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

COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING

INNER FRONT COVER PAGE

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

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

COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT OF

COMPUTER SCIENCE AND ENGINEERING

Department of Computer Science and Engineering

Vision: To achieve leadership in the field of Computer Science and Engineering by strengthening fundamentals and facilitating interdisciplinary sustainable research to meet the ever growing needs of the society.

Mission:

- To evolve continually as a center of excellence in quality education in computers and allied fields.
- To develop state-of-the-art infrastructure and create environment capable for interdisciplinary research and skill enhancement.
- To collaborate with industries and institutions at national and international levels to enhance research in emerging areas.
- To develop professionals having social concern to become leaders in top-notch industries and/or become entrepreneurs with good ethics.

PROGRAM OUTCOMES (PO)

Program Outcomes (PO)
The graduates of M. Tech. in Computer Science and Engineering (CSE) Program will be able to:

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

PO2 Write and present a substantial technical report/document.

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

PO4 Acquire knowledge to evaluate, analyze complex problems by applying principles of Mathematics, Computer Science and Engineering with a global perspective.

PO5 Explore, select, learn and model applications through use of state-of-art tools.

PO6 Recognize opportunities and contribute synergistically towards solving engineering problems effectively, individually and in teams, to accomplish a common goal and exhibit professional ethics, competence and to engage in lifelong learning.

Program Specific Criteria for M.Tech in Computer Science and Engineering

Professional Bodies: IEEE-CS, ACM

The M.Tech in Computer Science and Engineering curriculum is designed to enable the students to (a) analyze the problem by applying design concepts, implement the solution, interpret and visualize the results using modern tools (b) acquire breadth and depth wise knowledge in computer science domain (c) be proficient in Mathematics and Statistics, Humanities, Ethics and Professional Practice, Computer Architecture, Analysis of Algorithms, Advances in Operating Systems, Computer Networks and Computer Security courses along with elective courses (d) critically think and solve problems, communicate with focus on team work.

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

INDEX

RV COLLEGE OF ENGINEERING®, BENGALURU-560 059
(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.Tech in COMPUTER SCIENCE AND ENGINEERING

FIRST SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Total Credits**
1	18 MAT 11B	Probability Theory and Linear Algebra	MT	4	0	0	4
2	18 MCE 12	Advances in Algorithms and Applications	CS	3	1	1	5
3	18 MCE 13	Data Science	CS	3	1	1	5
4	18 HSS 14	Professional Skills Development	HSS	0	0	0	0
5	18 MCE 1AX	Elective Group-A	CS	4	0	0	4
6	18 MCE 1BX	Elective Group-B	CS	4	0	0	4
Total number of Credits				**18**	**2**	**2**	**22**
Total Number of Hours / Week				**18**	**4**	**4**	**26**

SECOND SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Total Credits**
1	18 MCE 21	Big Data Analytics	CS	3	1	1	5
2	18 MCE 22	Parallel Computer Architecture	CS	3	1	0	4
3	18 IM 23	Research Methodology	IEM	3	0	0	3
4	18 MCE 24	Minor Project	CS	0	0	2	2
5	18 MCE 2CX	Elective Group-C	CS	4	0	0	4
6	18 MCE 2DX	Elective Group-D	CS	4	0	0	4
7	18 XX 2GXX	Global Elective Group-G	R.BoS	3	0	0	3
Total number of Credits				**20**	**2**	**3**	**25**
Total Number of Hours / Week				**20**	**4**	**6**	**30**

I Semester		
GROUP A: CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	18 MCE 1A1	Computer Network Technologies
2.	18 MCE 1A2	Data Preparation and Analysis
3.	18 MCE 1A3	Applied Cryptography
GROUP B: CORE ELECTIVES		
1.	18 MCN 1B1	Cloud Computing Technology
2.	18 MCE 1B2	Intelligent Systems
3.	18 MCN 1B3	Wireless Network Security
II Semester		
GROUP C: CORE ELECTIVES		
1.	18 MCE 2C1	Wireless and Mobile Networks
2.	18 MCE 2C2	Natural Language Processing
3.	18 MCN 2C3	Cloud Security
GROUP D: CORE ELECTIVES		
1.	18 MCN 2D1	Internet of Things and Applications
2.	18 MCE 2D2	Deep Learning
3.	18 MCE 2D3	Security Engineering

GROUP E: GLOBAL ELECTIVES				
Sl. No.	**Host Dept**	**Course Code**	**Course Title**	**Credits**
1.	CS	18CS2G01	Business Analytics	03
2.	CV	18CV2G02	Industrial & Occupational Health and Safety	03
3.	IM	18IM2G03	Modelling using Linear Programming	03
4.	IM	18IM2G04	Project Management	03
5.	CH	18CH2G05	Energy Management	03
6.	ME	18ME2G06	Industry 4.0	03
7.	ME	18ME2G07	Advanced Materials	03
8.	CHY	18CHY2G08	Composite Materials Science and Engineering	03
9.	PHY	18PHY2G09	Physics of Materials	03
10.	MAT	18MAT2G10	Advanced Statistical Methods	03

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	
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.	**09 Hrs**
Unit – II	
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.	**09 Hrs**
Unit – III	
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.	**10 Hrs**
Unit – IV	
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).	**10 Hrs**
Unit – V	
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.	**09 Hrs**

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

Reference Books:	
1	Probability, Statistics and Random Processes, T. Veerarajan, 3rd Edition, 2008, Tata McGraw Hill Education Private Limited, ISBN:978-0-07-066925-3.
2	Probability and Random Processes With Applications to Signal Processing and Communications, Scott. L. Miller and Donald. G. Childers, 2nd Edition, 2012, Elsevier Academic Press, ISBN 9780121726515.
3	Linear Algebra and its Applications, 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.

Semester: I						
ADVANCES IN ALGORITHMS AND APPLICATIONS (Theory and Practice)						
Course Code	**:**	**18MCE12**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:1:1**		**SEE Marks**	**:**	**100**
Hours	**:**	**36L+24T+24P**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Analysis techniques: Growth of functions: Asymptotic notation, Standard notations and common functions, Substitution method for solving recurrences, Recursion tree method for solving recurrences, Master theorem. **Sorting in Linear Time** Lower bounds for sorting , Counting sort, Radix sort, Bucket sort	**07 Hrs**
Unit – II	
Advanced Design and Analysis Technique Matrix-chain multiplication, Longest common subsequence. An activity-selection problem, Elements of the greedy strategy **Amortized Analysis** Aggregate analysis, The accounting method , The potential method	**08 Hrs**
Unit – III	
Graph Algorithms Bellman-Ford Algorithm, Shortest paths in a DAG, Johnson's Algorithm for sparse graphs. **Maximum Flow:** Flow networks, Ford Fulkerson method and Maximum Bipartite Matching	**07 Hrs**
Unit – IV	
Advanced Data structures Structure of Fibonacci heaps, Mergeable-heap operations, Decreasing a key and deleting a node, Disjoint-set operations, Linked-list representation of disjoint sets, Disjoint-set forests. **String Matching Algorithms:** Naïve algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm	**07 Hrs**
Unit – V	
Multithreaded Algorithms The basics of dynamic multithreading, Multithreaded matrix multiplication, Multithreaded merge sort	**07 Hrs**
Unit – VI (Lab Component)	
Solve case studies by applying relevant algorithms and calculate complexity. For example: 1. Applied example of graph Algorithm 2. Real world applications of Advanced Data Structures 3. Real applications of Maximum Flow 4. String matching algorithms **Sample Experiment:** 1. Write code for an appropriate algorithm to find maximal matching.	**2 Hrs/ Week**

Six reporters Asif (A), Becky (B), Chris (C), David (D), Emma (E) and Fred (F), are to be assigned to six news stories Business (1), Crime (2), Financial (3), Foreign(4), Local (5) and Sport (6). The table shows possible allocations of reporters to news stories. For example, Chris can be assigned to any one of stories 1, 2 or 4.

	1	2	3	4	5	6
A					✓	
B	✓			✓		
C	✓	✓		✓		
D					✓	
E			✓		✓	✓
F				✓		

2. The table shows the tasks involved in a project with their durations and immediate predecessors.

Task	Duration (Days)	Immediate predecessors
A	2	
B	4	
C	5	A,B
D	3	B
E	6	C
F	3	C
G	8	D
H	2	D,F

Find minimum duration of this project.

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore the fundamentals in the area of algorithms by analysing various types of algorithms.
CO2	Analyze algorithms for time and space complexity for various applications
CO3	Apply appropriate mathematical techniques to construct robust algorithms.
CO4	Demonstrate the ability to critically analyze and apply suitable algorithm for any given problem.

Reference Books:	
1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms; Columbia University, 3rd Edition, 2009, ISBN: 978-0262033848
2	Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Addison-Wesley, 3rd Edition, 2007, ISBN: 978-0132847377
3	Kozen DC, The design and analysis of algorithms, Springer Science & Business Media, 2012, ISBN: 978-0387976877
4	Kenneth A. Berman, Jerome L. Paul, Algorithms, Cengage Learning, 2002. ISBN: 978-8131505212

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

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and assignments. A 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 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						
DATA SCIENCE (Theory and Practice)						
Course Code	**:**	**18MCE13**		**CIE Marks**	**:**	**100+50**
Credits L: T: P	**:**	**3:1:1**		**SEE Marks**	**:**	**100+50**
Hours	**:**	**36L+24T+24P**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Introduction to Data mining and machine learning: Describing structural patterns, Machine learning, Data mining, Simple examples, Fielded applications, Machine learning and statistics, Generalization as search, Enumerating the concept space, Bias.	**07 Hrs**
Unit – II	
The Data Science process: The roles in a Data Science project, Project roles, Stages of a data science project, Defining the goal, Data collection and management, Modelling, Model evaluation and critique, Presentation and documentation, Model deployment and maintenance, setting expectations, Determining lower and upper bounds on model performance, Choosing and evaluating models. Mapping problems to machine learning tasks, Solving classification problems, Solving scoring, Working without known targets, Problem-to-method mapping, Evaluating models, Evaluating classification models, Evaluating scoring, Evaluating probability models, Evaluating ranking models, Evaluating clustering models, Validating models.	**08 Hrs**
Unit – III	
Output knowledge representation: Decision trees, association rule mining: Association rule mining, Apriori Algorithm, Statistical modeling, Divide-and-conquer: Constructing decision trees.	**07 Hrs**
Unit – IV	
Linear Models: Linear regression, logistic regression, Extending linear models, Instance-based learning, Bayesian Networks, Combining multiple models.	**07 Hrs**
Unit –V	
K-Nearest Neighbors, Support Vector Machines Maximal Margin Classifier, Support Vector Classifiers, Classification with Non-linear Decision Boundaries, Unsupervised Learning: Principal Components Analysis, clustering methods: k means, hierarchical clustering.	**07 Hrs**
UNIT-VI (Lab Component)	
Using Open source tools(R/Python) design and execute for a given large dataset: 1. Principal Components Analysis 2. Decision Trees: Fitting Classification and Regression Trees, Bagging and Random Forests, Boosting. 3. Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, and K-Nearest Neighbors. 4. Support Vector Machines: Support Vector Classifier, ROC Curves, SVM with Multiple Classes 5. Clustering: K-Means and Hierarchical Clustering	**2 Hrs/ week**

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore and apply Machine Learning Techniques to real world problems.
CO2	Evaluate different mathematical models to construct algorithms.
CO3	Analyze and infer the strength and weakness of different machine learning models
CO4	Implement suitable supervised and unsupervised machine learning algorithms for various applications.

References:	
1.	Ian H. Witten & Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, 2nd edition, Elsevier Morgan Kaufmann Publishers, 2005, ISBN: 0-12-088407-0
2.	Nina Zumel and John Mount, Practical data science with R, Manning Publications, March 2014, ISBN 9781617291562
3.	Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, ISSN 1431-875X,ISBN 978-1-4614-7137-0 ISBN 978-1-4614-7138-7 (eBook), DOI 10.1007/978-1-4614-7138-7,2015,Springer Publication.
4.	Jiawei Han and Micheline Kamber: Data Mining – Concepts and Techniques, Third Edition, Morgan Kaufmann, 2006, ISBN 1-55860-901-6

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

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and assignments. A 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 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						
COMPUTER NETWORK TECHNOLOGIES (Group A: Core Elective)						
Course Code	**:**	**18MCE1A1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Foundations and Internetworking Network Architecture- layering & Protocols, Internet Architecture, Implementing Network Software- Application Programming Interface (sockets), High Speed Networks, Ethernet and multiple access networks (802.3), Wireless-802.11/Wi-Fi, Bluetooth(802.15.1), Cell Phone Technologies.Switching and Bridging, Datagrams, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches.	**08 Hrs**
Unit – II	
Internetworking Internetworking, Service Model, Global Addresses, Special IP addresses, Datagram Forwarding in IP, Subnetting and classless addressing-Classless Inter-domain Routing(CIDR), Address Translation(ARP), Host Configuration(DHCP), Error Reporting(ICMP), Routing, Routing Information Protocol(RIP), Routing for mobile hosts, Open Shortest Path First(OSPF), Switch Basics-Ports, Fabrics, Routing Networks through Banyan Network.	**09 Hrs**
Unit – III	
Advanced Internetworking Router Implementation, Network Address Translation(NAT), The Global Internet-Routing Areas, Interdomain Routing(BGP), IP Version 6(IPv6), extension headers, Multiprotocol Label Switching(MPLS)-Destination Based forwarding, Explicit Routing, Virtual Private Networks and Tunnels, Routing among Mobile Devices- Challenges for Mobile Networking, Routing to Mobile Hosts(MobileIP), Mobility in IPv6.	**10 Hrs**
Unit – IV	
End-to-End Protocols Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission-Silly Window Syndrome, Nagle's Algorithm, Adaptive Retransmission-Karn/Partridge Algorithm, Jacobson Karels Algorithm, Record Boundaries, TCP Extensions, Real-time Protocols	**09 Hrs**
Unit –V	
Congestion Control/Avoidance and Applications Queuing Disciplines-FIFO, Fair Queuing, TCP Congestion Control-Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery, Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. Network Management: Network Management System; Simple Network Management Protocol (SNMP) - concept, management components, SMI, MIB, SNMP messages, *features of SNMPv3*. What Next: Internet of Things, Cloud Computing, The Future Internet, Deployment of IPv6	**10 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Gain knowledge on networking research by studying a combination of functionalities and services of networking.
CO2	Analyze different protocols used in each layer and emerging themes in networking research.
CO3	Design various protocols and algorithms in different layers that facilitate effective communication mechanisms.
CO4	Apply emerging networking topics and solve the challenges in interfacing various protocols in real world.

Reference Books:	
1.	Larry Peterson and Bruce S Davis, Computer Networks: A System Approach, 5th edition, Elsevier, 2014, ISBN-13:978-0123850591, ISBN-10:0123850592.
2.	Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, Tata McGraw Hill, 2013,ISBN: 9781259064753
3.	S.Keshava, An Engineering Approach to Computer Networking, 1st edition, Pearson Education, ISBN-13: 978-0-201-63442-6
4.	Andrew S Tanenbaum, Computer Networks, 5th edition, Pearson, 2011, ISBN-9788-177-58-1652.

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: I						
Data Preparation and Analysis (Group A: Core Elective)						
Course Code	**:**	**18MCE1A2**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Data Objects and Attribute Types: Attributes, Nominal Attributes, Binary Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. **Basic Statistical Descriptions of Data:** Measuring the Central Tendency: Mean, Median, and Mode , Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Inter quartile Range, Graphic Displays of Basic Statistical Descriptions of Data	**09 Hrs**
Unit – II	
Measuring Data Similarity and Dissimilarity: Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes, Proximity Measures for Binary Attributes, Dissimilarity of Numeric Data: Minkowski Distance, Proximity Measures for Ordinal Attributes, Dissimilarity for Attributes of Mixed Types, Cosine Similarity.	**09 Hrs**
Unit – III	
Data Preprocessing: An Overview, Data Quality: Need of Preprocessing the Data, Major Tasks in Data Preprocessing. **Data Cleaning:** Missing Values, Noisy Data, Data Cleaning as a Process. **Data Integration:** Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution. **Data Reduction:** Overview of Data Reduction Strategies, Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric, Data Reduction, Histograms, Clustering, Sampling, Data Cube Aggregation.	**09 Hrs**
Unit – IV	
Data Transformation and Data Discretization: Data Transformation Strategies Overview, Data Transformation by Normalization, Discretization by Binning, Discretization by Histogram Analysis, Discretization by Cluster, Decision Tree, and Correlation Analyses, Concept Hierarchy Generation for Nominal Data. **Data Visualization:** Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.	**09 Hrs**
Unit –V	
Mining Complex Data Types: Mining Sequence Data: Time-Series, Symbolic Sequences, and Biological Sequences, Mining Graphs and Networks, Mining Other Kinds of Data. **Other Methodologies of Data Mining:** Statistical Data Mining, Views on Data Mining Foundations, Visual and Audio Data Mining. **Data Mining Applications:** Data Mining for Financial Data Analysis , Data Mining for Retail and Telecommunication Industries, Data Mining in Science and Engineering, Data Mining for Intrusion Detection and Prevention, Data Mining and Recommender Systems, Data Mining and Society**:** Ubiquitous and Invisible Data Mining, Privacy, Security, and Social Impacts of Data Mining	**10 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore the data of various domains, for preprocessing
CO2	Analyze the various techniques of data cleaning performing data analysis.
CO3	Apply various techniques for data extraction from dataset
CO4	Visualize the data using different tools for getting better insight.

References:	
1	Jiawei Han and Micheline Kamber: Data Mining – Concepts and Techniques, 3rd Edition, Morgan Kaufmann, 2006, ISBN 1-55860-901-6
2	Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson Education, 2007, ISBN 9788131714720
3	Insight into Data Mining, Theory & Practice by K. P. Soman, Shyam Diwakar, V. Ajay, PHI – 2006, ISBN: 978-81-203-2897-6
4	Ian H Witten & Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, 2nd edition, Elsevier Morgan Kaufmann Publishers, 2005, ISBN: 0-12-088407-0

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: I						
APPLIED CRYPTOGRAPHY **(Group A: Core Elective)** **(Common to CSE and CNE)**						
Course Code	**:**	**18MCE1A3**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Overview of Cryptography: Introduction, Information security and cryptography: Background on functions: Functions (1-1, one-way, trapdoor one-way), Permutations, and Involutions. Basic terminology and concepts, Symmetric-key encryption: Overview of block ciphers and stream ciphers, Substitution ciphers and transposition ciphers, Composition of ciphers, Stream ciphers, The key space. Classes of attacks and security models: Attacks on encryption schemes, Attacks on protocols, Models for evaluating security, Perspective for computational security.	**09 Hrs**
Unit – II	
Mathematical Background: Probability: Basic definitions, Conditional probability, Random variables, Binomial distribution, Birthday attacks and Random mappings. Information theory: Entropy, Mutual information. Number theory: The integers, Algorithms in Z, The integers modulo n, Algorithms in Zn, Legendre and Jacobi symbols, Blum integers. Abstract Algebra: Groups, Rings, Fields, Polynomial rings, Vector spaces.	**09 Hrs**
Unit – III	
Stream Ciphers: Introduction: Classification, Feedback shift registers: Linear feedback shift registers, Linear complexity, Berlekamp-Massey algorithm, Nonlinear feedback shift registers. Stream ciphers based on LFSRs: Nonlinear combination generators, Nonlinear filter generators, Clock-controlled generators. Other stream ciphers: SEAL.	**09 Hrs**
Unit – IV	
Block Ciphers: Introduction and overview, Background and general concepts: Introduction to block ciphers, Modes of operation, Exhaustive key search and multiple encryption. Classical ciphers and historical development: Transposition ciphers (background), Substitution ciphers (background), Polyalphabetic substitutions and Vigenere ciphers (historical). Polyalphabetic cipher machines and rotors (historical), Cryptanalysis of classical ciphers (historical).	**09 Hrs**
Unit –V	
Identification and Entity Authentication: Introduction, Passwords (weak authentication), Challenge-response identification (strong authentication), Customized and zero-knowledge identification protocols: Overview of zero-knowledge concepts, Feige-Fiat-Shamir identification protocol, GQ identification protocol, Schnorr identification protocol, Comparison: Fiat-Shamir, GQ, and Schnorr, Attacks on identification protocols.	**10 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Analyze background on functions, composition of ciphers and attacks on encryption schemes.
CO2	Evaluate mathematical background on cryptographic functions.
CO3	Identify stream cipher and block cipher algorithms and functionalities
CO4	Evaluate identification and Entity authentication schemes.

Reference Books:	
1	Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, Handbook of Applied Cryptography CRC Press, Taylor and Francis Group, ISBN-13: 978-0-84-938523-0.
2	Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C, 2nd Edition, ISBN:0-471-22357-3.
3	William Stallings, Cryptography and Network Security, 6th Edition, ISBN-13: 978-0-13-335469-0.
4	Niels Ferguson, Bruce Schneier, Tadayoshi Kohno, Cryptography Engineering, Design Principles and Practical Applications, 2010, Wiley. ISBN: 978-0-470-47424-2.

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: I						
CLOUD COMPUTING TECHNOLOGY **(Group B: Core Elective)** **(Common to PG-CSE and PG-CNE)**						
Course Code	**:**	**18MCN1B1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Introduction, Cloud Infrastructure Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Major challenges faced by cloud computing; Cloud Infrastructure: Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Service- and compliance-level agreements, User experience and software licensing. Exercises and problems	**09 Hrs**
Unit – II	
Cloud Computing: Application Paradigms Challenges of cloud computing, Existing Cloud Applications and New Application Opportunities, Workflows: coordination of multiple activities, Coordination based on a state machine model: The ZooKeeper, The MapReduce Programming model, A case study: The Grep TheWeb application, HPC on cloud, Biology research	**09 Hrs**
Unit – III	
Cloud Resource Virtualization. Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and para virtualization, Hardware support for virtualization, Case Study: Xen a VMM based para virtualization, Optimization of network virtualization, The darker side of virtualization, Exercises and problems.	**09 Hrs**
Unit – IV	
Cloud Resource Management and Scheduling Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers; Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Exercises and problems.	**10 Hrs**
Unit –V	
Cloud Security, Cloud Application Development Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis. Exercises and problems. Amazon Simple Notification services. **Latest topics:** Google messaging, Android Cloud to Device messaging, Isolation mechanisms for data privacy in cloud, Capability-oriented methodology to build private clouds.	**09 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Explain industry relevance of cloud computing and its intricacies, in terms of various challenges, vulnerabilities, SLAs, virtualization, resource management and scheduling, etc.
CO2	Examine some of the application paradigms, and Illustrate security aspects for building cloud-based applications.
CO3	Conduct a research study pertaining to various issues of cloud computing.
CO4	Demonstrate the working of VM and VMM on any cloud platforms(public/private), and run a software service on that.

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

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 I						
INTELLIGENT SYSTEMS (Group B: Core Elective) (Common to CSE, MD, CIM)						
Course Code	**:**	**18MCE1B2**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Overview of Artificial Intelligence: Artificial Intelligence and its Application areas; **Knowledge Representation and Search:** The Predicate Calculus: The Propositional Calculus, The Predicate Calculus, Using Inference Rules to Produce Predicate Calculus Expressions, Application: A Logic-Based Financial Advisor; **Structures and strategies for state space search:** Introduction, Structures for state space search ,Strategies for State Space Search, Using the State Space to Represent Reasoning with the Predicate Calculus; And/Or Graphs.	**09 Hrs**
Unit – II	
Heuristic Search: Introduction, Hill Climbing and Dynamic Programming, The Best-First Search Algorithm, Admissibility, Monotonicity and Informedness, Using Heuristics in Games, Complexity Issues. **Control and Implementation of State Space Search**: Introduction, Recursion-Based Search, Production Systems, The Blackboard Architecture for Problem Solving.	**09 Hrs**
Unit – III	
Other Knowledge Representation Techniques: Semantic Networks, Conceptual Dependencies, Scripts and Frames, Conceptual Graphs. **Knowledge Intensive Problem Solving** : Overview of Expert System Technology, Rule-Based Expert Systems, Model-Based, Case Based, and Hybrid Systems **Planning:** Introduction to Planning, Algorithms as State-Space Search, Planning graphs.	**09 Hrs**
Unit – IV	
Automated Reasoning: Introduction to Weak Methods in Theorem Proving, The General Problem Solver and Difference Tables, Resolution Theorem Proving; **Uncertain Knowledge and Reasoning:** Introduction to Uncertainty, Inference using Full-Joint Distribution, Independence, Bayes' Rule and its use. **Representing Knowledge in Uncertain Domain:** Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Network, Approximate Inference in Bayesian Network	**09 Hrs**
Unit –V	
Introduction to Learning: Forms of Learning: Supervised learning, Unsupervised Learning, Semi-Supervised and Reinforcement Learning; Parametric Models & Non-Parametric Models, Classification and Regression problems **Artificial Neural Networks:** ANN Structures, Single Layer feed-forward neural networks, Multi-Layer feed-forward neural networks, Learning in multilayer networks, networks. **Artificial Intelligence Current Trends :** The Science of Intelligent Systems, AI: Current Challenges and Future Directions;	**10 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore various Artificial Intelligence problem solving techniques.
CO2	Identify and describe the different AI approaches such as Knowledge representation, Search strategies, learning techniques to solve uncertain imprecise, stochastic and nondeterministic nature in AI problems.
CO3	Apply the AI techniques to solve various AI problems.
CO4	Analyze and compare the relative challenges pertaining to design of Intelligent Systems.

Reference Books	
1.	George F Luger, Artificial Intelligence – Structures and Strategies for Complex problem Solving, 6th Edition, Pearson Publication, 2009, ISBN-10: 0-321-54589-3, ISBN-13: 978-0-321-54589-3
2.	Stuart Russel, Peter Norvig, Artificial Intelligence A Modern Approach, 3rd Edition, Pearson Publication, 2015, ISBN-13: 978-93-325-4351-5
3.	Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2009, ISBN-10: 0070087709, ISBN-13: 978-0070087705
4.	Grosan, Crina, Abraham, Ajith, Intelligent Systems-A Modern Approach, Springer-Verlag Berlin Heidelberg 2011, ISBN 9783642269394, 2011.

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: I						
WIRELESS NETWORKS SECURITY **(Group B: Core Elective)** **(Common to PG-CSE and PG-CNE)**						
Course Code	**:**	**18MCN1B3**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives:

Graduates shall be able to

1. Explore the principles of wireless networks security technology
2. Illustrate the secure design of wireless network with various protocols
3. Analyze and choose the suitable wireless security technology based on requirements.
4. Investigate the upcoming security trends and threats in the wireless applications

Unit – I	
Overview of wireless network security technology: Wireless network security fundamentals, Types of wireless network security Technology, Elements of wireless security, Available solutions and policies for wireless security, Perspectives- prevalence and issues for wireless security, Inverted security model	**09 Hrs**
Unit – II	
Designing wireless network security: Wireless network security design issues , Cost justification and consideration –hitting where it hurts, assess your vulnerable point, security as Insurance, consequences of breach, Standard design issues- switches, flexible IP address assignment, router filtering, bandwidth management, firewalls and NAT, VLAN, VPN, Remote access security, third party solutions	**09 Hrs**
Unit – III	
Installing and deploying wireless network security: Testing techniques- Phase I to IV, Internetworking Wireless Security - Operation modes of Performance Enhancing Proxy (PEP), Adaptive usage of PEPs over a Radio Access Network (RAN), Problems of PEP with IPSec, Problems of Interworking between PEP and IPSec, Solutions, Installation and Deployment	**09 Hrs**
Unit – IV	
Security in Wireless Networks and Devices: Introduction, Cellular Wireless Communication Network Infrastructure , Development of Cellular Technology, Limited and Fixed Wireless Communication Networks , Wireless LAN (WLAN) or Wireless Fidelity (Wi-Fi) , WLAN (Wi-Fi) Technology, Mobile IP and Wireless Application Protocol, Standards for Wireless Networks , The IEEE 802.11, Bluetooth, Security in Wireless Networks, WLANs Security Concerns, *Best Practices for Wi-Fi Security	**10 Hrs**
Unit –V	
Security in Sensor Networks : Introduction , The Growth of Sensor Networks, Design Factors in Sensor Networks , Routing , Power Consumption, Fault Tolerance, Scalability , Product Costs, Nature of Hardware Deployed , Topology of Sensor Networks, Transmission Media, Security in Sensor Networks, Security Challenges, Sensor Network Vulnerabilities and Attacks, Securing Sensor Networks *Security Mechanisms and Best Practices for Sensor Networks, Trends in Sensor Network Security Research	**09 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore the existing threats in wireless networks and security issues
CO2	Design suitable security in wireless networks depending on context
CO3	Analyze the wireless installation and deployment techniques in real-world networks
CO4	Improve the security and energy management issues for the wireless devices

Reference Books:	
1.	John R.Vacca, Guide to Wireless Network security, 1st edition, 2006, Springer Publishers, ISBN 978-0-387-29845-0
2.	Joseph Migga Kizza, A Guide to Computer Network Security, Springer, 2009, ISBN: 978-1-84800-916-5
3.	William Stallings, Cryptography and Network Security,4th edition, November 16, 2005, ISBN 13: 9780131873162
4*	Technical Journal papers and manuals.

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						
BIG DATA ANALYTICS (Theory and Practice)						
Course Code	**:**	**18MCE21**		**CIE Marks**	**:**	**100+50**
Credits L: T: P	**:**	**3:1:1**		**SEE Marks**	**:**	**100+50**
Hours	**:**	**36L+24T+24P**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
INTRODUCTION TO NoSQL and BIG DATA **Classification of Digital Data:** Structured, Semi-Structured and Unstructured data. **NoSQL**: Where is it used?, What is it?, Types of NoSQL Databases, Why NoSQL?, Advantages of NoSQL, SQL versus NoSQL, NewSQL, Comparison of SQL, NoSQL and NewSQL, **Elasticsearch:** Talking to Elastic Search: Document Oriented, Finding your feet, Life inside Cluster: Scale Horizontally, Coping with Failure, Data-in Data-out: Document Metadata, Indexing a document, Retrieving a document. **Introduction to Big Data:** Distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications.	**08 Hrs**
Unit – II	
HADOOP ARCHITECTURE Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.	**07 Hrs**
Unit – III	
HADOOP ECOSYSTEM AND YARN Hadoop ecosystem components - SPARK, FLUME, Hadoop 2.0 New Features- NameNode High Availability, HDFS Federation, MRv2, YARN	**07 Hrs**
Unit – IV	
Real-Time Applications in the Real World Using HBase for Implementing Real-Time Applications- Using HBase as a Picture Management System Using Specialized Real-Time Hadoop Query Systems Apache Drill, Using Hadoop-Based Event-Processing Systems HFlame, Storm	**07 Hrs**
Unit –V	
HIVE AND HIVEQL, HBASE Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating. HBase concepts- Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper	**07 Hrs**
UNIT-VI (Lab Component)	
Exercise 1 --- Elastic Search **Build a platform to manage published journal papers:** Each journal document can have various attributes like, 1. Name 2. List of Author 3. Abstract 4. Content 5. Name of conference where the paper is published 6. Name of the journal where paper is published 7. Date of publication 8. List of references 9. Subject An Author can have various attributes like 1. Name	**2 Hrs/ Week**

2. Contact
3. University
4. Department
5. Designation

There are two types of users in the system

1. Author
2. Normal User

Authors are those who have published one or more papers. Author needs to register into the platform and upload his or her paper with the description fields as above. The system will store these details about the paper and also the paper document. It will parse the document to extract the "Abstract", "Reference" and other keywords from the documents and store it.

"Normal Users" will also have to register to the platform. Once they login they can do the following

1. They can list all the papers based on various attributes
2. They can search the papers based on keywords in abstract, contents, tags etc

Exercise 2 --- HDFS

Start by reviewing HDFS. You will find that its composition is similar to your local Linux file system. You will use the hadoop fs command when interacting with HDFS.

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

Exercise 3 --- MapReduce (Programs)

Using movie lens data

1. List all the movies and the number of ratings
2. List all the users and the number of ratings they have done for a movie
3. List all the Movie IDs which have been rated (Movie Id with at least one user rating it)
4. List all the Users who have rated the movies (Users who have rated at least one movie)
5. List of all the User with the max, min, average ratings they have given against any movie
6. List all the Movies with the max, min, average ratings given by any user

Exercise 4 – Extract facts using Hive

Hive allows for the manipulation of data in HDFS using a variant of SQL. This makes it excellent for transforming and consolidating data for load into a relational database. In this exercise you will use HiveQL to filter and aggregate click data to build facts about user's movie preferences. The query results will be saved in a staging table used to populate the Oracle Database. The moveapp_log_json table contains an activity column. Activity states are as follows:

1. RATE_MOVIE
2. COMPLETED_MOVIE
3. PAUSE_MOVIE
4. START_MOVIE
5. BROWSE_MOVIE
6. LIST_MOVIE
7. SEARCH_MOVIE

8. LOGIN
9. LOGOUT
10. INCOMPLETE_MOVIE

```
hive> SELECT * FROM movieapp_log_json LIMIT 5;
hive> drop table movieapp_log_json;
hive> CREATE EXTERNAL TABLE movieapp_log_json (
custId INT,
movieId INT,
genreId INT,
time STRING,
recommended STRING,
activity INT,
rating INT,
price FLOAT)
ROW FORMAT SERDE 'org.apache.hadoop.hive.contrib.serde2.JsonSerde'
LOCATION '/user/oracle/moviework/applog/'
hive> SELECT * FROM movieapp_log_json LIMIT 20;
hive> SELECT MIN(time), MAX(time) FROM movieapp_log_json
```

1. PURCHASE_MOVIE

Hive maps queries into Map Reduce jobs, simplifying the process of querying large datasets in HDFS. HiveQL statements can be mapped to phases of the Map Reduce framework. As illustrated in the following figure, selection and transformation operations occur in map tasks, while aggregation is handled by reducers. Join operations are flexible: they can be performed in the reducer or mappers depending on the size of the leftmost table.

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

Exercise 5 - Extract sessions using Pig

While the SQL semantics of HiveQL are useful for aggregation and projection, some analysis is better described as the flow of data through a series of sequential operations. For these situations, Pig Latin provides a convenient way of implementing data flows over data stored in HDFS. Pig Latin statements are translated into a sequence of Map Reduce jobs on the execution of any STORE or DUMP command. Job construction is optimized to exploit as much parallelism as possible, and much like Hive, temporary storage is used to hold intermediate results. As with Hive, aggregation occurs largely in the reduce tasks. Map tasks handle Pig's FOREACH and LOAD, and GENERATE statements. The EXPLAIN command will show the execution plan for any Pig Latin script. As of Pig 0.10, the ILLUSTRATE command will provide sample results for each stage of the execution plan. In this exercise you will learn basic Pig Latin semantics and about the fundamental types in Pig Latin, Data Bags and Tuples.

1. Start the Grunt shell and execute the following statements to set up a dataflow with the click stream data. Note: Pig Latin statements are assembled into Map Reduce jobs which are launched at execution of a DUMP or STORE statement.
2. Group the log sample by movie and dump the resulting bag.
3. Add a GROUP BY statement to the sessionize.pig script to process the click stream data into user sessions.

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore and apply the Big Data analytic techniques for business applications.
CO2	Apply non-relational databases, the techniques for storing and processing large volumes of structured and unstructured data, as well as streaming data.
CO3	Analyze methods and algorithms, to compare and evaluate them with respect to time and space requirements, make appropriate design choices when solving problems.
CO4	Develop and implement efficient big data solutions for various application areas using NoSQL database, Elastic Search and Emerging technologies.

Reference Books:	
1	Judith Hurwitz, Alan Nugent,Fern Halper, Marcia Kaufman, Big data for dummies, Wiley Publications, 1st edition, 2013, ISBN: 978-1-118-50422-2
2	Clinton Gormley, Zachary Tong, Elasticsearch – The Definitive Guide , O'Reilly Media, Inc. 1st edition, 2015. ISBN: 978-1-449-35854-9.
3	Tom White, HADOOP: The definitive Guide, 4th edition, O Reilly, 2015, ISBN-13: 978-1-4493-610-7
4	Chris Eaton, Dirk deroos et al., Understanding Big data: Analytics for Enterprise Class Hadoop and Streaming Data, 1st edition, Tata McGraw Hill, 2015, ISBN 13: 978-9339221270

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

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and assignments. A 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 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						
PARALLEL COMPUTER ARCHITECTURE						
Course Code	**:**	**18MCE22**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**36L+24T**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Fundamentals of computer design: Introduction; Classes computers; Defining computer architecture; Trends in Technology; Trends in power in Integrated Circuits; Trends in cost; Dependability, Measuring, reporting and summarizing Performance attributes; Quantitative Principles of computer design	**07 Hrs**
Unit – II	
Introduction to Parallel Programming: Motivation, Scope of Parallel Computing, Principles of Parallel Algorithm design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overheads, Parallel Algorithms Models using Open MP.	**07 Hrs**
Unit – III	
Programming Using the Using Message Passing Paradigm: Principles of Message Passing Programming, Building Blocks, MPI, Topologies and Embedding, Overlapping Communication with computation, Collective Communication and computation operations, Groups and Communicators.	**08 Hrs**
Unit – IV	
Data-Level Parallelism in Vector, SIMD, and GPU Architectures: Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism, Mobile versus Server GPUs and Tesla versus Core i7.	**07 Hrs**
Unit –V	
***Heterogeneous Computing** Heterogeneous Programming using Open ACC: Introduction, Execution Model, Memory Model, Features **Case Study**: Vector dot product, Matrix multiplication, Graph algorithms, and molecular dynamics.	**07 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore the fundamental concepts of parallel computer architecture.
CO2	Analyze the performance of parallel programming
CO3	Design parallel computing constructs for solving complex problems.
CO4	Demonstrate parallel computing concepts for suitable applications.

Reference Books	
1.	John L Hennessy, David A Patterson, Computer Architecture: A Quantitative Approach, Elsevier, 5th Edition; 2011, ISBN: 9780123838728.
2.	Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar : Introduction to Parallel Computing, 2nd edition, Pearson Education, 2007
3.	Rob Farber, Parallel Programming with Open ACC, 1st edition, 2016, ISBN :9780124103979
4*	http://hpac.rwth-aachen.de/people/springer/openacc_seminar.pdf

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						
RESEARCH METHODOLOGY (Common to all programs)						
Course Code	**:**	**18IM23**		**CIE Marks**	**:**	**100**
Credits	**:**	**L: T: P**	**3:0:0**	**SEE Marks**	**:**	**100**
Hours	**:**	**36L**		**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	**:**	**18MCE24**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**0:0:2**		**SEE Marks**	**:**	**100**
Hours	**:**	**48L**		**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						
WIRELESS AND MOBILE NETWORKS (Group-C: Core Elective)						
Course Code	**:**	**18MCE2C1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Fundamentals of Wireless Communication: Advantages, Limitations and Applications, Wireless Media, Infrared Modulation Techniques, Spread spectrum: DSSS and FHSS, Diversity techniques, MIMO, Channel specifications- Duplexing, Multiple access technique: FDMA, TDMA,CDMA, CSMA,OFDMA fundamentals, Frequency Spectrum, Radio and Infrared Frequency Spectrum, Wireless Local Loop (WLL): User requirements of WLL systems, WLL system architecture, MMDS, LMDS, WLL subscriber terminal, WLL interface to the PSTN	**09 Hrs**
Unit – II	
Fundamentals of cellular communications: Introduction, Cellular systems, Hexagonal cell geometry, Channel assignment strategies, Handoff strategies, Interference and System Capacity [Design problems], Co channel interference ratio, Frequency Reuse, Cellular system design in worst case scenario with omnidirectional antenna, Co-channel interference reduction, Directional antennas in seven cell reuse pattern, Cell splitting, Adjacent channel interference (ACI), Segmentation	**09 Hrs**
Unit – III	
Wireless Local Area Network (WLAN): Network components, Design requirements, WLAN architecture, Standards, WLAN Protocols- Physical Layer and MAC Layer, IEEE 802.11p, Security (WPA), Latest developments of IEEE 802.11 standards	**09 Hrs**
Unit – IV	
Wireless Personal Area Network (WPAN): Network architecture and components, WPAN technologies and protocols, Application software; ZigBee (802.15.4): Stack architecture, Components, Topologies, Applications; Bluetooth (802.15.1): Protocol stack, Link types, security aspects, Network connection establishment, error correction and topology; HR –WPAN (UWB) (IEEE 802.15.3), LR-WPAN (IEEE 802.15.4)	**09 Hrs**
Unit –V	
Security in Wireless Systems: Needs, Privacy definitions, Privacy requirements, Theft resistance, Radio System and Physical requirements, Law enforcement requirements, IEEE 802.11 Security. Wi-Fi Protected Access (WPA),Economies of Wireless Network, Economic Benefits, Economics of Wireless industry. Wireless data forecast, charging issues*, Tools: Wi-Fi Scanner, Aircrack, Kismet *	**10 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore the existing wireless networks and connectivity issues
CO2	Analyze the range of signals and path loss models for real world scenarios
CO3	Evaluate the security and energy management issues for wireless devices
CO4	Design suitable wireless network for various applications

Reference Books	
1.	Dr. Sunil Kumar S. Manvi & Mahabaleshwar S. Kakkasageri, Wireless and Mobile Network concepts and protocols, John Wiley India Pvt. Ltd, 1st edition, 2010, *ISBN* 13: 9788126520695

2.	Vijay K.Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, 2009, Indian Reprint ISBN: 978-81-312-1889-1
3.	Theodore S Rappaport, Wireless Communications, Principles and Practice, 2nd Edition, Pearson Education Asia, 2009, ISBN: 9780133755367
4*	Technical Journals, White papers

Open ended Lab experiments

1. Explore the scanning tools such as Wi-Fi Scanner, Aircrack, Kismet
2. Using QualNet simulator, design wireless networks such as IEEE 802.11, IEEE 802.15.5, UMTS
3. Review the features of LTE simulator and ONE (Opportunistic Network Environment)

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						
NATURAL LANGUAGE PROCESSING (Group-C: Core Elective)						
Course Code	**:**	**18MCE2C2**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives (CLO):

Students shall be able to

1. Demonstrate sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2. Train and evaluate empirical NLP systems.
3. Manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
4. Design, implement, and analyse NLP algorithms

Unit – I	
Overview and Language Modeling: Overview: Origins and challenges of NLP- Language and Grammar-Processing Indian Languages- NLP Applications -Information Retrieval. Language Modeling: Various Grammar- based Language Models - Statistical Language Model	**09 Hrs**
Unit – II	
Word Level and Syntactic Analysis: Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.	**09 Hrs**
Unit – III	
Hidden Markov and Maximum Entropy Models Markov Chains, The Hidden Markov Model, Computing Likelihood: The forward algorithm, Decoding: The Viterbi algorithm, Training HMMs: The forward-backward algorithm, **Speech Recognition** Speech Recognition Architecture, Applying HMM to speech, Feature Extraction: MFCC vectors.	**09 Hrs**
Unit – IV	
Machine Translation Introduction, Problems in machine translation, Characteristics of Indian languages, machine Translation approaches, Direct machine translation, Rule based machine translation, corpus based machine translation **NLP Applications** Information extraction, Machine Translation, Natural Language Generation, Discourse processing	**09 Hrs**
Unit –V	
Information Retrieval and Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval valuation Lexical Resources: WordNet, FrameNet, Stemmers, POS Tagger, Research Corpora. **Case Study: Learning to classify text using NLTK-** Supervised classification, Choosing the right features, Document classification, parts of speech tagging, Exploiting context, Evaluation, Accuracy, Precision and Recall, Confusion matrix, Cross- validation	**10 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Comprehend and compare different natural language processing models
CO2	Analyse spelling errors and error detection techniques
CO3	Extract dependency, semantics and relations from the text.
CO4	Differentiate various information retrieval models.

Reference Books	
1	Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, OUP India, 2008, ISBN : 9780195692327
2	Daniel Jurafsky and James H Martin, Speech and Language Processing, 2nd edition, Pearson Education, 2009
3	Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, Publisher: O'Reilly Media, June 2009, ISBN : 9780596516499
4	Alexander Clark, Chris Fox, Shalom Lappin, The Handbook of computational linguistics and Natural Language processing, 2010, Wiley Blackwell.

Open ended experiments / Tutorial Questions

1. Forming Sentences-1
2. Forming Sentences-2
3. Tokens and Types
4. Heap's Law
5. Dictionary Generation
6. Coarse-grained POS Tagging
7. Fine-grained POS Tagging
8. Chunking
9. Context Free Grammar

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						
CLOUD SECURITY **(Group-C: Core Elective)** **(Common to PG-CSE and PG-CNE)**						
Course Code	**:**	**18MCN2C3**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Introduction to cloud computing and security-understanding cloud computing, cloud scale IT foundation for cloud, the bottom line, roots of cloud computing, a brief primer on security, architecture, defense in depth, cloud is driving broad changes. Securing the cloud: architecture-requirements, patterns and architectural elements, cloud security architecture, key strategies for secure operations	**09 Hrs**
Unit – II	
Securing the cloud: data security-overview of data security in cloud computing, data encryption: applications and limits, sensitive data categorization, cloud storage, cloud lock-in Securing cloud : key strategies and best practises- Overall strategy, security controls, limits of security controls, best practices, security monitoring	**09 Hrs**
Unit – III	
Security criteria: Building an internal cloud, Security Criteria-private clouds: selecting an external cloud provide-Selecting CSP,-overview of assurance, over view of risks, security criteria, Evaluating clouds security: An information security framework-evaluation cloud security, checklist for evaluating cloud security	**09 Hrs**
Unit – IV	
Identity and access management Trust Boundaries, IAM Challenges, IAM Definitions ,IAM Architecture and Practice , Getting Ready for the Cloud 80 Relevant IAM Standards and Protocols for Cloud Services , IAM Practices in the Cloud, Cloud Authorization Management , Security Management in the Cloud, Security Management Standards , Security Management in the Cloud, Availability Management, SaaS Availability Management, PaaS Availability Management, IaaS Availability Management	**09 Hrs**
Unit –V	
Privacy: Privacy, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing , Legal and Regulatory Implications , U.S. Laws and Regulations , International Laws and Regulations, Audit and compliance, Internal Policy Compliance, Governance, Risk, and Compliance (GRC) Illustrative Control Objectives for Cloud Computing , Incremental CSP-Specific Control Objectives Additional Key Management Control Objectives, Control Considerations for CSP Users, Regulatory/External Compliance, Other Requirements , Cloud Security Alliance, Auditing the Cloud for Compliance	**10 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore compliance and security issues that arise from cloud computing architectures intended for delivering Cloud based enterprise IT services and business applications.
CO2	Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based IT services.
CO3	Illustrate the concepts and guiding principles for designing and implementing appropriate safeguards and countermeasures for Cloud based IT services
CO4	Design security architectures that assure secure isolation of physical and logical infrastructures of network and storage, comprehensive data protection at all layers, end-to-end identity and access management, monitoring and auditing processes and compliance with industry and regulatory mandates.

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

Open ended experiments / Tutorial Questions

1. Cloud authentication and authorization techniques
2. Cloud identity and access management
3. Cloud key management
4. Cloud auditing
5. Credential management
6. Cloud DoS protection
7. Cloud traffic hijacking protection
8. Identifying malicious insider, malilcious agent, malicious tenant
9. Virtualization attacks
10. Trust management and assurance
11. Resource Access Control schemes
12. Cloud data encryption and access
13. Cloud data integrity

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						
INTERNET OF THINGS AND APPLICATIONS (Group-D: Core Elective) (Common to PG-CSE and PG-CNE)						
Course Code	**:**	**18MCN2D1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
FUNDAMENTAL IOT MECHANISM AND KEY TECHNOLOGIES-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards Overview and Approaches, IETF IPv6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Lowpower WPAN, Zigbee IP(ZIP), IPSO	**09 Hrs**
Unit – II	
LAYER ½ CONNECTIVITY: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity :IPv6 Technologies for the IoT: Overview and Motivations. Address Capabilities,IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6.	**10 Hrs**
Unit – III	
Application Protocols- Common Protocols, Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP) , Service discovery ,Simple Network Management Protocol(SNMP) ,Real-time transport and sessions , Industry-specific protocols.	**09 Hrs**
Unit – IV	
Wireless Embedded Internet- 6LoWPAN, 6LoWPAN history and standardization ,Relation of 6LoWPAN to other trends , Applications of 6LoWPAN , Example: facility management , The 6LoWPAN Architecture , 6LoWPAN Introduction ,The protocol stack, Link layers for 6LoWPAN, Addressing , Header format , Bootstrapping , Mesh topologies , Internet integration	**09 Hrs**
Unit –V	
***The evolution of computing models towards edge computing**-Shared and central resources versus exclusive and local computation , IoT disrupts the cloud, characteristics of the new computing model , Blueprint of edge computing intelligence Trend drivers and state of the art for edge intelligence Industry needs, Hardware evolution, Software evolution, Architecture	**09 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Acquire knowledge of different use cases of IoT in real time scenarios
CO2	Explain key technologies for connectivity and communications in IoT
CO3	Examine different application protocols and their roles in IoT
CO4	Propose IoT-enabled applications for building smart spaces and services with security features, resource management and edge computing.

Reference Books:	
1.	Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications, student edition ,Wiley, 2013. ISBN: 978-1-118-47347-4.
2.	Zach Shelby Sensinode , Carsten Bormann, 6LoWPAN: The Wireless Embedded Internet, 1st Edition, John Wiley & Sons Ltd, 2009 , ISBN 9780470747995
3.	ArshdeepBahga, Vijay Madisetti, Internet of Things: A Hands on Approach, 1st Edition, Universities Press., 2015, ISBN, : 978-81-7371-954-7
4*	www.iec.ch/whitepaper/pdf/IEC_WP_Edge_Intelligence.pdf

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						
DEEP LEARNING **(Group-D: Core Elective)** **(Common to CSE, CS)**						
Course Code	**:**	**18MCE2D2**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	
Deep Feedforward Networks: Multilayer Perceptron, Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation Algorithm	**08 Hrs**
Unit – II	
Convolutional Networks: Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the basic convolution function, Structured Outputs, Data types, Efficient Convolution Algorithms, Random or Unsupervised features, The Neuroscientific basis for convolutional networks	**10 Hrs**
Unit – III	
Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, The Long Short-Term Memory and Other Gated RNNs	**10 Hrs**
Unit – IV	
Autoencoders: Undercomplete Autoencoders, Regularized Autoencoders, Representational Power, Layer Size and Depth, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Applications of Autoencoders	**08 Hrs**
Unit –V	
Structured Probabilistic Models For Deep Learning: The challenge of unstructured modelling, Using graphs to describe model structure: Directed, Undirected, Partition function, Energy-based models, Factor graphs; Sampling from graphical models, Advantages of structured modelling, learning about dependencies, Inference and approximate inference, The deep learning approach to structured probabilistic models	**10 Hrs**

Course Outcomes: After going through this course the student will be able to:	
CO1	Describe basic concepts of neural network, its applications and various learning models
CO2	Acquire the knowledge on Recurrent, Recursive Nets and Auto-encoder models
CO3	Analyze different Network Architectures, learning tasks, Convolutional networks
CO4	Evaluate and compare the solutions by various Neural Network approaches for a given problem

Reference Books	
1.	Ian Good Fellow, YoshuaBengio and Aaron Courville,Deep Learning (Adaptive Computation and Machine Learning Series), MIT Press (3 January 2017), ISBN-13: 978-0262035613.
2.	Simon Haykin, Neural Networks – A Comprehensive Foundation, Second Edition, PHI, 2005.
3.	Gunjan Goswami, Introduction to Artificial Neural Networks, S.K. Kataria & Sons; 2012 Edition, ISBN-13: 978-9350142967.
4.	Nikhil Buduma, Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, by O'Reilly Publications, 2016 Edition, ISBN-13: 978-1491925614.

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						
SECURITY ENGINEERING **(Group-D: Core Elective)** **(Common to PG-CSE, PG-CS)**						
Course Code	**:**	**18MCE2D3**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**46L**		**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives (CLO):

Graduates shall be able to:

1. Gain knowledge on security Engineering.
2. Acquire knowledge of password attacks and phishing counter measures.
3. Analyse access control mechanisms.
4. Identify network attack and relevant defence mechanism.
5. Evaluate exploiting the Edge for security threat.

Unit – I	
What Is Security Engineering: Introduction, A framework, Examples. Usability and Psychology: Introduction, Attacks Based on Psychology: Pretexting, Phishing, Insights from Psychology Research, What the Brain Does Better Than Computer.	**09 Hrs**
Unit – II	
Passwords: Difficulties with Reliable Password Entry, Difficulties with Remembering the Password, Naive Password Choice, User Abilities and Training, Social-Engineering Attacks, Trusted Path, Phishing Countermeasures, The Future of Phishing, System Issues, Attacks on Password Entry.	**09 Hrs**
Unit – III	
Access Control: Introduction, Operating System Access Controls, Groups and Roles, Access Control Lists, Unix Operating System Security, Apple's OS/X, Windows — Basic Architecture, Capabilities, Windows — Added Features, Middleware, Database Access Controls, General Middleware Issues, ORBs and Policy Languages, Sandboxing and Proof-Carrying Code, Virtualization, Trusted Computing.	**09 Hrs**
Unit – IV	
Network Attack and Defense: Introduction, Vulnerabilities in Network Protocols, Attacks on Local Networks, Attacks Using Internet Protocols and Mechanisms. Trojans, Viruses, Worms and Rootkits, Defense Against Network Attack, Filtering: Firewalls, Spam Filters, Censor ware and Wiretaps, Intrusion Detection.	**09 Hrs**
Unit –V	
The Bleeding Edge: Introduction, Computer Games, Types of Cheating, Aimbots and Other Unauthorized Software, Virtual Worlds, Virtual Economies, Web Applications e Bay, Google. Social Networking Sites, Privacy Technology: Anonymous Email — The Dining Cryptographers and Mixes, Anonymous Web Browsing — Tor, Confidential and Anonymous Phone Calls, Email Encryption, Steganography and Forensics Countermeasures.	**10 Hrs**

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

CO1	Analyze attacks based on psychology, attacks on network and defence mechanisms
CO2	Identify password attacks and phishing counter measures.
CO3	Evaluate issues related to access control mechanisms.
CO4	Analyze exploiting the computing edge and countermeasures.

Reference Books:	
1	Rose Anderson, Security Engineering, 2nd Edition, Wiley 2012, ISBN-10: 1111138214.
2	William Stallings, Cryptography and Network Security, 6th Edition, ISBN-13: 978-0-13-335469-0.
3	Joseph MiggaKizza, Computer Network Security, Springer International Edition, 2009, ISBN 978-1-84800-916-5.
4	Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C, 2nd Edition, ISBN: 0-471-22357-3.

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

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:	
5.	Maintenance Engineering Handbook, Higgins & Morrow, SBN 10: 0070432015 / ISBN 13: 9780070432017, Published by McGraw-Hill Education. Da Information Services.
6.	H. P. Garg, Maintenance Engineering Principles, Practices & Management, 2009,S. Chand and Company, New Delhi, ISBN:9788121926447
7.	Fundamental Principles of Occupational Health and Safety, Benjamin O. ALLI, Second edition,2008 International Labour Office – Geneva: ILO, ISBN 978-92-2-120454-1
8.	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	
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.	**08 Hrs**
Unit – II	
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.	**07 Hrs**
Unit – III	
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.	**07 Hrs**
Unit – IV	
Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, Types of solar cells and fabrication. **Wind Energy:** Classification, Factors influencing wind, WECS & classification.	**07Hrs**
Unit-V	
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.	**07 Hrs**

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)

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		
PHYSICS OF MATERIALS (Group G: Global Elective)		
Course Code: 18PHY2G09		**CIE Marks: 100**
Credits: L:T:P:: 3:0:0		**SEE Marks: 100**
Hours: 36L		**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	
Crystal Structure : Symmetry elements-seven crystals systems-Reciprocal lattice-Packing fraction, Lattice Vibration-Brillouin zones, Analysis of Crystal structure using XRD, Thermal properties.	**07 Hrs**
Unit – II	
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.	**07 Hrs**
Unit -III	
Magnetic Materials : Dia and Paramagnetic materials-Quantum theory of paramagnetic materials-Paramagnetic susceptibility of conduction electrons-Ferro-anti ferromagnetic materials-Superconductors and Applications..	**07 Hrs**
Unit -IV	
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.	**07 Hrs**
Unit -V	
Novel Materials Smart materials-shape memory alloys-shape memory effects-Martensitia Transformation functional properties-processing-texture and its nature.	**08 Hrs**

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

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.

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: 36L		**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	
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.	**07 Hrs**
Unit – II	
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.	**07 Hrs**
Unit -III	
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.	**07 Hrs**
Unit -IV	
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.	**07 Hrs**
Unit -V	
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	**08 Hrs**

plausibility of serial dependence, sources of autocorrelation, Durbin-Watson test for auto correlated variables.	

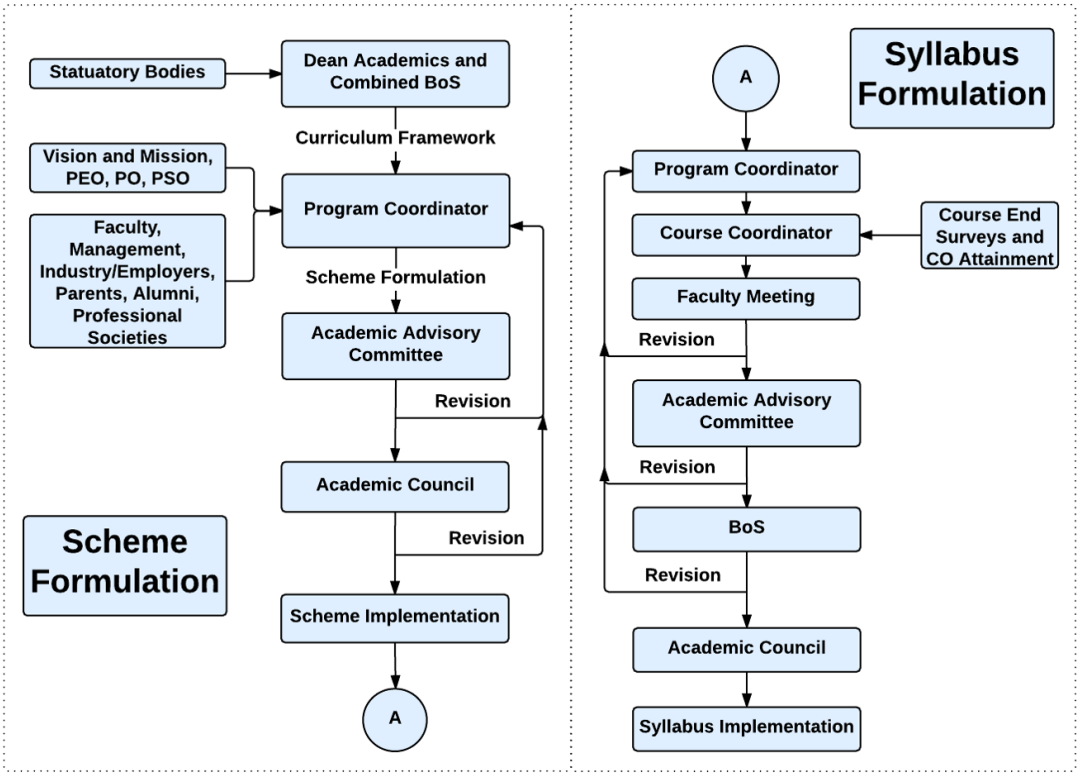
Reference Books:	
1	Fundamentals of Statistics (Vol. I and Vol. II), A. M. Goon, M. K. Gupta and B. Dasgupta, 3rd Edition, 1968, World Press Private Limited, ISBN-13: 978-8187567806.
2	Applied Statistics and Probability for Engineers, John Wiley & Sons, Inc., 3rd Edition, 2003, ISBN 0-471-20454-4.
3	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: After completing the course, the students will be able to	
CO1:	Identify and interpret the fundamental concepts of sampling techniques, estimates and types, hypothesis, linear statistical models and linear regression arising in various fields engineering
CO2:	Apply the knowledge and skills of simple random sampling, estimation, null and alternative hypotheses, errors, one way ANOVA, linear and multiple linear regressions.
CO3:	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.

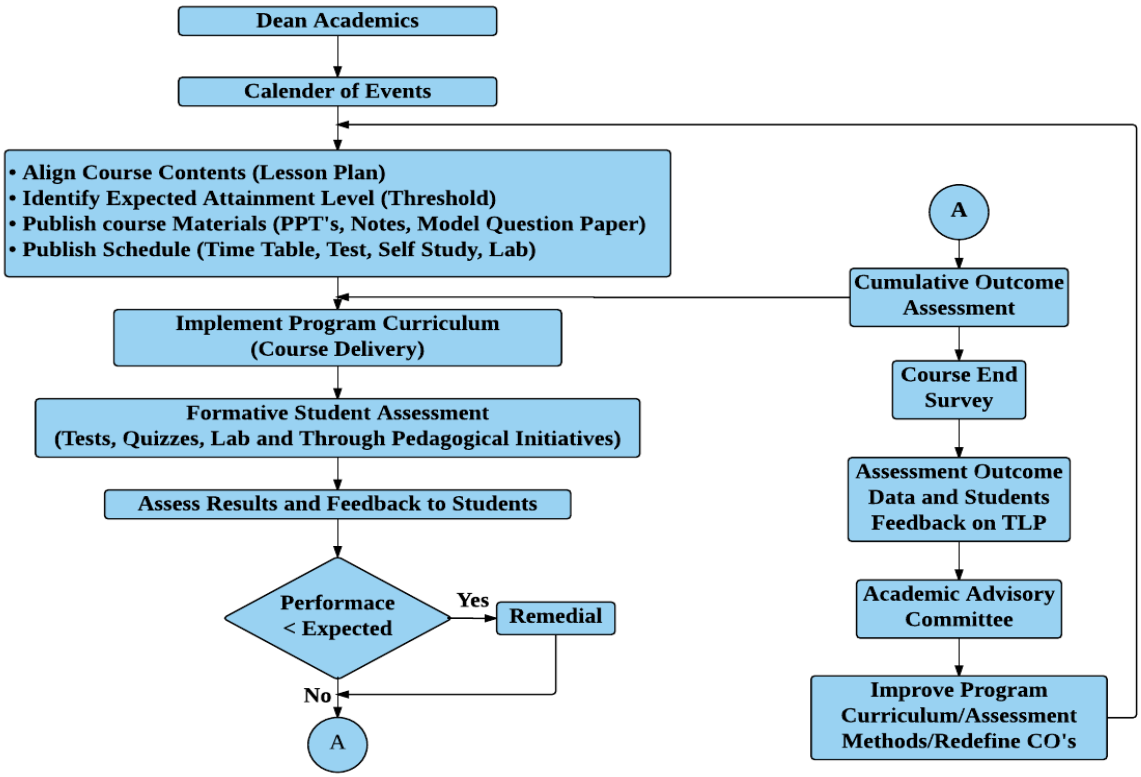
Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks):
CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. 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.

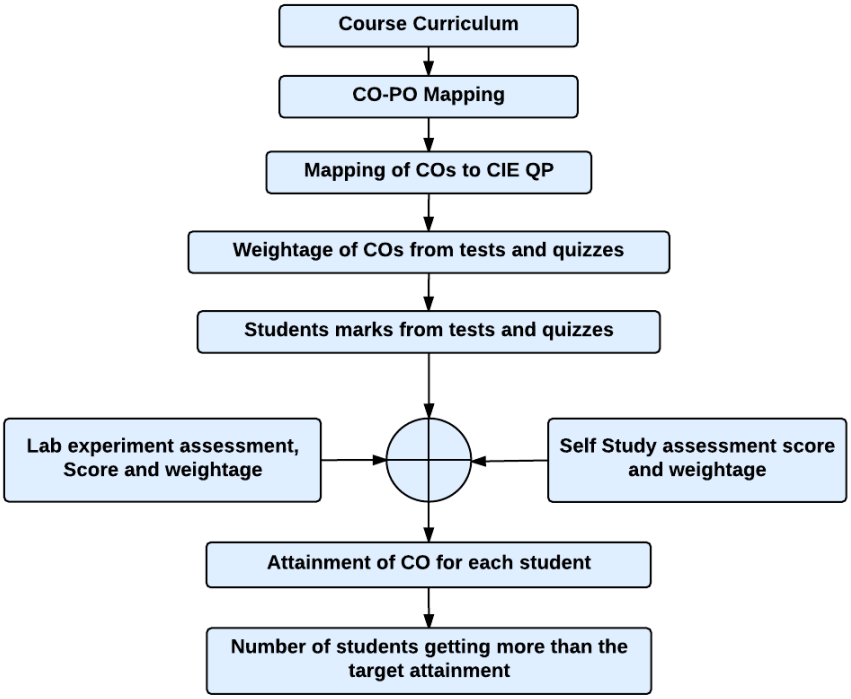
Curriculum Design Process



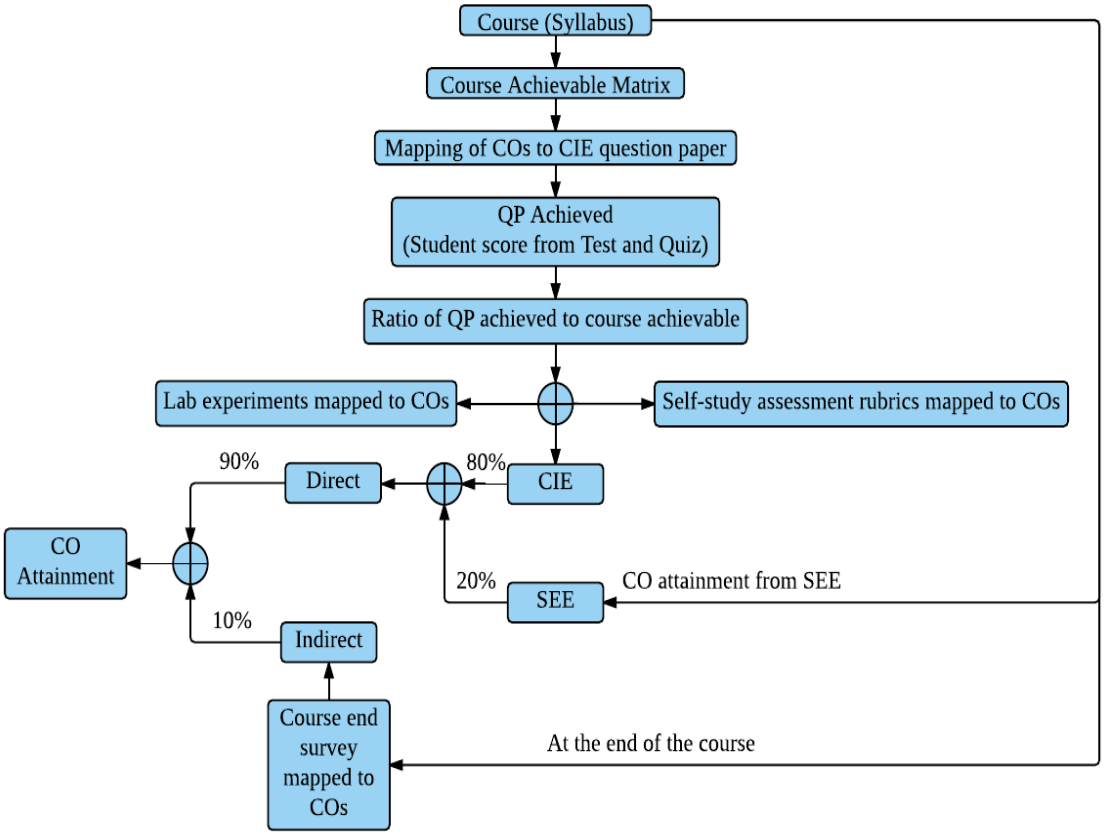
Academic Planning And Implementation



Process For Course Outcome Attainment



Final CO Attainment Process


Course (Syllabus)
Course Achievable Matrix
Mapping of COs to CIE question paper
QP Achieved
(Student score from Test and Quiz)
Ratio of QP achieved to course achievable
Lab experiments mapped to COs
Self-study assessment rubrics mapped to COs
90%
Direct
80%
CIE
CO
Attainment
20%
SEE
CO attainment from SEE
10%
Indirect
Course end
survey
mapped to
COs
At the end of the course

Program Outcome Attainment Process