopsys submission, Preliminary seminar for the approval of selected topic and objectives formulation	20%
II	Mid term seminar to review the progress of the work and documentation	40%
III	Oral presentation, demonstration and submission of project report	40%

** Phase wise rubrics to be prepared by the respective departments
CIE Evaluation shall be done with weightage / distribution as follows:

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development/ experimental setup 25%
- Conducting experiments/ implementation / testing 25%
- Demonstration & Presentation 15%
- Report writing 25%

Scheme of Semester End Examination (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

- Brief write up about the project 05%
- Presentation / Demonstration of the Project 20%
- Methodology and Experimental results & Discussion 25%
- Report 20%
- Viva Voce 30%

SEMESTER : II						
METRICS AND MODELS (Professional Elective-C1)						
Course Code	**:**	**18MSE2C1**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**12 Hrs**

Introduction:

Introduction: Quality: Popular views; Quality: Professional views; Software quality; Total quality management.

Overview of Software Quality Metrics: Product quality metrics; In-process quality metrics; Metrics for software maintenance; Examples of metrics programs; Collecting software engineering data.

Unit – II	**10 Hrs**

Applying the 7 Basic Quality Tools in Software Development:

Ishikawa's seven basic tools; Checklist; Pareto diagram; Histogram; Run charts; Scatter diagram; Control chart; Cause-and-effect diagram; Relations diagram.

Defect Removal Effectiveness:

Review; A closer look at defect removal effectiveness; Defect removal effectiveness and quality planning; Cost effectiveness of phase defect removal; Defect removal effectiveness and process maturity level.

Unit -III	**10 Hrs**

The Rayleigh Model:

Reliability models; The Rayleigh model; Basic assumptions; Reliability and predictive validity.

Exponential Distribution and Reliability Growth Models:

The exponential model; Reliability growth models; Model assumptions; Criteria for model evaluation; Modeling process; Test compression factor; Estimating the distribution of total defects over time.

Unit –IV	**10 Hrs**

Quality Management Models:

The Rayleigh model framework; The code integration pattern; The PTR submodel; The PTR arrival / backlog projection model; Reliability growth models; Criteria for model evaluation; In-process metrics and reports; Orthogonal defect classification.

In-Process Metrics for Software Testing:

In-process metrics for software testing; In-process metrics and quality management; Possible metrics for acceptance testing to evaluate vendor-developed software; When is the product good enough to ship?

Unit –V	**10 Hrs**

Metrics and Lessons Learned for Object-Oriented Projects:

Object-oriented concepts and constructs; Design and complexity metrics; Productivity metrics; Quality and quality management metrics; Lessons learned for OO projects.

Availability Metrics:

Definition and measurements of system availability; Reliability, availability, and defect rate; Collecting customer outage data for quality improvement; In-process metrics for outage and availability.

Course Outcome

After going through this course, the students will be able to:

CO1	Comprehend the need for measurement of software artefacts.
CO2	Apply various software quality metrics in process of software development
CO3	Design and analyse various models for software management.
CO4	Compare and evaluate metrics and various models for assuring software quality.

Reference Books	
1	Metrics and Models in Software Quality Engineering; Stephan H. Kan, 2nd Edition, Pearson, 2015, ISBN-13:9789332551602.
2	Software Metrics: A Rigorous Approach, Fenton N. E., S. L. Pfleeger; 2nd Edition, Thomson, 2003, ISBN-13: 9789812403858.
3	Software Quality Engineering:, Jeff Tian; John Wiley and Sons Inc., 2014, ISBN-13:9788126508051.
4	Metrics-driven Enterprise Software Development; Sdatta , Cengage Learning India Pvt.ltd; 2014, ISBN-13:9788131522370.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
MACHINE LEARNING **(Professional Elective-C2)** **Common to VLSI, CS, CNE, DCE, BMI**						
Course Code	**:**	**18MCS2C2**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**10 Hrs**
Introduction: Overview ofProbability Theory, Model Selection, Introduction to Machine learning. Linear Regression – Basis Function models, Bias Variance Decomposition, Bayesian linear Regression; Stochastic gradient Descent, Discriminant Functions, Bayesian Logistic regression. Examples on linear regression, logistic regression	
Unit – II	**11 Hrs**
Supervised Learning Kernel Methods: Dual representations, Construction of a kernel, Radial Basis Function Networks, Gaussian Process, Tree Based methods.Sparse Kernel Machines: Maximum margin classifiers (SVM), RVM.Examples on spam, mixer and k nearest neighbour	
Unit – III	**11 Hrs**
Unsupervised Learning **Mixture Models:** K-means Clustering, Mixtures of Gaussians, Maximum likelihood, EM for Gaussian mixtures, The EM Algorithm in General, Principal Component Analysis, Probabilistic PCA. Examples on Market booklet analysis	
Unit – IV	**11 Hrs**
Random Forests Introduction, Definition of Random Forests, Details of Random ,Out of Bag Samples , Variable Importance, Proximity Plots, Random Forests and Over-fitting, Analysis of Random Forests, Variance and the De-Correlation Effect, Bias, Adaptive Nearest Neighbors.	
Unit –V	**09 Hrs**
Ensemble Learning Introduction, Boosting and Regularization Paths, Penalized Regression, The "Bet on Sparsity" Principle, Regularization Paths, Over-fitting and Margins, Learning Ensembles, Learning a Good Ensemble, Rule Ensembles	

Course Outcomes

After going through this course the student will be able to:

CO1	Explore the basics of Probability, data distributions and neural networks Algorithms.
CO2	Apply the various dimensionality reduction techniques and learning models for the given Application.
CO3	Analyze the different types of supervised and unsupervised learning models.
CO4	Evaluate the classification and regression algorithms for given data set.

Reference Books:

1	Pattern Recognition and Machine Learning, Christopher M Bishop,2nd Edition, February 2006,Springer, ISBN-13: 978-0387-31073-2.
2	The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, 2nd Edition, 2008, Springer, ISBN 978-0-387-84858-7
3	Data Mining – Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufmann, 3rd Edition, 2006,Elsevier, ISBN 1-55860-901-6
4	Practical data science with R, Zumel, N., & Mount, J, 2014, Manning Publications ISBN 9781617291562

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
COMPUTER SYSTEM PERFORMANCE & ANALYSIS (Professional Elective-C3)						
Course Code	**:**	**18MIT2C3**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**12 Hrs**
Introduction: The art of Performance Evaluation, Common mistakes in Performance Evaluation, A systematic approach to Performance Evaluation, Selecting an evaluation technique. **Metrics of Performance:** What is a performance metric? Characteristics of a good performance metric, Processor and system performance metrics, Other types of performance metrics, Speedup and relative change, Means versus ends metrics, Summary.	
Unit – II	**10 Hrs**
Average Performance and Variability: Why mean values? Indices of central tendency, Other types of means**,** Quantifying variability, Summary. **Errors in Experimental Measurements:** Accuracy, precision, and resolution, Sources of errors, A model of errors, Quantifying errors.	
Unit -III	**10 Hrs**
Comparing Alternatives: Comparing two alternatives, Comparing more than two alternatives, Summary, For further reading, Exercises. **Measurement Tools and Techniques:** Events and measurement strategies, Interval timers, Program profiling, Event tracing, Indirect and ad hoc measurements, Perturbations due to measuring.	
Unit –IV	**10 Hrs**
Benchmark Programs: Types of benchmark programs, benchmark strategies, example of benchmark programs, summary. **Linear regression models:** Least squares minimization, confidence intervals for regression parameters, correlation, multiple linear regression, verifying linearity, nonlinear models, summary.	
Unit –V	**10 Hrs**
The design of experiments: Types of experiments, terminology, two factor experiments, generalized m-factor experiments, $n2^m$ experiments, summary. **Queueing Analysis:** Queuing Network models, basic assumptions and notation, Operational analysis, stochastic analysis, summary.	

Course Outcome	
After going through this course, the students will be able to:	
CO1	Comprehend the need for performance evaluation and its systematic approach.
CO2	Apply performance measurement techniques to evaluate computer systems.
CO3	Design and analyse various performance evaluation techniques.
CO4	Compare and evaluate performance of computer systems using sophisticated models.

Reference Books	
1	Measuring Computer Performance: A Practitioner's Guide; David J. Lilja, Cambridge University Press, 2005,ISBN: 9781107439863.
2	The Art of Computer Systems Performance Analysis, Raj Jain; John Wiley, 2008,ISBN: 8126519053.
3	Probability and Statistics with Reliability, Queuing and Computer Science Applications; Trivedi K S, Kishor S. Trivedi; 2nd Edition, John Wiley, 2008,ISBN: 978-0-471-33341-8.
4	Research Methodology; R. Panneerselvam, Prentice Hall, 2004, ISBN - 9788120324527.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
DATA ENGINEERING (Professional Elective-D1)						
Course Code	**:**	**18MSE2D1**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**12 Hrs**

Object and Object-Relational Databases:
Overview of Object Database Concepts , Object Database Extensions to SQL , The ODMG Object Model and the Object Definition Language ODL , Object Database Conceptual Design , The Object Query Language OQL , Overview of the C++ Language Binding in the ODMG

1. Case Study: Geographical object–oriented databases.

Unit – II	**10 Hrs**

Distributed Databases, NOSQL Systems:
Distributed Database Concepts ,Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design ,Overview of Concurrency Control and Recovery in Distributed Databases , Overview of Transaction Management in Distributed Databases, Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems, Distributed Database Architectures, Distributed Catalog Management, Introduction to NOSQL Systems ,The CAP Theorem , Document-Based NOSQL Systems and MongoDB ,NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems , NOSQL Graph Databases and Neo4j

2. Distributed Database Case Study on Google's Big Tables.

Unit –III	**10 Hrs**

Data Warehousing and Online Analytical Processing what is Data Warehouse:
Basic Concepts Data Warehouse, Data Warehouse Modeling: Data Cube, A Multidimensional Data Model ,Stars, Snowflakes, and Fact Constellations: Schemas for Multidimensional Data Models. Dimensions: The Role of Concept Hirearchies, Measures: The Categorization and Computation. Typical OLAP Operations, Starnet query model for querying multidimensional databases.

3. A Data Warehouse Prototype for the Tourism Industry: A Case Study.

Unit –IV	**10 Hrs**

Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods, Frequent Item set Mining Methods, Which Patterns Are Interesting? Pattern Evaluation Methods. **Classification:** Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Support Vector Machines.

Unit –V	**10 Hrs**

Database Security:
Introduction to Database Security Issues , Discretionary Access Control Based on Granting and Revoking Privileges, Mandatory Access Control and Role-Based Access Control for Multilevel Security, SQL Injection, Introduction to Statistical Database Security , Introduction to Flow Control, Encryption and Public Key Infrastructures , Privacy Issues and Preservation , Challenges to Maintaining Database Security.

Course Outcome
On completion of the course, the students will be able to

CO1	Develop solutions using Object oriented database.
CO2	Acquire knowledge on concepts of distributed database and NOSQL systems.
CO3	Acquire proficiency and Develop appropriate solutions using datamining mining technique.
CO4	Discover and design database for recent applications database for better interoperability and security.

Reference Books	
1	Fundamentals of Database Systems, Elmasri and Navathe: Pearson Education, 7th Edition, Pearson Publications, ISBN-13: 978-0-13-397077-7.
2	Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke: 3rd Edition, McGraw-Hill, 2013.
3	Data Mining – Concepts and Techniques; Jiawei Han and Micheline Kamber; 3rd Edition; Morgan Kaufmann Publishers Inc, 2011,ISBN 9789380931913.
4	Database Systems: A Practical Approach to Design, Implementation, and Management, Thomas Connolly , Carolyn Begg , 6th Edition, Pearson Publications, ISBN- 9780134410951.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
AGILE TECHNOLOGIES (Professional Elective-D2)						
Course Code	**:**	**18MSE2D2**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**12 Hrs**
Why Agile?: Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, How to Be Agile?: Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor.	
Unit – II	**10 Hrs**
Understanding XP: The XP Lifecycle, The XP Team, XP Concepts, Adopting XP: Is XP Right for Us?, Go!, Assess Your Agility.**Practicing XP:** Thinking: Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives, Collaborating: Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand-Up Meetings, Coding Standards, Iteration Demo, Reporting,	
Unit –III	**10 Hrs**
Releasing: **"**Done Done", No Bugs, Version Control, Ten-Minute Build, Continuous Integration, Collective Code Ownership, Documentation. **Planning:** Vision, Release Planning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, Estimating. **Developing:** Incremental requirements, Customer Tests, Test-Driven Development, Refactoring, Simple Design ,Incremental Design and Architecture, Spike Solutions, Performance Optimization, Exploratory.	
Unit –IV	**10 Hrs**
Mastering Agility Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading, Improve the Process: Understand Your Project, Tune and Adapt, Break the Rules, Rely on People :Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People, Eliminate Waste :Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput.	
Unit –V	**10 Hrs**
Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, Seek Technical Excellence :Software Doesn't Exist, Design Is for Understanding, Design Trade-offs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery.	

Course Outcomes

On completion of the course, the students will be able to:

CO1	Understand The XP Lifecycle, XP Concepts, Adopting XP .
CO2	Work on Pair Programming, Root-Cause Analysis, Retrospectives, Planning, Incremental Requirements, Customer Tests.
CO3	Implement Concepts to Eliminate Waste.
CO4	Appreciate and focus on the most important aspects of project development and sprints.

Reference Books

1	The Art of Agile Development (Pragmatic guide to agile software development), James shore, Chromatic, O'Reilly Media, Shroff Publishers & Distributors, 2007
2	Agile and Iterative Development A Manger's Guide, Craig Larman , First Edition, India, Pearson Education, 2004
3	The Good, the Hype and the Ugly, Meyer, B., Agile!:, 1st Edition, Springer, 2014, ISBN 978-3-319-05155-0
4	Essential Scrum: A Practical Guide to the Most Popular Agile Process (Addison-Wesley Signature Series (Cohn)), Kenneth S. Rubin , 1st Edition .

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER: II						
SOFTWARE PROJECT MANAGEMENT (Professional Elective-D3)						
Course Code	**:**	**18MSE2D3**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**12 Hrs**

Metrics:
Introduction, The Metrics Roadmap, A Typical Metrics Strategy, What Should you Measure?, Set Targets and track Them, Understanding and Trying to minimize variability, Act on data, People and Organizational issues in Metrics Programs, Common Pitfalls to watch out for in Metrics Programs, Matrices implementation checklists and tools, **Software configuration management:** Introduction, Some Basic Definitions and terminology, the processes and activities of software configuration management, configuration status accounting, configuration audit, software configuration management in geographically distributed teams, Metrics in software configuration management, software configuration management tools and automation.

Unit – II	**10 Hrs**

Risk Management:
Introduction, What is risk management and why is it important?, Risk management cycle, Risk identification: common tools and techniques, Risk Quantifications, Risk Monitoring, Risk Mitigation, Risks and Mitigation in the context of global project teams, some practical techniques risk management, Metrics in risk management. **Project Planning and Tracking:** Components of Project Planning and Tracking, The "What " Part of a Project Plan, The "What Cost " Part of a Project Plan, The "When " Part of Project Planning, The "How " Part of a Project Planning: Tailoring of Organizational Processes For the Project, The " By Whom " Part of the Project Management Plan : Assigning Resources, Putting it all together : The Software Management Plan, Activities Specific to Project Tracking, Interfaces to the Process Database. **Project Closure:** When Does Project Closure Happen?. Why Should We Explicitly do a Closure?, An Effective Closure Process, Issues that Get Discussed During Closure, Metrics for Project Closure, Interfaces to the Process Database.

Unit –III	**10 Hrs**

Software Requirements gathering:
Inputs and start criteria for requirements gathering, Dimensions of requirements gathering, Steps to be followed during requirements gathering, outputs and quality records from the requirements phase, skill sets required during requirements phase, differences for a shrink-wrapped software, challenges during the requirements management phase, Metrics for requirements phase. **Estimation:** What is Estimation? when and why is Estimation done?, the three phases of Estimation, Estimation methodology, formal models for size Estimation, Translating size Estimate into effort Estimate, Translating effort Estimates into schedule Estimate, common challenges during Estimation , Metrics for the Estimation processes.

Design and Development Phases:
Some differences in our chosen approach, salient features of design, evolving an architecture/ blueprint, design for reusability, technology choices/constraints, design to standards, design for portability, user interface issues, design for testability, design for diagnose ability, design for maintainability, design for install ability, inter-operability design, challenges during design and development phases, skill sets for design and development, metrics for design and development phases.

Unit –IV	**10 Hrs**

Project management in the testing phase:
Introduction, What is testing?, what are the activities that makeup testing?, test scheduling and types of tests, people issues in testing, management structures for testing in global teams, metrics for testing phase. **Project management in the Maintenance Phase:** Introduction, Activities during Maintenance Phase, management issues during Maintenance Phase, Configuration management during Maintenance Phase, skill sets for people in the maintenance phase, estimating size, effort, and people resources for the maintenance phase, advantages of using geographically distributed teams for the maintenance phase, metrics for the maintenance phase.

Unit –V		10 Hrs
Globalization issues in project management: Evolution of globalization, challenges in building global teams, Models for the execution of global projects, some effective management techniques for managing global teams. **Impact of the internet on project management:** Introduction, the effect of internet on project management, managing projects for the internet, Effect on the project management activities. **People focused process models:** Growing emphasis on people centric models, people capability maturity model(P-CMM), other people focused models in the literature, how does an organization choose the models to use?		
Course Outcome **After going through this course, the students will be able to:**		
CO1	Understand the importance of metrics in project management.	
CO2	Formulate the strategy for project planning & progressing.	
CO3	Apply the knowledge of project management in project development.	
CO4	Realize globalization issues in project management.	
Reference Books		
1	Managing Global Software Projects , Ramesh Gopalaswamy: Fifteenth reprint 2013,Tata McGraw Hill, ISBN-978-0-07-059897-3.	
2	Managing the Software Process, Watts S Humphrey, Pearson Education, New Delhi, 2002, ISBN-9788177583304.	
3	Software Project Management in practice, Pankaj Jalote, Pearson Education, New Delhi, 2002, ISBN – *9780201737219.*	
4	Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide), 5th Edition, 2013, ISBN: 978-1-935589-67-9.	

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
BUSINESS ANALYTICS (Global Elective-G01)						
Course Code	**:**	**18CS2G01**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **08 Hrs**

Business analytics

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling.

Unit – II **08 Hrs**

Trendiness and Regression Analysis

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

Unit – III **08 Hrs**

Organization Structures of Business analytics

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

Unit – IV **08 Hrs**

Forecasting Techniques

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

Unit –V **07 Hrs**

Decision Analysis

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

Course Outcomes

After going through this course the student will be able to:

CO1	Explore the concepts, data and models for Business Analytics.
CO2	Analyze various techniques for modelling and prediction.
CO3	Design the clear and actionable insights by translating data.
CO4	Formulate decision problems to solve business applications

ReferenceBooks

1	Business analytics Principles, Concepts, and Applications FT Press Analytics, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, 1st Edition, 2014, ISBN-13: 978-0133989403, ISBN-10: 0133989402
2	The Value of Business Analytics: Identifying the Path to Profitability, Evan Stubs , John Wiley & Sons, ISBN:9781118983881 |DOI:10.1002/9781118983881,1st Edition 2014
3	Business Analytics,James Evans, Pearsons Education 2ndEdition, ISBN-13:978-0321997821ISBN-10:0321997824
4	Predictive Business Analytics Forward Looking Capabilities to Improve Business,Gary Cokins and Lawrence Maisel, Wiley; 1stEdition, 2013.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
INDUSTRIAL AND OCCUPATIONAL HEALTH AND SAFETY (Global Elective-G02)						
Course Code	**:**	**18CV2G02**		**CIE**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

UNIT – I **7 Hrs**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

UNIT – II **9 Hrs**

Occupational health and safety: Introduction, Health, Occupational health: definition, Interaction between work and health, Health hazards, workplace, economy and sustainable development, Work as a factor in health promotion. Health protection and promotion Activities in the workplace: National governments, Management, Workers, Workers' representatives and unions, Communities, Occupational health professionals. Potential health hazards: Air contaminants, Chemical hazards, Biological hazards, Physical hazards, Ergonomic hazards, Psychosocial factors, Evaluation of health hazards: Exposure measurement techniques, Interpretation of findings recommended exposure limits. Controlling hazards: Engineering controls, Work practice controls, Administrative controls. Occupational diseases: Definition, Characteristics of occupational diseases, Prevention of occupational diseases.

UNIT – III **9 Hrs**

Hazardous Materials characteristics and effects on health: Introduction, Chemical Agents, Organic Liquids, Gases, Metals and Metallic Compounds, Particulates and Fibers, Alkalies and Oxidizers, General Manufacturing Materials, Chemical Substitutes, Allergens, Carcinogens, Mutagens, Reproductive Hazards, Sensitizers and Teratogens, Recommended Chemical Exposure Limits. Physical Agents, Noise and Vibration, Temperature and Pressure, Carcinogenicity, Mutagenicity and Teratogenicity. Ergonomic Stresses:Stress-RelatedHealthIncidents,Eyestrain,RepetitiveMotion,LowerBackPain,VideoDisplay Terminals.

UNIT – IV **7 Hrs**

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT – V **7 Hrs**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components,
over hauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps,
iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Course Outcomes
After successful completion of this course the student will be able to:

CO1	Explain the Industrial and Occupational health and safety and its importance.
CO2	Demonstrate the exposure of different materials, occupational environment to which the employee can expose in the industries.
CO3	Characterize the different type materials, with respect to safety and health hazards of it.

CO4	Analyze the different processes with regards to safety and health and the maintenance required in the industries to avoid accidents.

Reference Books

1	Maintenance Engineering Handbook, Higgins & Morrow, SBN 10: 0070432015 / ISBN 13: 9780070432017, Published by McGraw-Hill Education. Da InformationServices.
2	H. P. Garg, Maintenance Engineering Principles, Practices & Management, 2009,S. Chand and Company, New Delhi, ISBN:9788121926447
3	Fundamental Principles of Occupational Health and Safety, Benjamin O. ALLI, Second edition,2008 International Labour Office – Geneva: ILO, ISBN 978-92-2-120454-1
4	Foundation Engineering Handbook, 2008, Winterkorn, Hans, Chapman & Hall London. ISBN:8788111925428.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
MODELING USING LINEAR PROGRAMMING (Global Elective-G03)						
Course Code	**:**	**18IM2G03**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**08 Hrs**
Linear Programming: Introduction to Linear Programming problem **Simplex methods:** Variants of Simplex Algorithm – Use of Artificial Variables	
Unit – II	**08 Hrs**
Advanced Linear Programming : Two Phase simplex techniques, Revised simplex method **Duality:** Primal-Dual relationships, Economic interpretation of duality	
Unit – III	**08 Hrs**
Sensitivity Analysis: Graphical sensitivity analysis, Algebraic sensitivity analysis - changes in RHS, Changes in objectives, Post optimal analysis - changes affecting feasibility and optimality	
Unit – IV	**08 Hrs**
Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems.	
Unit –V	**07 Hrs**
Assignment Problem: Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).	

Course Outcomes **After going through this course the student will be able to:**	
CO1	Explain the various Linear Programming models and their areas of application.
CO2	Formulate and solve problems using Linear Programming methods.
CO3	Develop models for real life problems using Linear Programming techniques.
CO4	Analyze solutions obtained through Linear Programming techniques.

Reference Books	
1	Operation Research An Introduction, Taha H A, 8th Edition, 2009, PHI, ISBN: 0130488089.
2	Principles of Operations Research – Theory and Practice, Philips, Ravindran and Solberg - John 2nd Edition, 2000, Wiley & Sons (Asia) Pvt Ltd, ISBN 13: 978-81-265-1256-0
3	Introduction to Operation Research, Hiller, Liberman, Nag, Basu, 9th Edition, 2012, Tata McGraw Hill ISBN 13: 978-0-07-133346-7
4	Operations Research Theory and Application, J K Sharma, 4th Edition, 2009, Pearson Education Pvt Ltd, ISBN 13: 978-0-23-063885-3.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project.

Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
PROJECT MANAGEMENT (Global Elective-G04)						
Course Code	**:**	**18IM2G04**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**08 Hrs**
Introduction: Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS), Introduction to Agile Methodology.	
Unit – II	**08 Hrs**
Capital Budgeting: Capital Investments: Importance and Difficulties, phases of capital budgeting, levels of decision making, facets of project analysis, feasibility study – a schematic diagram, objectives of capital budgeting	
Unit – III	**08 Hrs**
Project Costing: Cost of Project, Means of Finance, Cost of Production, Working Capital Requirement and its Financing, Profitability Projections, Projected Cash Flow Statement, Projected Balance Sheet, Multi-year Projections, Financial Modeling, Social Cost Benefit Analysis	
Unit – IV	**08Hrs**
Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Critical Path Method (CPM), Computerized project management	
Unit-V	**07 Hrs**
Project Management and Certification: An introduction to SEI, CMMI and project management institute USA – importance of the same for the industry and practitioners. PMBOK 6 - Introduction to Agile Methodology, Themes / Epics / Stories, Implementing Agile. **Domain Specific Case Studies on Project Management:** Case studies covering project planning, scheduling, use of tools & techniques, performance measurement.	

Course Outcomes
After going through this course the student will be able to:

CO1	Explain project planning activities that accurately forecast project costs, timelines, and quality.
CO2	Evaluate the budget and cost analysis of project feasibility.
CO3	Analyze the concepts, tools and techniques for managing projects.
CO4	Illustrate project management practices to meet the needs of Domain specific stakeholders from multiple sectors of the economy (i.e. consulting, government, arts, media, and charity organizations).

Reference Books

1	Project Planning Analysis Selection Financing Implementation & Review, Prasanna Chandra, 8th Edition, 2010, Tata McGraw Hill Publication, ISBN 0-07-007793-2.
2	A Guide to the Project Management Body of Knowledge (PMBOK Guide), Project Management Institute, 5th Edition, 2013, ISBN: 978-1-935589-67-9
3	Project Management A System approach to Planning Scheduling & Controlling, Harold Kerzner, 11th Edition, 2013, John Wiley & Sons Inc., ISBN 978-1-118-02227-6.
4	Project Management – Planning and Controlling Techniques, Rory Burke, 4th Edition, 2004, John Wiley & Sons, ISBN:9812-53-121-1

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
ENERGY MANAGEMENT (Global Elective-G05)						
Course Code	**:**	**18CH2G05**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEEMarks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**08 Hrs**
Energy conservation: Principles of energy conservation, Energy audit and types of energy audit, Energy conservation approaches, Cogeneration and types of cogeneration, Heat Exchangersandclassification.	
Unit-II	**08 Hrs**
Wet Biomass Gasifiers: Introduction, Classification of feedstock for biogas generation, Biomass conversion technologies: Wet and dry processes, Photosynthesis, Biogas generation, Factors affecting bio-digestion, Classification of biogas plants, Floating drum plant and fixed dome plant their advantages and disadvantages	
Unit –III	**08 Hrs**
Dry Biomass Gasifiers : Biomass energy conversion routes, Thermal gasification of biomass, Classification of gasifiers, Fixed bed systems: Construction and operation of up draught and down draught gasifiers.	
Unit –IV	**08Hrs**
Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, Types of solar cells and fabrication. **Wind Energy:** Classification, Factors influencing wind, WECS & classification.	
Unit –V	**07 Hrs**
Alternative liquid fuels: Introduction, Ethanol production: Raw materials, Pre-treatment, Conversion processes with detailed flow sheet. Gasification of wood: Detailed process, Gas purification and shift conversion, Biofuel from water hyacinth.	

Course Outcome
After going through this course, the students will be able to:

CO1	Understand the use alternate fuels for energy conversion
CO2	Develop a scheme for energy audit
CO3	Evaluate the factors affecting biomass energy conversion
CO4	Design a biogas plant for wet and dry feed

Reference Books

1	Nonconventional energy, Ashok V Desai, 5th Edition, 2011, New Age International (P) Limited, ISBN 13: 9788122402070.
2	Biogas Technology - A Practical Hand Book, KhandelwalK C and Mahdi S S, Vol. I & II, 1986, McGraw-Hill Education, ISBN-13: 978-0074517239.
3	Biomass Conversion and Technology, Charles Y Wereko-Brobby and Essel B Hagan,1stEdition, 1996, John Wiley & Sons, ISBN-13: 978-0471962465.
4	Solar Photovoltaics: Fundamental Applications and Technologies, C. S. Solanki, 2nd Edition, 2009, Prentice Hall of India, ISBN:9788120343863.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
INDUSTRY 4.0 (Global Elective-G06)						
Course Code	**:**	**18ME2G06**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**07 Hrs**
Introduction: Industrial, Internet, Case studies, Cloud and Fog, M2M Learning and Artificial Intelligence, AR, Industrial Internet Architecture Framework (IIAF), Data Management.	
Unit – II	**08 Hrs**
The Concept of the IIoT: Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, TCP/IP, API: A Technical Perspective, Middleware Architecture.	
Unit – III	**08 Hrs**
Data Analytics in Manufacturing: Introduction, Power Consumption in manufacturing, Anomaly Detection in Air Conditioning, Smart Remote Machinery Maintenance Systems with Komatsu, Quality Prediction in Steel Manufacturing. Internet of Things and New Value Proposition, Introduction, Internet of Things Examples, IoTs Value Creation Barriers: Standards, Security and Privacy Concerns. Advances in Robotics in the Era of Industry 4.0, Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics.	
Unit – IV	**08 Hrs**
Additive Manufacturing Technologies and Applications: Introduction, Additive Manufacturing (AM) Technologies, Stereo lithography, 3DP, Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing, Laser Engineered Net Shaping, Advantages of Additive Manufacturing, Disadvantages of Additive Manufacturing. Advances in Virtual Factory Research and Applications, The State of Art, The Virtual Factory Software , Limitations of the Commercial Software	
Unit –V	**08 Hrs**
Augmented Reality: The Role of Augmented Reality in the Age of Industry 4.0, Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Maintenance , Assembly, Collaborative Operations , Training. Smart Factories: Introduction, Smart factories in action, Importance, Real world smart factories, The wayforward. A Roadmap: Digital Transformation, Transforming Operational Processes, Business Models, Increase Operational Efficiency, Develop New Business Models.	

Course Outcomes
After going through this course the student will be able to:

CO1	Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals
CO2	Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services
CO3	Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits
CO4	Evaluate the effectiveness of Cloud Computing in a networked economy

Reference Books

1	Industry 4.0 the Industrial Internet of Things, Alasdair Gilchrist, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7
2	Industry 4.0: Managing The Digital Transformation, Alp Ustundag, EmreCevikcan, Springer, 2018 ISBN 978-3-319-57869-9.
3	Designingtheindustry - Internet of things connecting the physical, digital and virtual worlds, OvidiuVermesan and Peer Friess, Rivers Publishers, 2016 ISBN978-87-93379-81-7
4	The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Christoph Jan Bartodziej, Springer Gabler, 2017 ISBN 978-3-6581-6502-4.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
ADVANCED MATERIALS (Global Elective-G07)						
Course Code	**:**	**18ME2G07**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**07 Hrs**
Classification and Selection of Materials: Classification of materials. Properties required in Engineering materials, Criteria of selection of materials. Requirements / needs of advance materials.	
Unit – II	**08 Hrs**
Non Metallic Materials: Classification of n on metallic materials, Rubber: Properties, processing and applications. Plastics: Thermosetting and Thermoplastics, Applications and properties. Ceramics: Properties and applications. Adhesives: Properties and applications. Optical fibers: Properties and applications. Composites : Properties and applications.	
Unit – III	**08 Hrs**
High Strength Materials: Methods of strengthening of alloys, Materials available for high strength applications, Properties required for high strength materials, Applications of high strength materials	
Unit – IV	**08 Hrs**
Low & High Temperature Materials Properties required for low temperature applications, Materials available for low temperature applications, Requirements of materials for high temperature applications, Materials available for high temperature applications, Applications of low and high temperature materials.	
Unit –V	**08 Hrs**
Nanomaterials: Definition, Types of nanomaterials including carbon nanotubes and nanocomposites, Physical and mechanical properties, Applications of nanomaterials	

Course Outcomes
After going through this course the student will be able to:

CO1	Describe metallic and non metallic materials
CO2	Explain preparation of high strength Materials
CO3	Integrate knowledge of different types of advanced engineering Materials
CO4	Analyse problem and find appropriate solution for use of materials.

Reference Books

1	The Science & Engineering of Materials, Donald R. Askeland, and Pradeep P. Fulay, 5th Edition, Thomson, 2006, ISBN-13-978-0534553968
2	Nanotechnology, Gregory L. Timp, 1999th Editionmm Springer, 1999 ISBN-13: 978-0387983349
3	Material Science and Metallurgy, Dr. VD Kodgire and Dr. S V Kodgire, 42nd Edition 2018, Everest Publishing House ISBN NO: 81 86314 00 8
4	Processing and Fabrication of Advanced Materials, N Bhatnagar, T S Srivatsan, 2008, IK International, ISBN: 978819077702

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
COMPOSITE MATERIALS SCIENCE AND ENGINEERING (Global Elective-08)						
Course Code	**:**	**18CHY2G08**		**CIE Marks**	**:**	**100**
CreditsL:T:P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit-I — **08 Hrs**

Introduction to composite materials

Fundamentals of composites – need for composites – Enhancement of properties – Classification based on matrix- Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Constituents of composites, Interfaces and Interphases, Distribution of constituents, Types of Reinforcements, Particlereinforced
composites, Fibre reinforced composites. Fiber production techniques for glass, carbon and ceramic fibers Applications of various types of composites.

Unit – II — **08 Hrs**

Polymer matrix composites (PMC)

Polymer resins – Thermosetting resins, Thermoplastic resins & Elastomers,
Reinforcement fibres-Types, Rovings, Woven fabrics. PMC processes – Hand Layup Processes, Spray up processes – Compression Moulding – Injection Moulding – Resin Transfer Moulding – Pultrusion – Filament winding – Injection moulding. Glass fibre and carbon fibre reinforced composites (GFRP & CFRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Mechanical Testing of PMC- Tensile Strength, Flexural Strength, ILSS, Impact Strength- As per ASTM Standard. Applications of PMC in aerospace, automotive industries**.**

Unit -III — **08 Hrs**

Ceramic matrix composites and special composites

Engineering ceramic materials – properties – advantages – limitations – monolithicceramics
– need for CMC – ceramic matrix – various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – Aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering – Hot pressing – Cold Isostatic Pressing (CIPing) – Hot isostatic pressing (HIPing). Applications of CMC in aerospace, automotive industries- Carbon /carbon composites – advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol-gel technique- Processing of Ceramic Matrix composites.

Unit –IV — **07 Hrs**

Metal matrix composites

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder metallurgyprocess–diffusionbonding–stircasting–squeezecasting,asprayprocess,
Liquid infiltration In-situ reactions-Interface-measurement of interface properties- applications of MMC in aerospace, automotive industries.

Unit –V		08 Hrs
Polymer nano composites Introduction and Significance of polymer Nano composites. Intercalated And Exfoliated Nanocomposites. Classification of Nano fillers- nanolayers, nanotubes, nanoparticles. Preparation of Polymer Nano composites by Solution, In-situ Polymerization and melt mixing techniques. Characterization Of polymer nanocomposites- XRD, TEM, SEM and AFM. Mechanical and Rheological properties of Polymer Nano composites. Gas barrier,		
Chemical-Resistance, Thermal and Flame retardant properties of polymer nanocomposites. Optical properties and Biodegradability studies of Polymer nanocomposites, Applications of polymer nano-composites.		
Course Outcomes **After completing the course, the students will be able to:**		
CO1	Understand the purpose and the ways to develop new materials upon proper combination of known materials.	
CO2	Identify the basic constituents of a composite materials and list the choice ofmaterials available	
CO3	Will be capable of comparing/evaluating the relative merits of using alternatives forimportant engineering and other applications.	
CO4	Get insight to the possibility of replacing the existing macro materials with nano-materials	
Reference Books		
1	Composite Materials Science and Engineering, Krishan K Chawla, 3rd EditionSpri nger-verlag Gmbh,2012 , ISBN: 978-0387743646	
2	The Science and Engineering of Materials, K Balani, Donald R Askeland, 6thEdition- Cengage, Publishers,2013, ISBN: 13: 978-8131516416	
3	Polymer Science and Technology, Joel R Fried , 2nd Edition, Prentice Hall, 2014,ISBN: 13: 978-0137039555	
4	Nanomaterials and nanocomposites, Rajendra Kumar Goyal , 2nd Edition,CRCPress-Taylor & Francis, 2010, ISBN: 10-9781498761666, 1498761666	

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
PHYSICS OF MATERIALS (Global Elective-09)						
Course Code	**:**	**18PHY2G09**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **08 Hrs**

Crystal Structure

Discussion of lattice and lattice parameters, seven crystals systems, crystal planes, Miller indices, Interplanar distance, Packing fraction, Structure of different crystals-NaCl and Diamond, Bragg's law, Powder method, Bragg's spectrometer, Qualitative Analysis of Crystal structure using XRD, Reciprocal lattice, Crystal defects-Point, Line, Planar and Volume defects.

Unit – II **08 Hrs**

Dielectric Materials

Basic concepts, Langevin's Theory of Polarisation, Types of Polarisation, Dipolar relaxation, Frequency Dependence of total polarization (polarizability as a function of frequency), Qualitative discussion of Internal Field and ClaussiusMossotti, Dielectric loss spectrum, Dielectric strength, Dielectric Breakdown, Breakdown mechanisms in solid dielectrics, Applications of Solid Insulating materials in capacitors and Liquid insulating materials in Transformers, Dielectric Heating, Piezoelectricity, Direct and Inverse Piezoelectric effect, Coupling factor, spontaneous polarization, Piezolelectricty in Quartz, Various piezoelectric materials- PZT, PVDF, Ferroelectricity, Barium titanate, Poling in Ceramics.

Unit – III **08 Hrs**

Magnetic Materials

Review of Dia, Para and Ferromagnetic materials, Weiss theory of Ferromagnetism, Hysteresis effect, Magnetostriction, Anti-ferromagnetism, Ferrimagnetsim, Soft and Hard magnetic materials, examples and applications in Transformer cores and Magnetic storage devices, Superconductors, properties, Types of Superconductors, BCS theory, High Temperature Superconductors, Applications in Cryotron and SQUID.

Unit – IV **07 Hrs**

Semiconducting Materials

Semiconductors-Direct and Indirect band gap semiconductors, Importance of Quantum confinement-quantum wires and dots, size dependent properties, Top down approach, Fabrication process by MillingandLithography,Bottomupapproach,fabricationprocessbyvapourphaseexpansionand vapor phase condensation, Polymer semi-conductors-Photo conductive polymers, Applications.

Unit –V **08 Hrs**

Novel Materials

Smart materials-shape memory alloys, Austenite and Martensite phase, Effect of temperature and mechanical load on phase transformation, Pseudoeleasticity, Transformation hysteresis, Superelasticity, Characterization technique-Differntial Scanning calorimetry, Preparation technique-spin coating, Nitinol, CuAlNi alloy andapplications.

Biomaterials-Metallic, ceramic and polymer biomaterials, Titanium and Titanium alloys, Carbon nanotubes, Graphene- Properties and Applications.

Course Outcomes

After going through this course the student will be able to:

CO1	Apply the principles of Physics in Engineering.
CO2	Apply the knowledge of Physics for material analysis.
CO3	Identify and Analyze Engineering Problems to achieve practical solutions.
CO4	Develop solutions for Problems associated with Technologies.

Reference Books	
1	Solid State Physics, S O Pillai, 6th Edition, New Age International Publishers, ISBN10-8122436978.
2	Introduction to Solid State Physics, C.Kittel, 7th Edition, 2003, John Wiley & Sons, ISBN 9971-51-780
3	Engineering Physics, Dr.M N Avadhanulu, Dr. P G Kshirsagar, S Chand Publishing, Reprint 2015.
4	The Science and Engineering of Materials, Askeland, Fulay, Wright, Balanai, 6th Editi on, Cengage Learning, ISBN-13:978-0-495-66802-2.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : II						
ADVANCED STATISTICAL METHODS (Global Elective-G10)						
Course Code	**:**	**18MAT2G10**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**07 Hrs**
Sampling Techniques: Concepts of random sampling from finite and infinite populations, Simple random sampling (with replacement and without replacement), Sampling distribution of proportions, Expectation and standard error of sample mean and proportion, Sampling distributions ofdifferences and sums.	
Unit – II	**08 Hrs**
Estimation: Point estimation, Estimator and estimate, Criteria for good estimates - unbiasedness, consistency, efficiency and sufficiency, Method of moment's estimation and maximum likelihood estimation, Confidence intervals-population mean (large sample).	
Unit – III	**08 Hrs**
Tests of Hypothesis: Principles of Statistical Inference, Formulation of the problems with examples. Simple and composite hypotheses. Null and alternative hypotheses. Tests - type I and type II error, Testing of mean and variance of normal population (one sample and two samples), Exact and asymptotic tests of proportions. Chi squared test for goodness of fit (Relevant case studies).	
Unit – IV	**07 Hrs**
Linear Statistical Models: Definition of linear model and types, One way ANOVA and two way ANOVAmodels-oneobservationpercell,multiplebutequalnumberofobservationpercell(Relevant case studies).	
Unit –V	**09 Hrs**
Linear Regression: Simple linear regression, Estimation of parameters, Properties of least square estimators, Estimation of error variance, Multivariate data, Multiple linear regressions, Multiple and partial correlation, Autocorrelation-introduction and plausibility of serial dependence, sources of autocorrelation, Durbin-Watson test for auto correlated variables.	

Course Outcomes
After going through this course the student will be able to:

CO1	Identify and interpret the fundamental concepts of sampling techniques, estimates and types, hypothesis, linear statistical models and linear regression arising in various fields engineering.
CO2	Apply the knowledge and skills of simple random sampling, estimation, null and alternative hypotheses, errors, one way ANOVA, linear and multiple linear regressions.
CO3	Analyse the physical problem to establish statistical/mathematical model and use appropriate statistical methods to solve and optimize the solution.
CO4	Distinguish the overall mathematical knowledge gained to demonstrate the problems of sampling techniques, estimation, tests of hypothesis, regression and statistical model arising in many practical situations.

Reference Books

1.	Fundamentals of Statistics (Vol. I and Vol. II), A. M. Goon, M. K. Gupta and B. Dasgupta, 3rd Edition, 1968, World Press Private Limited, ISBN-13: 978-8187567806.
2.	Applied Statistics and Probability for Engineers, Douglas C. Montgomery and George C. Runger, 6th Edition, John Wiley & Sons, 2014, ISBN:13 9781118539712, ISBN (BRV):9781118645062.
3.	Fundamentals of Mathematical Statistic-A Modern Approach, S.C. Gupta and V.K. Kapoor, 10th Edition, 2000, S Chand Publications, ISBN: 81-7014-791-3.
4.	Regression Analysis: Concepts and Applications, F. A. Graybill and H. K. Iyer, Belmont, Calif, 1994, Duxbury Press, ISBN-13: 978-0534198695.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

Scheme of Semester End Examination (SEE) for 100 marks
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer on

SYLLABUS

FOR

SEMESTER III & IV

SEMESTER : III						
SOCIAL NETWORK ANALYSIS (Theory)						
Course Code	**:**	**18MSE31**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L+26T**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**10Hrs**

Social Network Analysis: History, Concepts, and Research: Introduction, SNA Definition and features, The Development of Social Network Analysis: A Brief History, Basic Concepts and Research of SNA: Design, Theorization, and Data Processing.

Social Network Analysis: What is network analysis? , Development of Social Network , Key concepts and measures in network analysis

Unit – II	**10Hrs**

Online Identities and Social Networking: Introduction , Background on Digital Identities, Putting Social Relations to Work, Social Digital Identity, Information and Threats in Social Networks

Discovering Sets of Key Players in Social Networks :

Information Theory in SNA, Methods for Discovering Sets of Key Players, Discovering Sets of Key Players Using Entropy Measures

Unit – III	**12Hrs**

Decentralized Online Social Networks: Introduction, Challenges for DOSN, The Case for Decentralizing OSNs, General Purpose DOSNs, Specialized Application Centric DOSNs, Delay-Tolerant DOSN

Understanding and Predicting Human Behaviour for Social Communities: Introduction, User Data Management, Inference and Distribution, Enabling New Human Experiences, The Social Enabler, Applications

Unit – IV	**10Hrs**

Security and Privacy in Online Social Networks: Introduction, Security Objectives: Privacy, Integrity, and Availability, Attack Spectrum and Countermeasures.

Optimizing Targeting of Intrusion Detection Systems in Social Networks: Introduction, Background, Epidemic Propagation in Social Networks.

Security Requirements for Social Networks: Introduction, Context, Threats, and Incidents, Two patterns

Unit – V	**10Hrs**

Visualization and applications of social networks :

Graph theory , Centrality , Clustering ,Node-Edge Diagrams , Matrix representation , Visualizing online social networks, Visualizing social networks with matrix-based representations , Matrix and Node-Link Diagrams, Hybrid representations , Applications ,Cover networks , Community welfare ,Collaboration networks , Co-Citation networks.

Course Outcomes

After successful completion of this course the student will be able to:

CO1: Comprehend basic notation, concepts and terminology used in network science.
CO2: Visualize, Analyze, summarize and compare different networks and its security.
CO3: Use relevant tools to analyze real world networks
CO4: Use advanced network analysis methods to perform empirical investigations of network data.

Reference Books:

1.	Social Networks and the Semantic Web, Peter Mika, First Edition, Springer. ISBN-13: 978-0-387-71000-6
2.	Handbook of Social Network Technologies and Applications, BorkoFurht, 1st Edition, , 2010,

	Springer, ISBN 978-1-4419-7141-8
3.	Computational Social Network Analysis- Trends, Tools and Research Advances, Ajith Abraham ,Aboul-Ella Hassanien, Springer, ISBN 978-1-84882-228-3
4.	Social Network Data Analytics, Charu C. Aggarwal, 2014, Springer; ISBN 978-1-4419-8462-3

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE(Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER: III						
INTERNSHIP						
Course Code	**:**	**18MSE32**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

1) The duration of the internship shall be for a period of 8 weeks on full time basis after II semester final exams and before the commencement of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization of the respective PG programme in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization : Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 -Activities of the Department
    - Chapter 3 - Tasks Performed : summaries the tasks performed during 8 week period
    - Chapter 4 – Reflections : Highlight specific technical and soft skills that you acquired during internship
    - References & Annexure

Course Outcomes

After going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments,	45%
Review-II	Importance of resource management, environment and sustainabilitypresentation skills and report writing	55%

Scheme for Semester End Evaluation (SEE):
The SEE examination shall be conducted by an external examiner (domain expert) and aninternal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

SEMESTER: III						
MAJOR PROJECT : PHASE-I						
Course Code	**:**	**18MSE33**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10**		**SEE Duration**	**:**	**3 Hours**

GUIDELINES

1. The Major Project work comprises of Phase-I and Phase-II. Phase-I is to be carried out in third semester and Phase-II in fourth semester.
2. The total duration of the Major project Phase-I shall be for 16 weeks.
3. Major project shall be carried out on individual student basis in his/her respective PG programme specialization. Interdisciplinary projects are also considered.
4. The allocation of the guides shall be preferably in accordance with the expertise of the faculty.
5. The project may be carried out on-campus/industry/organization with prior approval from Internal Guide, Associate Dean and Head of the Department.
6. Students have to complete Major Project Phase-I before starting Major Project Phase-II.
7. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes

After going through this course the students will be able to:

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation shall be carried out in tworeviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Selection of the topic, Literature Survey, Problem Formulationand Objectives	45%
Review-II	Methodology and Report writing	55%

Scheme for Semester End Evaluation (SEE):

Major Project Phase-I evaluation shall be done by an external examiner (domain expert) and respective guide as per the schedule. Maximum of four candidates per batch shall be allowed to take examination. The batches are to be formed based on specific domain of work.

SEMESTER: III						
MOBILE APPLICATION DEVELOPMENT (ProfessionalElective-E1)						
Course Code	**:**	**18MIT3E1**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**10Hrs**
Essentials For Mobile Application Development: Background about mobile technologies, Overview of Android, Android architecture, Android for mobile application development, Android development Framework – Android SDK, Emulators / Android AVD Android Project Framework , Setting up development environment, Running android app, Dalvik Virtual Machine & .apk file extension, android debug bridge. Fundamentals: Basic Building blocks - Activities, Services, Broadcast Receivers & Content providers, UI Components - Views & notifications, Components for communication -Intents & Intent Filters, Android API levels (versions & version names)	
Unit – II	**11Hrs**
Android UI Architecture & UI Widgets: Application context, Intents, Activity life cycle, Supporting different devices, multiple screen sizes, Fundamental Android UI design – Layouts, Drawable resources, UI widgets, Notification, Toasts, Menu, Dialogs, Lists & Adapters, Building dynamic UI with fragments.	
Unit – III	**11Hrs**
Data Storage, Services & Content Providers: Saving Data, Interacting with other Applications, Working with system permissions, Applications with content sharing, Shared Preferences, Preferences activity, Files access, SQLite database, Threads, Overview of services in Android, Implementing a Service, Service lifecycle, Inter Process Communication.	
Unit – IV	**10Hrs**
Advanced Android: Building apps with Multimedia, Building apps with Graphics & Animations, Building apps with Location Based Services and Google maps, Building apps with Connectivity & Cloud, Sensors, Bluetooth, Camera, Telephony Services.	
Unit – V	**12Hrs**
Testing, Debugging & Deployment of Android Application: Role and use of Dalvik Debug Monitor Server (DDMS), adb tool, How to debug Android application, Use of Step Filters, Breakpoints, Suspend and Resume, How to use LogCat, Preparing for publishing – Signing & Versioning of apps, Using Google Play to distribute & Monetize, Best practices for security & privacy.	

Course Outcomes

After successful completion of this course the student will be able to:

CO1:Comprehend the basic features of Android Platform and the Application Development Process. Acquire familiarity with basic building blocks of Android Application and its architecture.

CO2: Apply and explore the basic framework, usage of SDK to build apps incorporating Android features in developing mobile applications.

CO3: Demonstrate proficiency in coding on a mobile programming platform using advanced Android technologies like multimedia, involving the sensors and hardware features of the phone.

CO4: Demonstrate proficiency in testing, debugging and deployment of Android applications.

Reference Books

1.	Android Programming, Phillips, Stewart, Hardy and Marsicano, 2nd Edition, 2015; Big Nerd Ranch Guide; ISBN-13 978-0134171494
2.	Professional Android 2 Application Development; Reto Meier; 1stEdition; 2012;Wiley India Pvt.ltd; ISBN-13: 9788126525898
3.	Beginning Android 3; Mark Murphy; 1stEdition; 2011; A press Springer India Pvt Ltd. ; ISBN-13: 978-1-4302-3297-1
4.	Android Programming – Pushing the limits by Hellman; Eric Hellman; Wiley; 2013; ISBN 13: 978-1118717370

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER: III						
WEB INTELLIGENCE (ProfessionalElective-E2)						
Course Code	**:**	**18MSE3E2**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**12Hrs**
Introduction to Web Intelligence: What is Web Intelligence?, Benefits of Intelligent Web, Ingredients of Web Intelligence, Topics of Web Intelligence, Related Technologies. Information Retrieval: Document Representation, Retrieval Models, Evaluation of Retrieval Performance	
Unit – II	**10Hrs**
Semantic Web: The Layered-Language Model, Metadata and Ontologies, Ontology Languages for the Web. Data Mining Techniques: Classification and Association, Clustering	
Unit – III	**10Hrs**
Web Usage Mining: Web-Log Processing, Analyzing Web Logs, Applications of Web Usage Mining, Clustering of Web Users, Classification Modeling of Web Users, Association Mining of Web Usages, Sequence-Pattern Analysis of Web Logs	
Unit – IV	**10Hrs**
Web Content Mining: Web Crawlers, Search Engines, Personalization of Web Content, Multimedia Information Retrieval	
Unit – V	**10Hrs**
Web Structure Mining: Modeling Web Topology, PageRank Algorithm, Hyperlink-Induced Topic Search (HITS), Random Walks on the Web, Social Networks, Reference and Index Pages	

Course Outcomes

After successful completion of this course the student will be able to:

CO1:Inspect the models of information retrieval, semantic webs, search engines, and web mining.

CO2:Apply data mining tools to develop projects in web mining and information retrieval.

CO3:Gain the knowledge of fundamental concepts on knowledge representation and Ontological Engineering.

CO4:Apply of Web Intelligence on the Social Web

Reference Books:

1.	Building an Intelligent Web: Theory and Practice.Akerkar, R. &Lingras, P. (2008).Jones and Bartlett Publishers, Sudbury, Massachusetts. ISBN-13: 978-0-7637-4137-2
2.	Data Mining: Practical Machine Learning Tools and Techniques.Witten, Ian H. & Frank, E. 2nd Edition, 2005, Morgan Kaufman. ISBN 0120884070, 9780120884070
3.	Advanced Techniques in Web Intelligence – 1, Juan D.Vel´asquez and Lakhmi C. Jain (Eds.): Sep-2010, Springer.
4.	Evolution of the Web in Artificial Intelligence Environments, RichiNayak, NikhiIchalkaranje, Lakhmi C. Jain: 2008, Springer.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER: III						
NATURAL LANGUAGE PROCESSING (ProfessionalElective-E3)						
Course Code	**:**	**18MSE3E3**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **10Hrs**

Overview and Language Modeling
Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications -Information Retrieval. Language Modeling: Various Grammar- based Language Models - Statistical Language Model
Accessing Text Corpora Accessing Text Corpora, Conditional Frequency Distributions

Unit – II **10Hrs**

Processing Raw Text
Accessing Text from the Web and from Disk, Strings: Text Processing at the Lowest Level Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text ,Regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings

Unit – III **10Hrs**

Categorizing and Tagging Words
Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, How to Determine the Category of a Word
Learning to Classify Text
Supervised Classification, Further Examples of Supervised Classification, Evaluation, Decision Trees, Naive Bayes Classifiersand other machine Learning models.

Unit – IV **10Hrs**

Extracting Information from the text
Information Extraction, Chunking, Developing and Evaluating Chunkers, Recursion in Linguistic Structure, Named Entity Recognition, Term weighting, Inverse document frequency, Residual inverse document frequency
Analyzing Sentence Structure
Some Grammatical Dilemmas, What's the Use of Syntax?, Context-Free Grammar, Parsing with Context-Free Grammar, Dependencies and Dependency Grammar, Grammar Development.

Unit – V **12Hrs**

Analyzing the Meaning of words and Sentences
The semantics of English sentences, Representing Meaning, Semantic Analysis, Lexical semantics, Word-sense disambiguation, Supervised – Dictionary based and Unsupervised Approaches, Compositional semantics, Semantic Role Labelling and Semantic ParsingApplications of NLP- Spell-checking, Summarization
Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries.Machine Translation– Overview.

Course Outcomes
After successful completion of this course the student will be able to:
CO1:Understand the approaches to syntax and semantics in Natural Language Processing, the various types of language processors, the elements of formal language theory, the types of grammar, and the computational morphology.
CO2:Understand the basic parsing technique for context-free grammars, the data structures and algorithms for parsing, and the approaches to ambiguity resolution.
CO3:Apply the fundamental algorithms and techniques in the area of Natural Language Processing.
CO4:Comprehend and compare different natural language models.

Reference Books	
1.	Artificial Intelligence (SIE), Kevin Night and Elaine Rich, Nair B., McGraw Hill- 2008
2.	Introduction to AI and ES, Dan W. Patterson, 2007, Pearson Education
3.	Introduction to Expert Systems, Peter Jackson, 3rd Edition, 2007, Pearson Education
4.	Artificial Intelligence, Deepak Khemani ,Tata McGraw Hill Education 2013

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER: IV						
MAJOR PROJECT : PHASE-II						
Course Code	**:**	**18MSE41**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:20**		**SEE Marks**	**:**	**100**
Hours/Week	**:**	**40**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

1. Major Project Phase-II is continuation of Phase-I.
2. The duration of the Phase-II shall be of 16 weeks.
3. The student needs to complete the project work in terms of methodology, algorithm development, experimentation, testing and analysis of results.
4. It is mandatory for the student to present/publish the work in National/International conferences or Journals
5. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes:

After going through this course the students will be able to:

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation shall be carried out in threereviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Review and refinement of Objectives, Methodology and Implementation	20%
Review-II	Design, Implementation and Testing	40%
Review-III	Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication	40%

Scheme for Semester End Evaluation (SEE):

Major Project Phase-II SEE shall be conducted in two stages. This is initiated after fulfilment of submission of project report and CIE marks.

Stage-1Report Evaluation

Evaluation of Project Report shall be done by guide and an external examiner.

Stage-2Project Viva-voce

Major Project Viva-voce examination is conducted after receipt of evaluation reports from guide and external examiner.

Both Stage-1 and Stage-2 evaluations shall be completed as per the evaluation formats.

SEE procedure is as follows:

	Internal Guide	**External Examiner**	**TOTAL**	
SEE Report Evaluation	100 marks	100 marks		200 marks
			(A)	(200/2) = 100 marks
Viva-Voce	Jointly evaluated by Internal Guide & External Evaluator		(B)	100 marks
			Total Marks	**[(A)+(B)]/2 = 100**

SEMESTER: IV						
TECHNICAL SEMINAR						
Course Code	**:**	**18MSE42**		**CIE Marks**	**:**	**50**
Credits L:T:P	**:**	**0:0:2**		**SEE Marks**	**:**	**50**
Hours/Week	**:**	**4**		**SEE Duration**	**:**	**30 Mins**

GUIDELINES

1) The presentation shall be done by individual students.
2) The seminar topic shall be in the thrust areas of respective PG programs
3) The seminar topic could be complementary to the major project work
4) The student shall bring out the technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation along with the report.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes

After going through this course the student will be able to:

CO1: Identify topics that are relevant to the present context of the world
CO2: Perform survey and review relevant information to the field of study.
CO3: Enhance presentation skills and report writing skills.
CO4: Develop alternative solutions which are sustainable

Scheme of Continuous Internal Evaluation (CIE): Evaluation shall be carried out in two reviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Selection of Topic, Review of literature, Technical Relevance, Sustainability and Societal Concerns, Presentation Skills	45%
Review-II	Technological Developments, Key Competitors, Report writing	55%

Scheme for Semester End Evaluation (SEE):

The SEE examination shall be conducted by an external examiner and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.