RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

R.V. Vidyaniketan Post, Mysore Road

Bengaluru – 560 059

Scheme and Syllabus of I & II Semesters

(Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)

in

SOFTWARE ENGINEERING

DEPARTMENT OF

INFORMATION SCIENCE & ENGINEERING

INNER FRONT COVER PAGE

College Vision & Mission
(To be included from our side)

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INFORMATION SCIENCE & ENGINEERING

Department Vision & Mission

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.

PROGRAM OUTCOMES

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.

PROFESSIONAL SOCIETY

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

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	CE	Professional Core 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.	PHY	Physics
21.	CHY	Chemistry
22.	MAT	Mathematics

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R V COLLEGE OF ENGINEERNG, BENGALURU-560 059
(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

M.Tech in SOFTWARE ENGINEERING

FIRST SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Total 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							

SECOND SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Total 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							

I Semester		
GROUP A: CORE 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: CORE ELECTIVES		
1.	18 MSE 1B1	Fault Tolerant System
2.	18 MIT 1B2	Enterprise Application Development
3.	18 MSE 1B3	Artificial Neural Networks
II Semester		
GROUP C: CORE ELECTIVES		
1.	18 MSE 2C1	Metrics And Models For Software Engineering
2.	18MCS 2C2	Machine Learning
3.	18 MIT 2C3	Computer System Performance & Analysis
GROUP D: CORE ELECTIVES		
1.	18 MSE 2D1	Data Engineering
2.	18 MSE 2D2	Agile Technologies
3.	18 MSE 2D3	Software Project Management

GROUP E: 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.	CHY	18CHY2G08	Composite Materials Science and Engineering	3
9.	PHY	18PHY2G09	Physics of Materials	3
10.	MAT	18MAT2G10	Advanced Statistical Methods	3

I Semester				
PROBABILITY THEORY AND LINEAR ALGEBRA (Common to MCN, MCS, MDC, MCE, MRM, MIT, MSE)				
Course Code: 18MAT11B		**CIE Marks**	**:**	**100**
Credits: L:T:P :4: 0:0		**SEE Marks**	**:**	**100**
Hours : 47		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

The students will be able to:

1. Understand the basics of Probability theory and Linear Algebra.
2. Develop probability models for solving real world problems in engineering applications.
3. Apply standard probability distributions to fit practical situations.
4. Compute the characteristic polynomial, Eigen values and Eigen vectors and use them in applications.
5. Diagonalize and orthogonally diagonalize symmetric matrices.

Unit – I	**9 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	**9 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	**10 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	**10 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	**9 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.

Expected Course Outcomes:

After completion of the course, the students should have acquired the ability 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, Gilbert Strang, 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 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 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.

Advanced Data Structures and Algorithms (Theory and Practice)		
Course Code:18MSE12		**CIE Marks: 100 + 50**
Credits: L:T:P:4:0:1		**SEE Marks: 100 + 50**
Hours: 45L		**SEE Duration: 3Hrs**

Course Learning Objectives:

	Graduates shall be able to:
1	Understand the implementation, complexity analysis and applications of advanced data structures.
2	Analyze various algorithms for efficiency.
3	Develop mathematical skills for algorithm design, analysis, and evaluation
4	Design and implement efficient solutions to various real world problems through algorithms.

Unit-I	**09 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	**09 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	**09 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	**09 Hrs**
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	**09 Hrs**
Probabilistic and Randomized Algorithms: Probabilistic algorithms, Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms, Probabilistic numeric algorithms.	

Laboratory Component:

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, 2002 Pearson Education India, , ISBN: 8177588265, 9788177588262.
3	The Algorithm Design Manual, Steven S Skiena, 2008, Springer, ISBN: 9781848000704, 9781848000698.
4.	Introduction to algorithms, Cormen, Thomas H., Leiserson, Charles E., Rivest, Ronald L. and Clifford Stein – 3rd Edition, 2009,MIT Press, ISBN-13: 978-0262033848.

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

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. The marks component for each assignment is 15 marks. **Total CIE is 20+50+30=100 Marks.**

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.

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

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.

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: 45L		**SEE Duration: 3Hrs**

Course Learning Objectives:	
	Students shall be able to:
1	Understand of the underlying Important Issues of Software Quality.
2	Gain an advanced knowledge of a range of testing approaches and tools.
3	Develop an effective and systematic software testing technique for specialized technologies like object-oriented software and web-based software etc.
4	Understand the need of automated testing tools and various kinds of automated testing tools.

Unit-I	**09 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	**09 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	**09Hrs**
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	**09 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	**09 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.

Expected 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, Ksheerasagar Naik and Priyadarshi Tripathy, 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

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.

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

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. The marks component for each assignment is 15 marks. **Total CIE is 20+50+30=100 Marks.**

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.

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

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: I						
PROFESSIONAL SKILL DEVELOPMENT (Common to all Programs)						
Course Code	**:**	**18HSS14**		**CIE Marks**	**:**	**50**
Credits:L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**Audit Course**
Hours	**:**	**18L**				

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	**02 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

Scheme of Continuous Internal Examination (CIE)

Evaluation of CIE will be carried out in TWO Phases.

Phase	**Activity**
I	After 9 hours of training program, 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	Similarly students will have to take up another test after the completion 18 hours of training. 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%. Needless to say the attendance requirement will be the same as in any other course.	

Semester: I		
Service Oriented Architecture (Group A : Core Elective)		
Course Code: I8MSE1A1		**CIE Marks: 100**
Credits: L:T:P :3: 1:0		**SEE Marks: 100**
Hours: 36L+12T		**SEE Duration: 3Hrs**

Course Learning Objectives:	
	Graduates shall be able to:
1	Comprehend the need for SOA and its evolution.
2	Explore various patterns of service design and techniques.
3	Formulate experiments with various levels and factors.
4	Demonstrate applicability of SOA in various domains.

Unit-I	**09 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	**09 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	**09 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	**09 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	**09 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.	

Expected 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; 2018; Wiley; 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

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100

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 (Group A : Core Elective)		
Course Code: 18MIT1A2		**CIE Marks: 100**
Credits: L:T:P :3:1:0		**SEE Marks: 100**
Hours: 36L+12T		**SEE Duration: 3Hrs**

Course Learning Objectives:	
	Graduates shall be able to:
1	Explore the various Information Retrieval Techniques such as document indexing and retrieval, query processing, recommender systems, etc.
2	Extract relevant information from large collection of unstructured data or documents.
3	Evaluation of Information retrieval methods
4	Analyze performance of textual document indexing, relevance ranking, web search, etc

Unit-I	**10 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	**09 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	**10 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	**09 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	10 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.	

Expected 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, Prabhakar Raghavan, Hinrich Schütze:, 2008, Cambridge University Press, England, ISBN 13: 9780521865715.
2.	Statistical Language Models for Information Retrieval, ChengXiang Zhai, , 2009, Morgan & Claypool Publishers,ISBN: 9781598295900
3.	Modern Information Retrieval, Ricardo Baeza-Yates, Berthier Ribeiro-Neto, 2009, Addison Wesley Longman Publishing Co. Inc, ISBN-10: 0321416910.
4.	Information Retrieval Data Structures and Algorithms; William B. Frakes, Ricardo Baeza-Yates; First Edition; 2012;Pearson Education Limited; ISBN-9788131716922.

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100

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		
Software Architecture (Group A : Core Elective)		
Course Code: 18MSE1A3		**CIE Marks: 100**
Credits: L:T:P :3:1:0		**SEE Marks: 100**
Hours: 36L+12T		**SEE Duration: 3Hrs**

Course Learning Objectives:	
	Students shall be able to:
1	To understand Architectural drivers.
2	To study about Quality Attribute workshop.
3	To develop Architectural views and styles.
4	To learn the documentation of architecture.

Unit-I	**09 Hrs**
Introduction and architectural drivers: Introduction – What is software architecture? – Standard Definitions – Architectural structures – Influence of software architecture on organization-both business and technical – Architecture Business Cycle- Introduction – Functional requirements – Technical constraints – Quality Attributes	
Unit – II	**09 Hrs**
Quality attribute workshop: Quality Attribute Workshop – Documenting Quality Attributes – Six part scenarios – Case studies.	
Unit -III	**09 Hrs**
Architectural views: Introduction – Standard Definitions for views – Structures and views - Representing views-available notations – Standard views – 4+1 view of RUP, Siemens 4 views, SEI's perspectives and views – Case studies	
Unit –IV	**09 Hrs**
Architectural styles: Introduction – Data flow styles – Call-return styles – Shared Information styles - Event styles – Case studies for each style	
Unit –V	**09 Hrs**
Documenting the architecture: Good practices – Documenting the Views using UML – Merits and Demerits of using visual languages – Need for formal languages - Architectural Description Languages – ACME – Case studies. Special topics: SOA and Web services – Cloud Computing – Adaptive structures	

Expected Course Outcomes: After going through this course, the students will be able to	
CO1:	Ability to understand the software architectural requirements, drivers and to explain about the influence of software architecture on business and technical activities.
CO2:	Able to analyze the quality attribute workshop and to apply the concept to prepare the documentation on quality attribute.
CO3:	Ability to understand, identify the key architectural structures and to use the views to specify architecture.
CO4:	Ability to use & evaluate the styles to specify architecture.

Reference Books	
1.	Software Architectures Principles and Practices", Len Bass, Paul Clements, and Rick Kazman, 2nd Edition, 2003,Addison-Wesley,. ISBN : 0321154959
2.	Architecting Software Intensive System. A Practitioner's Guide", Anthony J Lattanze, 2010, Auerbach Publications, 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, 2010. Addison- Wesley, ISBN: 0321552687.
4.	Cloud Computing. Principles and Paradigms, Rajkumar Buyya, James Broberg, and Andrzej Goscinski, 2011, John Wiley & Sons, ISBN 978-0-470-88799-8.

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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 Systems (Group B : Core Elective)		
Course Code: 18MSE1B1		**CIE Marks: 100**
Credits: L:T:P :4:0:0		**SEE Marks: 100**
Hours: 45L		**SEE Duration: 3Hrs**

Course Learning Objectives:	
	Students shall be able to:
1	Understand the differences between fault, error and failure. Discuss the process by which a fault eventually causes a system failure. Understand the link between fault model and the corresponding dependability mechanisms. Introduction of terms such as fail-safe, fail-operational, fail-stop, etc. Concepts such as fault tree, FMECA, FMEA, etc.
2	HW/System: Calculate reliability of a system. Use of tools for reliability modelling. Design of dependable HW.
3	Middleware: Understand critical functions such as clock synchronization, consensus, FDIR protocols, etc. Understand Byzantine failures and its impact on system complexity. Introduction to asynchronous message-passing distributed systems.
4	SW: Understand the various methods for SW fault tolerance. NVP, recovery blocks, run-time checks, problem of predicate detection.

Unit-I	**09 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	**09 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	**09 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	**09 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	**09 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.	

Expected Course Outcomes: 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, 2006, Spirnger, 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, Yuanqing Xia, 2014,john wiley & sons, ,ISBN : 978-1-118-54133-3.

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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 (Group B : Core Elective)		
Course Code: 18MIT1B2		**CIE Marks: 100**
Credits: L:T:P :4:0:0		**SEE Marks: 100**
Hours: 45L		**SEE Duration: 3Hrs**

Course Learning Objectives:

	Students shall be able to:
1	Understand the outline of Enterprise application development architecture.
2	Comprehend mapping and concurrency process of Enterprise application development.
3	Identify appropriate design methodology to construct enterprise applications to solve a problem.
4	Obtain overview of planning of configuration, package structure and layers of enterprise applications.

Unit-I	**09 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	**09 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	**09 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	**09 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	**09 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.	

Expected Course Outcomes: 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, Veerakumar Esakimuthu Anubhav 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 Pallab Saha, 2013, ISBN:9781466645189,

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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		
Artificial Neural Networks (Group B : Core Elective)		
Course Code: 18 MSE 1B3		**CIE Marks: 100**
Credits: L:T:P :4:0:0		**SEE Marks: 100**
Hours: 45L		**SEE Duration: 3Hrs**

Course Learning Objectives:	
	Students shall be able to:
1	Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.
2	Perform computation for dynamical systems using neural networks.
3	Explain mechanisms of supervised/unsupervised learning from data and information processing in different ANN architectures.
4	Acquire the ANN practitioner's competence to apply and develop ANN based solutions to data analytics problem.

Unit-I	**09 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	**09 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	**09 Hrs**
Radial Basis Function Networks : Training Process of the RBF Network, Applications of RBF Networks, **Recurrent Hopfield Networks**, **Self-Organizing Kohonen Networks**	
Unit –IV	**09 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	

Expected Course Outcomes: 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, 2017, Springer, 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, 2006, Prentice Hall, ISBN: 978-981-4522-74-8.

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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		
Cyber Security and Digital Forensics (Theory & Practice)		
Course Code: 18MSE21		**CIE Marks: 100 + 50**
Credits: L:T:P : 4:0:1		**SEE Marks: 100 + 50**
Hours: 48L		**SEE Duration: 3 Hrs**

Course Learning Objectives:	
	Graduates shall be able to:
1	Understand the fundamentals of cybercrime and forensics and assess the security policies of organizations.
2	Demonstrate and investigate the use of tools used in digital forensics for investigations.
3	Analyze the different types of forensics and describe its legal challenges.
4	Investigate both criminal and civil matters using evolving digital technology.

Unit-I	**10 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	**09 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	**10 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	**10 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	**09 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
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

Expected Course Outcomes: 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, Sunit Belapure and Nina Godbole, Wiley India Pvt Ltd, ISBN: 978-81-265-21791, 2013.
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.

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

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. The marks component for each assignment is 15 marks. **Total CIE is 20+50+30=100 Marks.**

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.

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

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: II		
Human Computer Interaction (Theory)		
Course Code: 18MSE22		**CIE Marks: 100**
Credits: L:T:P :3:1:0		**SEE Marks: 100**
Hours:36L+12T		**SEE Duration: 3**

Course Learning Objectives:	
	Graduates shall be able to:
1	Demonstrate knowledge of human computer interaction design concepts and related methodologies.
2	Recognize theories and concepts associated with effective user interface design to real-world application.
3	Improve quality and usability of the design, and will understand the theory behind by making use of necessary interfaces.
4	Conceptualize, design and evaluate interactive products systematically.

Unit-I	**09 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	**09 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	**09 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	**09 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	**09 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.	

Expected Course Outcomes: 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, 2016, Pearson Publications, ISBN: 9780123822291.
2.	The essential guide to user interface design, Wilbert O Galitz, 3rd Edition , 2007,Wiley, 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, 2011, Wiley, ISBN: 978-1-119-02075-2.

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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	**:**	**36**		**SEE Duration**	**:**	**3 hours**

Unit – I	
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.	**07 Hrs**
Unit – II	
Data and data collection: Overview of probability and data types Primary 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	**08 Hrs**
Unit – III	
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	**07 Hrs**
Unit – IV	
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.	**07 Hrs**
Unit-V	
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	**07 Hrs**

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	Kothari C.R., Research Methodology Methods and techniques by, New Age International Publishers, 4th edition, ISBN: 978-93-86649-22-5
2	Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., Management Research Methodology, Pearson Education: New Delhi, 2006. ISBN: 978-81-77585-63-6
3	William M. K. Trochim, James P. Donnelly, The Research Methods Knowledge Base, 3rd Edition, Atomic Dog Publishing, 2006. ISBN: 978-1592602919
4	Levin, R.I. and Rubin, D.S., Statistics for Management, 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 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 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	**:**	**18MSE24**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**0:0:4**		**SEE Marks**	**:**	**100**
Credits	**:**	**02**		**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 Outcomes: After completing the 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 (Group C : Core Elective)		
Course Code: 18MSE2C1		**CIE Marks: 100**
Credits: L:T:P :4:0:0		**SEE Marks: 100**
Hours: 45L		**SEE Duration: 3**

Course Learning Objectives:	
	Graduates shall be able to:
1	Comprehend the need for measurement of software artefacts.
2	Explore various software quality metrics and tools in software development.
3	Articulate models for software management.
4	Demonstrate metrics and lessons learned for object-oriented projects.

Unit-I	**09 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	**09 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	**09 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	**09 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	**09 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.	

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

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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 **(Group C: Core Elective)** **Common to VLSI, CS, CNE, DCE, BMI, MSE**						
Course Code	**:**	**18MCS2C2**		**CIE Marks**	**:**	**100**
Credits: L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	48L		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**9 Hrs**
Introduction: Overview of Probability 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	**10 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	**10 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	**10 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	**9Hrs**
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	
Expected 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

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100

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 (Group C : Core Elective)		
Course Code: 18MIT2C3		**CIE Marks: 100**
Credits: L:T:P :4:0:0		**SEE Marks: 100**
Hours: 45L		**SEE Duration: 3**

Course Learning Objectives:	
	Graduates shall be able to:
1	Comprehend the need for performance evaluation and its systematic approach.
2	Explore various types of monitoring and capacity planning techniques.
3	Formulate experiments with various levels and factors.
4	Demonstrate working of various queues, their representations and rules.

Unit-I	**09 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	**09 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	**09 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	**09 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	**09 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.	

Expected Course Outcomes: 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; 2005,Cambridge University Press, ISBN: 9781107439863.
2.	The Art of Computer Systems Performance Analysis; Raj Jain; 2008, John Wiley; ISBN: 8126519053.
3	Probability and Statistics with Reliability, Queuing and Computer Science Applications; Trivedi K S, Kishor S. Trivedi; 2nd Edition; 2008, John Wiley; ISBN: 978-0-471-33341-8.
4.	Research Methodology; R. Panneerselvam; 2004, Prentice Hall; ISBN - 9788120324527.

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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 **(Group D : Core Elective)**		
Course Code: 18MSE2D1		**CIE Marks: 100**
Credits: L:T:P :4:0:0		**SEE Marks: 100**
Hours: 40L		**SEE Duration: 3**

Course Learning Objectives:	
	Students shall be able to:
1	Define parallel and distributed databases and its applications.
2	Show applications of Object Oriented database
3	Explain basic concepts, principles of intelligent databases.
4	Utilize the advanced topics of data warehousing and mining .

Unit-I	**08 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	**07 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	**08 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	**07 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.	

Expected Course Outcomes: 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, 2013,McGraw-Hill.
3	Data Mining – Concepts and Techniques; Jiawei Han and Micheline Kamber; 3rd Edition; 2011, Morgan Kaufmann Publishers Inc, ISBN 9789380931913.
4.	Database Systems: A Practical Approach to Design, Implementation, and Management, Thomas Connolly , Carolyn Begg , 6th Edition, Pearson Publications, ISBN- 9780134410951.

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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 **(Group D : Core Elective)**		
Course Code: 18MSE2D2		**CIE Marks: 100**
Credits: L:T:P :4:0:0		**SEE Marks: 100**
Hours: 42L		**SEE Duration: 3**

Course Learning Objectives:	
	Students shall be able to:
1	To understand how an iterative, incremental development process leads to faster delivery of more useful software
2	To understand the essence of agile development methods.
3	To understand the principles and practices of extreme programming .
4	To understand the roles of prototyping in the software process.

Unit-I	**10 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	**08 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	**08 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	**07 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	**09 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.	

Expected 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, 2007, Shroff Publishers & Distributors,
2.	Agile and Iterative Development A Manger's Guide, Craig Larman , First Edition, India, 2004, Pearson Education,
3	The Good, the Hype and the Ugly, Meyer, B., Agile!:, 1st Edition, 2014, Springer. 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 .

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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 (Group D : Core Elective)		
Course Code: 18MSE2D3		**CIE Marks: 100**
Credits: L:T:P : 4:0:0		**SEE Marks: 100**
Hours: 46L		**SEE Duration: 3**

Course Learning Objectives:	
	Graduates shall be able to:
1	To define and highlight importance of software project management .
2	To formulate strategy in managing projects.
3	To estimate the cost associated with a project.
4	To plan, schedule and monitor projects for the risk management.

Unit-I	**10 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	**09 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	**09 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	09 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	**09 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?	

Expected Course Outcomes: 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, 2002, Pearson Education, New Delhi, ISBN- 9788177583304.
3	Software Project Management in practice, Pankaj Jalote, 2002, Pearson Education, New Delhi, 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.

Continuous Internal Evaluation (CIE): Total marks: 100

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 is 20+50+30=100 Marks.**

Semester End Evaluation (SEE): Total marks: 100
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 (Group G: Global Elective)						
Course Code	**:**	**18CS2G01**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**36L**		**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives:

Graduates shall be able to

1. Formulate and solve business problems to support managerial decision making.
2. Explore the concepts, processes needed to develop, report, and analyze business data.
3. Use data mining techniques concepts to identify specific patterns in the data
4. Interpret data appropriately and solve problems from various sectors such as manufacturing, service, retail, software, banking and finance.

Unit – I	
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.	**07 Hrs**
Unit – II	
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	**07 Hrs**
Unit – III	
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.	**07 Hrs**
Unit – IV	
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.	**08 Hrs**
Unit –V	
Decision Analysis: Formulating Decision Problems, Decision Strategies with and without Outcome, Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	**07 Hrs**

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

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

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 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 (Group G :Global Elective)		
Course Code: 18CV 2G 02		**CIE Marks:100**
Credits : L: T: P : 3:0:0		**SEE Marks :100**
Hours : 36L		**SEE Duration:3Hrs**

Course Learning Objectives :

1	To understand the Industrial and Occupational health and safety and its importance.
2	To understand the different materials, occupations to which the employee can exposed to.
3	To know the characteristics of materials and effect on health.
4	To evaluate the different processes and maintenance required in the industries to avoid accidents.

UNIT – I **7Hrs**

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 **7Hrs**

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 **8Hrs**

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-Related Health Incidents, Eyestrain, Repetitive Motion, Lower Back Pain, Video Display Terminals.

UNIT – IV **7Hrs**

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 **7Hrs**

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.

Expected 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 Information Services.
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.

Continuous Internal Evaluation (CIE): Total marks: 100
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 is 20+50+30=100 Marks.

Semester End Evaluation (SEE): Total marks: 100
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 (Group G: Global Elective)						
Course Code	**:**	**18IM2G03**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**36L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Linear Programming: Introduction to Linear Programming problem **Simplex methods:** Variants of Simplex Algorithm – Use of Artificial Variables	**07 Hrs**
Unit – II	
Advanced Linear Programming : Two Phase simplex techniques, Revised simplex method **Duality:** Primal-Dual relationships, Economic interpretation of duality	**07 Hrs**
Unit – III	
Sensitivity Analysis: Graphical sensitivity analysis, Algebraic sensitivity analysis - changes in RHS, Changes in objectives, Post optimal analysis - changes affecting feasibility and optimality	**07 Hrs**
Unit – IV	
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.	**08 Hrs**
Unit –V	
Assignment Problem: Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).	**07 Hrs**

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	Taha H A, Operation Research An Introduction, PHI, 8th Edition, 2009, ISBN: 0130488089.
2	Philips, Ravindran and Solberg - Principles of Operations Research – Theory and Practice, John Wiley & Sons (Asia) Pvt Ltd, 2nd Edition, 2000, ISBN 13: 978-81-265-1256-0
3	Hiller, Liberman, Nag, Basu, Introduction to Operation Research, Tata McGraw Hill 9th Edition, 2012, ISBN 13: 978-0-07-133346-7
4	J K Sharma, Operations Research Theory and Application, Pearson Education Pvt Ltd, 4th Edition, 2009, 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 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 (Group G: Global Elective)						
Course Code	**:**	**18IM2G04**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**36L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
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.	**07 Hrs**
Unit – II	
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	**07 Hrs**
Unit – III	
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	**08 Hrs**
Unit – IV	
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	**07Hrs**
Unit-V	
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.	**07 Hrs**

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	Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 8th Edition, 2010, ISBN 0-07-007793-2.
2	Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide), 5th Edition, 2013, ISBN: 978-1-935589-67-9

3	Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
4	Rory Burke, Project Management – Planning and Controlling Techniques, John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

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 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.

II Semester		
ENERGY MANAGEMENT (Group G: Global Elective)		
Course Code: 18CH2G05		**CIE Marks: 100**
Credits: L:T:P: 3:0:0		**SEE Marks: 100**
Hours: 36L		**SEE Hrs: 3**

Course Learning Objectives(CLO):

Students are able to:

1. Explain the importance of energy conservation and energy audit.
2. Understand basic principles of renewable sources of energy and technologies.
3. Outline utilization of renewable energy sources for both domestics and industrial application.
4. Analyse the environmental aspects of renewable energy resources.

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 Exchangers and classification.	
Unit-II	**07 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	**07 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	**07 Hrs**
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 outcomes (CO):	
On completion of the course, the student should have acquired the ability 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, Khandelwal K 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, 1st Edition, 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):
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 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 (Group G: Global Elective)						
Course Code	**:**	**18ME2G06**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**36L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Introduction: Industrial, Internet, Case studies, Cloud and Fog, M2M Learning and Artificial Intelligence, AR, Industrial Internet Architecture Framework (IIAF), Data Management.	**07 Hrs**
Unit – II	
The Concept of the IIoT: Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, TCP/IP, API: A Technical Perspective, Middleware Architecture.	**07 Hrs**
Unit – III	
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.	**08 Hrs**
Unit – IV	
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	**07 Hrs**
Unit –V	
Augmented Reality: The Role of Augmented Reality in the Age of Industry 4.0, Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Maintenance , Assembly, Collaborative Operations , Training. Smart Factories: Introduction, Smart factories in action, Importance, Real world smart factories, The way forward. A Roadmap: Digital Transformation, Transforming Operational Processes, Business Models, Increase Operational Efficiency, Develop New Business Models.	**07 Hrs**

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	Alasdair Gilchrist, INDUSTRY 4.0 THE INDUSTRIAL INTERNET OF THINGS, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7
2	Alp Ustundag, Emre Cevikcan, Industry 4.0: Managing The Digital Transformation, Springer, 2018 ISBN 978-3-319-57869-9.
3	Ovidiu Vermesan and Peer Friess, Designing the industry - Internet of things connecting the physical, digital and virtual worlds, Rivers Publishers, 2016 ISBN 978-87-93379-81-7
4	Christoph Jan Bartodziej, The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, 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 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 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 (Group G: Global Elective)						
Course Code	**:**	**18ME2G07**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**36L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Classification and Selection of Materials: Classification of materials. Properties required in Engineering materials, Criteria of selection of materials. Requirements / needs of advance materials.	**07 Hrs**
Unit – II	
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.	**07 Hrs**
Unit – III	
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	**08 Hrs**
Unit – IV	
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.	**07 Hrs**
Unit –V	
Nanomaterials: Definition, Types of nanomaterials including carbon nanotubes and nanocomposites, Physical and mechanical properties, Applications of nanomaterials	**07 Hrs**

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	Donald R. Askeland, and Pradeep P. Fulay, The Science & Engineering of Materials, 5th Edition, Thomson, 2006, ISBN-13-978-0534553968
2	Gregory L. Timp, Nanotechnologym 1999th Editionmm Springer, 1999 ISBN-13: 978-0387983349
3	Dr. VD Kodgire and Dr. S V Kodgire, Material Science and Metallurgym 42nd Edition 2018, Everest Publishing House ISBN NO: 81 86314 00 8
4	N Bhatnagar, T S Srivatsan, Processing and Fabrication of Advanced Materials, 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 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 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 (Common to AS, BT, CH, CV, IM, ME)		
Course Code: 18CHY2G08		**CIE Marks: 100**
Credits: L:T:P :: 3:0:0		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**

Course Learning Objectives:	
1	Understand the properties of composite materials.
2	Apply the basic concepts of Chemistry to develop futuristic composite materials for high-tech applications in the area of Engineering.
3	Impart knowledge in the different fields of material chemistry so as to apply it to the problems in engineering field.
4	Develop analytical capabilities of students so that they can characterize, transform and use materials in engineering and apply knowledge gained in solving related engineering problems.

Unit-I	
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, Particle reinforced composites, Fibre reinforced composites. Fiber production techniques for glass, carbon and ceramic fibers Applications of various types of composites.	**07 Hrs**
Unit – II	
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**.**	**08 Hrs**
Unit -III	
Ceramic matrix composites and special composites Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics – 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.	**07 Hrs**
Unit –IV	
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 metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties- applications of MMC in aerospace, automotive industries.	**07 Hrs**

Unit –V	
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.	**07 Hrs**

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 of materials available
CO3:	Will be capable of comparing/evaluating the relative merits of using alternatives for important 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 Edition Springer-verlag Gmbh, , ISBN: 9780387743646, 0387743642
2	The Science and Engineering of Materials, K Balani, Donald R Askeland, 6th Edition-Cengage, Publishers, ISBN: 9788131516416
3	Polymer Science and Technology, Joel R Fried , 2nd Edition, Prentice Hall, ISBN: 9780137039555
4	Nanomaterials and nanocomposites, Rajendra Kumar Goyal , 2nd Edition, CRC Press-Taylor & Francis, ISBN: 9781498761666, 1498761666

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Total CIE 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 (Group G: Global Elective)		
Course Code: 18PHY2G09		**CIE Marks: 100**
Credits: L:T:P:: 3:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3Hrs**

Course Learning Objectives (CLO):
Student are able to 1.Classify the crystals based on lattice parameters. 2.Explain the behavior of Dielectrics with change in frequency. 3.Classify the magnetic materials based on Quantum theory as well understand superconductors. 4.Explain direct and indirect bandgap semiconductors, polymer semiconductors and Photoconductive polymers. 5.Describe the behavior of Smart materials and its phases and apply to Engineering applications.

Unit-I	**07 Hrs**
Crystal Structure : Symmetry elements-seven crystals systems-Reciprocal lattice-Packing fraction, Lattice Vibration-Brillouin zones, Analysis of Crystal structure using XRD, Thermal properties.	
Unit-II	**07 Hrs**
Dielectric Materials: Basic concepts-Langevin's Theory of Polarisation-Clausius-Mossotti Relation-Ferro electricity-Piezoelectricity-Properties of Dielectric in alternating fields-The complex Dielectric Constant and Dielectric Loss, Polarizability as a function of frequency-Complex dielectric constant of non-polar solids-Dipolar relaxation, Applications.	
Unit -III	**07Hrs**
Magnetic Materials : Dia and Paramagnetic materials-Quantum theory of paramagnetic materials-Paramagnetic susceptibility of conduction electrons-Ferro-anti ferromagnetic materials-Superconductors and Applications..	
Unit -IV	**07 Hrs**
Semiconducting Materials Semiconductor-Direct and Indirect bonding characteristics-Importance of Quantum confinement-quantum wires and dots-Ferro electric semiconductors-applications-Polymer semiconductors-Photo conductive polymers, Applications.	
Unit -V	**08 Hrs**
Novel Materials Smart materials-shape memory alloys-shape memory effects-Martensitia Transformation functional properties-processing-texture and its nature.	

Reference Books:	
1.	Solid State Physics, S O Pillai, 6th Edition, New Age International Publishers, ISBN 10-8122436978.
2.	Introduction to Solid State Physics, C.Kittel, 7th Edition, 2003, John Wiley & Sons, ISBN 9971-51-180.
3.	Material Science, Rajendran V and Marikani, 1st Edition, Tata McGraw Hill, ISBN 10-0071328971.
4.	The Science and Engineering of Materials, Askeland, Fulay, Wright, Balanai, 6th Edition, Cengage Learning, ISBN-13:978-0-495-66802-2.

Course Outcomes (CO's):
CO1: Analyse crystals using XRD technique. CO2: Explain Dielectric and magnetic materials. CO3:Integrate knowledge of various types of advanced engineering Materials. CO4: Use materials for novel applications.

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 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.

II Semester		
ADVANCED STATISTICAL METHODS (Global Elective)		
Course Code: 18MAT2G10		**CIE Marks: 100**
Credits: L:T:P:: 3:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3Hrs**

Course Learning Objectives (CLO):
Students are able to: 1. Adequate exposure to learn sampling techniques, random phenomena for analyzing data for solving real world problems. 2. To learn fundamentals of estimation and problems used in various fields of engineering and science. 3. Explore the fundamental principles of statistical inference and tests of hypothesis. 4. Apply the concepts of regression and statistical models to solve the problems of engineering applications.

Unit-I	**07 Hrs**
Sampling Techniques: Random numbers, Concepts of random sampling from finite and infinite populations, Simple random sampling (with replacement and without replacement). Expectation and standard error of sample mean and proportion.	
Unit-II	**07 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, Properties of maximum likelihood estimator (no proofs), Confidence intervals-population mean (large sample), population proportion.	
Unit -III	**07Hrs**
Tests of Hypothesis: Principles of Statistical Inference, Formulation of the problems with examples, Simple and composite hypothesis, Null and alternative hypothesis, Tests - type I and type II error, Testing of mean and variance of normal population (one sample and two samples), Chi squared test for goodness of fit.	
Unit -IV	**07 Hrs**
Linear Statistical Models: Definition of linear model and types, One way ANOVA and two way ANOVA models-one observation per cell, multiple but equal number of observation per cell.	
Unit -V	**08 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.	

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, John Wiley & Sons, Inc., 3rd Edition, 2003, ISBN 0-471-20454-4.
3	S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistic, D. C. Montgomery and G. C. Runger, 10th Edition, 2000, A Modern Approach, 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.

Course outcomes (CO's):

On completion of the course, the student should have acquired the ability 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: Analyze 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.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks):
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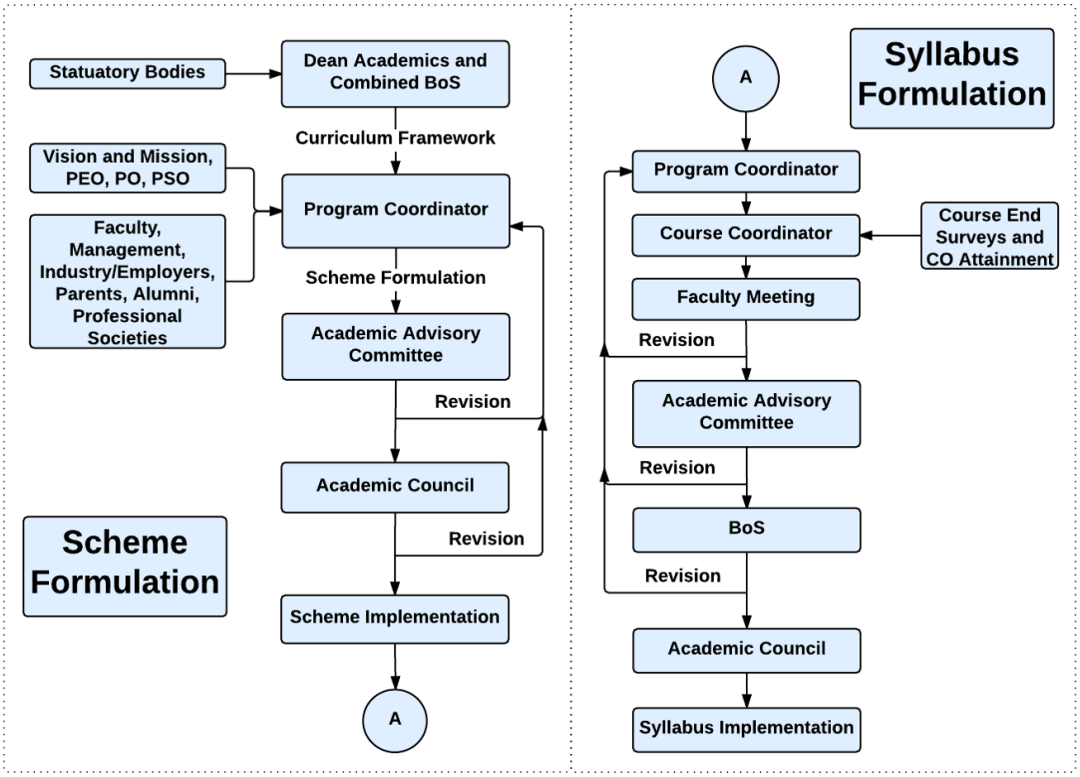
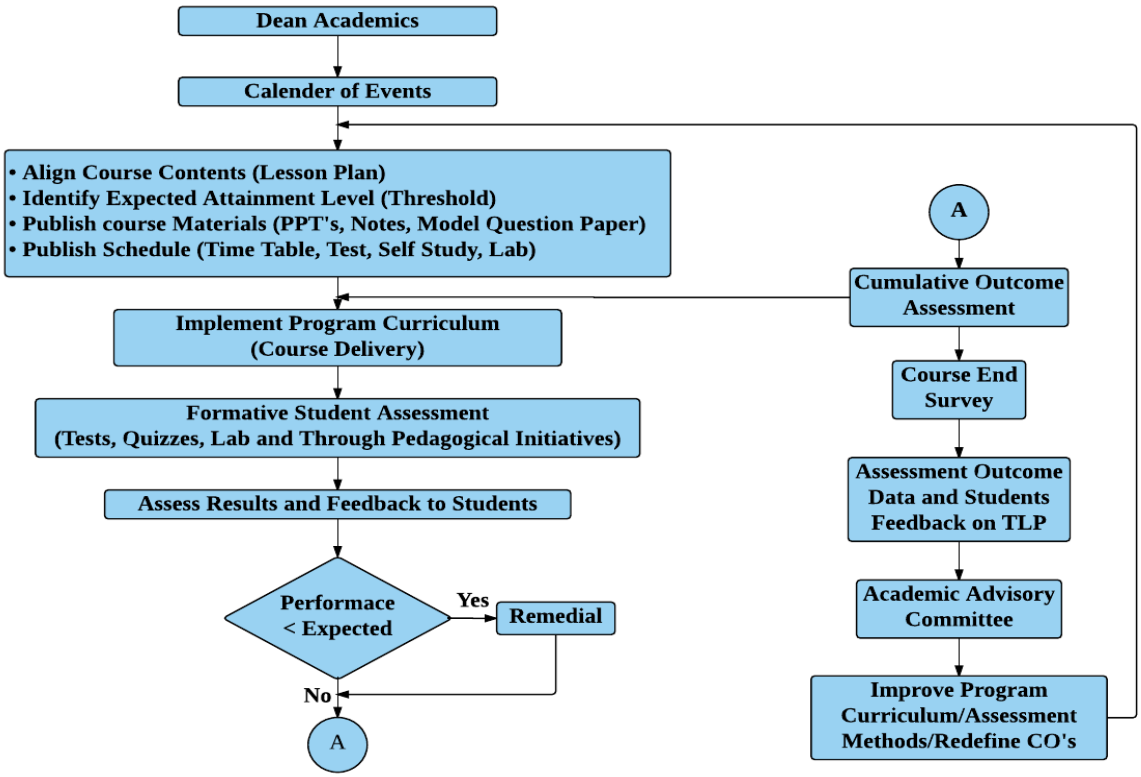
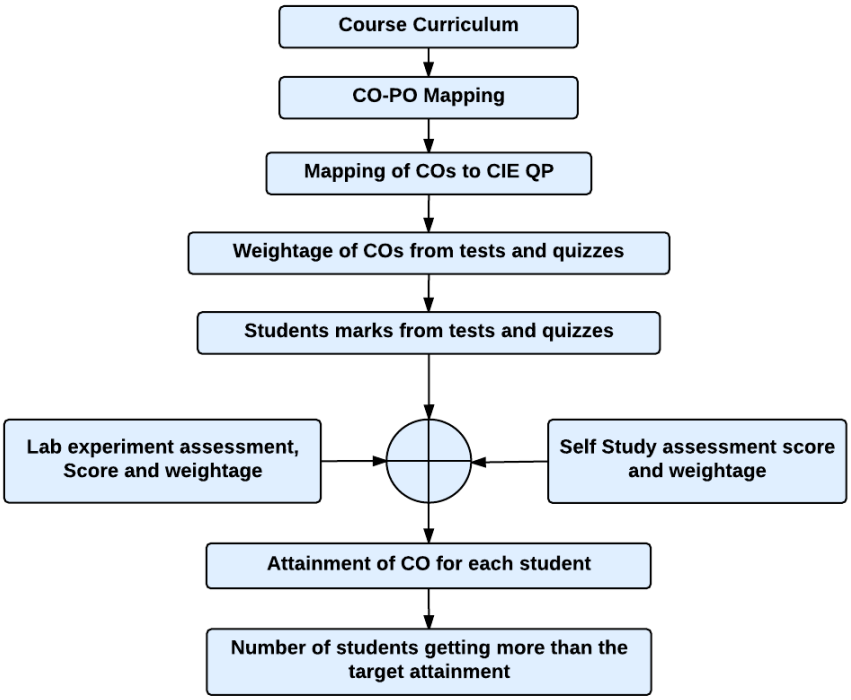
Curriculum Design Process



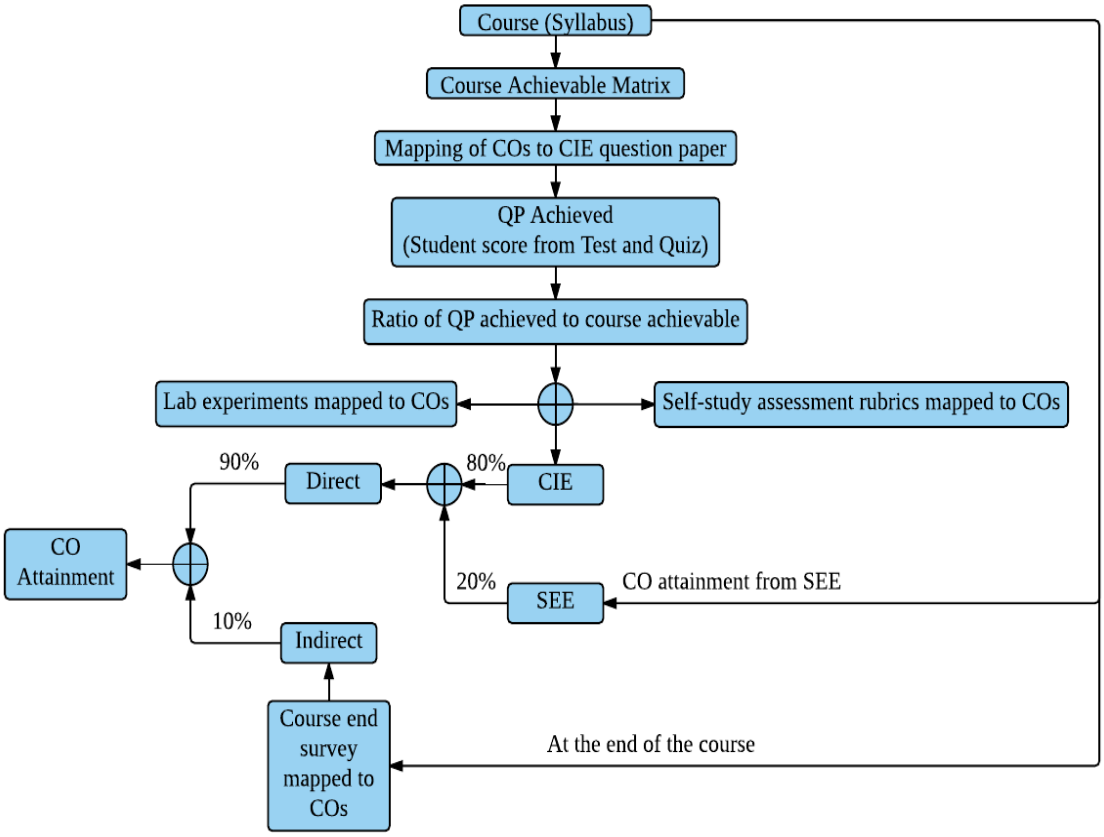
Academic Planning And Implementation



Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process