RV COLLEGE OF ENGINEERING®

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

Scheme and Syllabus of I to IV Semester

(Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)

in

COMPUTER NETWORK ENGINEERING

DEPARTMENT OF

COMPUTER SCIENCE AND ENGINEERING

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work and Innovation

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COMPUTER NETWORK 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

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

PROGRAM OUTCOMES (PO)

The graduates of M. Tech. in Computer Network Engineering (CNE) Program will be able to:

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

PO2 Write and present a substantial technical report/document.

PO3 Demonstrate a degree of mastery over the area of Computer Network Engineering Program.

PO4 Explore, enhance and solve complex problems with a research perspective by evaluating, analyzing, designing and applying computer networking principles to solve real world scenarios by engaging in lifelong learning.

PO5 Demonstrate leadership skills and apply computer networking principles for projects considering ethical factors to accomplish a common goal for sustainable society.

PO6 Explore, select, learn and model computer network applications through use of tools

Program Specific Criteria for M. Tech. in Computer Network Engineering

Professional Bodies: IEEE-CS, ACM

The M.Tech program in Computer Network Engineering prepares the students for career in networking domain. The curriculum emphasizes (a) courses on Mathematics, Humanities, Ethics and Professional Practice, Information and Network Security, Computer Networks, Computer Network security, Wireless Communications along with elective courses. (b) problem solving, critical thinking and communication skills with focus on team work.

ABBREVIATIONS

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

CONTENTS

RV COLLEGE OF ENGINEERING®, BENGALURU - 560059
(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.Tech Program in COMPUTER NETWORK ENGINEERING

FIRST SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18 MAT 11B	Probability Theory and Linear Algebra	MT	4	0	0	4
2	18 MCN 12	Information and Network Security	CS	3	1	1	5
3	18 MCN 13	Advances in Computer Networks	CS	3	1	1	5
4	18 HSS 14	Professional Skill Development	HSS	0	0	0	0
5	18 MCN 1AX	Elective Group-A	CS	4	0	0	4
6	18 MCN 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**	**Credits**
1	18 MCN 21	Wireless Communication Technologies	CS	3	1	1	5
2	18 MCN 22	Advances in Network Management	CS	3	1	0	4
3	18 IM 23	Research Methodology	IEM	3	0	0	3
4	18 MCN 24	Minor Project	CS	0	0	2	2
5	18 MCN 2CX	Elective Group-C	CS	4	0	0	4
6	18 MCN 2DX	Elective Group-D	CS	4	0	0	4
7	18 XX 2GXX	Global Elective Group-G	CS	3	0	0	3
Total number of Credits				**20**	**2**	**3**	**25**
Total Number of Hours / Week				**20**	**4**	**6**	**30**

SEMESTER : I		
GROUP A: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	18MCN1A1	Wireless Ad-Hoc and Sensor Networks
2.	18MCN1A2	Data Management Essentials
3.	18MCE1A3	Applied Cryptography
GROUP B: PROFESSIONAL ELECTIVES		
1.	18MCN1B1	Cloud Computing Technology
2.	18MCN1B2	Information Coding
3.	18MCN1B3	Wireless Network Security
SEMESTER : II		
GROUP C: PROFESSIONAL ELECTIVES		
1.	18MCN2C1	Network Routing and Protocols
2.	18MCS2C2	Machine Learning
3.	18MCN2C3	Cloud Security
GROUP D: PROFESSIONAL ELECTIVES		
1.	18MCN2D1	Internet of Things and Applications
2.	18MCN2D2	Advances in Algorithms
3.	18MCE2D3	Security Engineering

GROUP G: 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.	CY	18CHY2G08	Composite Materials Science and Engineering	03
9.	PY	18PHY2G09	Physics of Materials	03
10.	MA	18MAT2G10	Advanced Statistical Methods	03

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.Tech Program in COMPUTER NETWORK ENGINEERING

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18MCN31	High Speed Networks	CS	4	1	0	**5**
2	18MCN32	Internship	CS	0	0	5	**5**
3	18MCN33	Major Project : Phase-I	CS	0	0	5	**5**
4	18MCN3EX	Professional Elective-E	CS	4	0	0	**4**
Total number of Credits				**8**	**1**	**10**	**19**
Total Number of Hours/Week				**8**	**2**	**20**	**30**

SEMESTER : III		
GROUP E: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
4.	18MCE3E1	Software Defined Systems
5.	18MCN3E2	Data Storage Technology and Networks
6.	18MCE3E3	Cyber Security

FOURTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18 MCN41	Major Project : Phase-II	CS	0	0	20	**20**
2	18 MCN42	Technical Seminar	CS	0	0	2	**2**
Total number of Credits				**0**	**0**	**22**	**22**
Total Number of Hours / Week				**0**	**0**	**44**	**44**

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

Unit – I	**10 Hrs**

Matrices and Vector spaces:

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

Unit – II	**10 Hrs**

Orthogonality and Projections of vectors:

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

Unit – III	**11 Hrs**

Random Variables:

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

Unit – IV	**11 Hrs**

Discrete and Continuous Distributions:

Binomial, Poisson, Exponential, Gaussian distributions.

Multiple Random variables:

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

Unit – V	**10 Hrs**

Random Processes:

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

Course Outcomes

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

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

Reference Books	
1	Probability, Statistics and Random Processes, T. Veerarajan, 3rd Edition, 2008, Tata McGraw Hill Education Private Limited, ISBN:978-0-07-066925-3.
2	Probability and Random Processes With Applications to Signal Processing and Communications, Scott. L. Miller and Donald. G. Childers, 2nd Edition, 2012, Elsevier Academic Press, ISBN 9780121726515.
3	Linear Algebra and its Applications, 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

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

Scheme of Semester End Examination (SEE) for 100 marks

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

SEMESTER : I						
INFORMATION AND NETWORK SECURITY (Theory and Practice)						
Course Code	**:**	**18MCN12**		**CIE Marks**	**:**	**100+50**
Credits L: T: P	**:**	**3:1:1**		**SEE Marks**	**:**	**100+50**
Hours	**:**	**39L+26T+26P**		**SEE Duration**	**:**	**3 + 3 Hrs**

Unit – I	**09 Hrs**

Basics of Information Security:
NSTISSC security model; Components of an Information System, Securing components, Balancing Information Security and Access, Approaches to Information Security implementation; The Security System Development Life Cycle. Introduction; Information Security Policy, Standards, and Practices;

Unit – II	**08 Hrs**

Classical Encryption Techniques

Symmetric Cipher Model- Cryptography, Cryptanalysis and Brute-Force Attack, Block Ciphers and the Data Encryption Standard - Traditional Block Cipher Structure- Stream Ciphers and Block Ciphers, Feistel Cipher Structure, The Data Encryption Standard-Encryption and Decryption, Advanced Encryption Standard-AES Structure-General and Detailed.

Unit – III	**08 Hrs**

Public Key Cryptography and RSA
Principles of Public-Key Cryptosystems-Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptosystems, Public-Key Cryptanalysis, The RSA algorithm-Algorithm, Computational Aspects, The security of RSA, Other Public key cryptography algorithms- Diffie-Hellman Key Exchange

Unit – IV	**07 Hrs**

Cryptographic Hash Functions
Applications of Cryptographic Hash Functions, Secure Hash Algorithms-SHA-512 Logic, Message Authentication Codes – Message Authentication Requirements, Message Authentication Functions-Message Encryption, Message Authentication Code, Digital Signatures-Properties, Attacks and Forgeries, Digital Signature Requirements, Direct Digital Signature, Remote Authentication: KERBEROS.

Unit –V	**07 Hrs**

Transport Layer Security and Network Security Applications:
Web Security Considerations, Secure Socket Layer, Transport Layer security, HTTPS, Secure Shell-SSH. Pretty good privacy, notation, operational description. Block chain: Introduction to block chain, types of block chain.

Unit – VI (Lab Component)	**2 Hrs/ Week**

PART A: ***Implement Programs from 1 to 4 in C / C++ or JAVA;***

1. Develop a program to demonstrate the secure data transmission using Encryption and Decryption.
2. Develop a program to demonstrate the usage of AES algorithm for Message Encryption and Decryption.
3. Develop a program to demonstrate the use of RSA cryptosystem for security.
4. Develop a program to demonstrate the usage of Diffie-Hellman key exchange for message authentication.

PART B: ***Simulate vulnerability tests, port scans and IDP using Penetration testing and Network security tools.***

1. Demonstrate the following using Nmap tool.
   - Determine open ports and services running in an host
   - Determine the operating system running on the host
   - Alter the source IP of the scan

2. Demonstrate the use of Digital signatures using Cryptool by performing following:
   - Creation of signature
   - Storing the signature
   - Verifying the signature

3. Demonstrate Intrusion Detection System using Snort tool by performing following:
   - Analyze packets, IP protocols
   - Capture alerts and send it to administrator
   - Detect Threats

4. Demonstrate Penetration testing using MetaSploit tool
   - Vulnerability scan Target services detection

Course Outcomes **After going through this course the student will be able to:**	
CO1	Analyze security policies and standards at organizational level.
CO2	Analyze the requirement of various security issues, block chain and provide a secure solution for applications.
CO3	Develop applications to ensure Confidentiality, Integrity and Authenticity of the information.
CO4	Apply appropriate cryptographic algorithms to ensure security of information through network.

Reference Books	
1	Principles of Information Security , Michael E. Whitman and Herbert J. Mattord, Cengage Learning; 4th Edition, 2012, ISBN-10: 1111138214.
2	Cryptography and Network Security, William Stallings, 6th Edition, ISBN-13: 978-0-13-335469-0.
3	Computer Network Security, Joseph Migga Kizza, Springer International Edition, 2009, ISBN 978-1-84800-916-5.
4	Mastering Block chain Packet Publishing Ltd. Imran Bashir, 1st Edition, 2017, ISBN 978-1-78712-544-5

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

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

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

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

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

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

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

SEMESTER : I						
ADVANCES IN COMPUTER NETWORKS (Theory and Practice)						
Course Code	**:**	**18MCN13**		**CIE Marks**	**:**	**100+50**
Credits L: T: P	**:**	**3:1:1**		**SEE Marks**	**:**	**100+50**
Hours	**:**	**39L+26T+26P**		**SEE Duration**	**:**	**3 + 3 Hrs**

Unit – I	**07 Hrs**

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.

Unit – II	**08 Hrs**

Internetworking

Internetworking, Service Model, Global Addresses, Special IP addresses, Datagram Forwarding in IP, Subnetting and classless addressing-Classless Interdomain Routing (CIDR), Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Routing, Routing Information Protocol(RIP), Switch Basics-Ports, Fabrics, Routing Networks through Banyan Network

Unit – III	**09 Hrs**

Advanced Internetworking

Router Implementation, Network Address Translation(NAT), The Global Internet-Routing Areas, Interdomain Routing(BGP), IP Version 6(IPv6), 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 (Mobile IP), Mobility in IPv6.

Unit – IV	**08 Hrs**

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.

Unit –V	**07 Hrs**

Congestion Control/Avoidance and Applications

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.

Domain Name System: Name space, Domain namespace, Distribution of Name space, DNS in the Internet, Resolution, DNS messages, Type of records, Registrars.

What Next: Internet of Things, Cloud Computing, The Future Internet, Deployment of IPv6

Unit – VI (Lab Component)	**2 Hrs/ Week**

PART A: ***Implement Programs from 1 to 3 in any programming language. Using any Protocol Analyzer to analyze exercises given from 4-5***

1. A program to implement routing protocol for a simple topology of routers that simulates the routing tables for routers for observing the working of IP protocol.
2. Design and demonstrate the concepts of client-server communication using TCP/UDP protocol.
3. Design a solution to compute the Internet checksum and verify the same.
4. Capture the packets that are transmitted after clicking on the URL of the web site of your college. Analyze the packets captured and prepare a brief report of your analysis w.r.t different protocols.

5. Capture the traffic, analyze the data at lower levels and demonstrate the layering of the protocols. Filter the captured packets in a LAN for a unique subscriber. **PART B:** ***Simulation Programs using Qualnet/ OPNET /NS3 or any other equivalent simulator*** 6. Simulate a 3 node point to point network with duplex links between them. Set the Queue size and vary the bandwidth and find the number of packets dropped. Simulate a four-node point-to-point network, and connect the links as follows: n0->n2, n1->n2 and n2->n3. Apply TCP agent changing the parameters and determine the number of packets sent/received by TCP/UDP.

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 implement algorithms in different layers to develop and implement effective communication mechanisms.
CO4	Apply emerging networking topics and solve the challenges in interfacing various protocols in real world.

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

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

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

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

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

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

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

Phase	**Activity**

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

SEMESTER : I						
WIRELESS ADHOC AND SENSOR NETWORKS (Professional Elective-A1)						
Course Code	**:**	**18MCN1A1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **11 Hrs**

Ad-hoc Wireless Networks

Introduction, Issues in Ad-hoc Wireless Networks, Adhoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols(MACAW,FAMA,BTMAMARCH), Contention-Based Protocols with Reservation Mechanisms(D-PRMA,CATA,HRMA) Contention-Based Protocols with Scheduling Mechanisms(DPS,DWOP).

Unit – II **10 Hrs**

Routing Protocols for Ad-hoc Wireless Networks

Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols(DSDV,WRP,CGSR); On-Demand Routing Protocols(DSR,AODV,LAR,ABR), Hybrid Routing Protocols(CEDAR,ZHLS).

Unit – III **11 Hrs**

Transport Layer and Security Protocols for Ad-hoc Networks

Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer, Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Secure routing Ad-hoc Wireless Networks.

Unit – IV **10 Hrs**

Basic Wireless Sensor Technology and Systems

Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, Wireless Transmission Technology and Systems, Available Wireless Technologies

Unit –V **10 Hrs**

Fundamentals of MAC Protocols

Routing Challenges and Design Issues in WSNs, Routing Strategies in WSNs. Middleware for Wireless Sensor Networks: Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware.

Case study: A Decade of Research in Opportunistic Networks: Challenges, Relevance, and Future Directions

Course Outcomes

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

CO1	Acquire appropriate knowledge to exploit the benefits of wireless adhoc and sensor networks
CO2	Analyze the protocol design issues of adhoc and sensor networks
CO3	Solve issues related to security provisioning for Adhoc networks
CO4	Critique protocol designs in terms of their energy-efficiency for various applications

Reference Books

1.	Ad-hoc Wireless Networks, C. Siva Ram Murthy & B. S. Manoj, Pearson Education, 2nd Edition, 2011, ISBN-10: 0132465698, ISBN-13: 9780132465694.
2.	Wireless Sensor Networks: Technology, Protocols and Applications, Kazem Sohraby, Daniel Minoli, Taieb Znati, WILEY, Second Edition (Indian), 2014, ISBN: 978-0-471-74300-2.
3.	Adhoc Wireless Networks, Ozan K Tonguz, Gianluigi Ferrari- 2nd edition, WILEY student Edition, ISBN-978-81-265-2304-7
4.	Wireless Sensor Networks- An Information Processing Approach, Feng Zhao & Leonidas J. Guibas, Elsevier, 2007, ISBN-9781558609143.

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

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

SEMESTER : I						
DATA MANAGEMENT ESSENTIALS (Professional Elective-A2)						
Course Code	**:**	**18MCN1A2**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**11 Hrs**
Data and information modeling and representation: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations and Dealing with Constraint Violations. Relational Database Design: Relational Database Design Using ER-to-Relational Mapping, Mapping EER Model Constructs to Relations.	
Unit – II	**10 Hrs**
SQL: SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Schema Change Statements in SQL, Basic Queries in SQL, Insert, Delete, and Update Statements in SQL.	
Unit – III	**11 Hrs**
Parallel database systems: Architecture of parallel databases, Parallel query evaluation, parallelizing joins and parallel − query optimization. **Distributed database systems:** Distributed database architecture, Properties of distributed database, Types of distributed database, storing data in a distributed DBMS, distributed query processing, Database Concurrency control protocols. Transaction failure and Recovery, Database recovery protocol.	
Unit – IV	**10 Hrs**
Data Pre-processing and Fundamentals of Data Mining Data cleaning, Data Integration and Transformation, Data Reduction. Data Warehouse and OLAP Technology: A Multidimensional data model, Data warehouse Architecture, Data warehouse implementation, From Data Warehousing to Data Mining. Working with R and other tools.	
Unit –V	**10 Hrs**
Data Models for Some Advanced Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. More Recent Applications: Mobile databases; Multimedia databases, Geographical Information Systems, Genome data management.	

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

CO1	Analyze appropriate database models to solve real world problem.
CO2	Design and represent the real world data using parallel, distributed and other enhanced database models
CO3	Apply SQL queries and enhanced database techniques using modern tools.
CO4	Examine the concept of relational, parallel and distributed database.

Reference Books

1	Fundamentals of database systems, Ramez Elmasri and B.Navathe, 6th Edition, Addison Wesley, 2013, ISBN 9780130575913.
2	Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, McGraw Hill,2007, ISBN 978-0072465631 .
3	Data Mining Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufmann Publishers, 3rd Edition, 2011, ISBN: 9780123814791.
4	Practical Data Science with R, Nina Zumel, John Mount, Manning Publications, 2014, ISBN: 9781617291562.

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

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

SEMESTER : I						
APPLIED CRYPTOGRAPHY (Professional Elective-A3)						
Course Code	**:**	**18MCE1A3**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I — **11 Hrs**

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.

Unit – II — **10 Hrs**

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.

Unit – III — **10 Hrs**

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.

Unit – IV — **10 Hrs**

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).

Unit –V — **11 Hrs**

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.

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	Handbook of Applied Cryptography, Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, CRC Press, Taylor and Francis Group, ISBN-13: 978-0-84-938523-0.
2	Applied Cryptography: Protocols, Algorithms, and Source Code in C, Bruce Schneier, 2nd Edition, **ISBN:**0-471-22357-3.
3	Cryptography and Network Security, William Stallings, 6th Edition, **ISBN-13:** 978-0-13-335469-0.

4	Cryptography Engineering: Design Principles and Practical Applications, Niels Ferguson, Bruce Schneier, Tadayoshi Kohno, 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

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

Scheme of Semester End Examination (SEE) for 100 marks

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

SEMESTER : I						
CLOUD COMPUTING TECHNOLOGY (Professional Elective-B1)						
Course Code	**:**	**18MCN1B1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **11 Hrs**

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

Unit – II **10 Hrs**

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

Unit – III **10 Hrs**

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.

Unit – IV **11 Hrs**

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.

Unit –V **10 Hrs**

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.

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.	Cloud Computing Theory and Practice. Dan C Marinescu: Elsevier (MK), 1st Edition, 2013, ISBN: 9780124046276.
2.	Distributed Computing and Cloud Computing, from parallel processing to internet of things. Kai Hwang, Geoffery C.Fox, Jack J Dongarra: Elsevier(MK), 1st Edition, 2012, ISBN: 978-0-12-385880-1
3.	Cloud Computing Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski: Willey, 1st Edition, 2014, ISBN: 978-0-470-88799-8.
4.	Cloud Computing Implementation, Management and Security, John W Rittinghouse, James F Ransome: 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

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

Scheme of Semester End Examination (SEE) for 100 marks

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

SEMESTER : I						
INFORMATION CODING (Professional Elective-B2)						
Course Code	**:**	**18MCN1B2**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**11 Hrs**
Information Theory: Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memory less channels – BSC, BEC – Channel capacity, Shannon limit.	
Unit – II	**10 Hrs**
Data Coding Techniques: Pulse Code Modulation-Delta Modulation-Adaptive Delta Modulation-Differential Pulse code modulation-Comparison of Different Pulse code Modulation Techniques. Textual Data Encoding techniques: ASCII-Unicode- Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm.	
Unit – III	**11 Hrs**
Audio and Speech Coding: Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Coding Speech at lower pulse rate(ADPCM) Channel Vocoder, Linear Predictive Coding. **Source Coding:** Image and Video, Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF.	
Unit – IV	**10 Hrs**
Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard.	
Unit –V	**10 Hrs**
Error Control Coding: Block Codes: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, *Cyclic codes - Syndrome calculation, Encoder and decoder - CRC -Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding	

Course Outcomes

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

CO1	Explore various concepts of Information Coding techniques
CO2	Apply appropriate coding techniques for different applications
CO3	Analyze the various coding, sampling and compression techniques
CO4	Implement data coding algorithms for real world applications

Reference Books

1.	Information Theory, Coding and Cryptography, R Bose, 2nd Edition, TMH, 2008 **ISBN:** 9780070669017
2.	A student's guide to Coding and Information Theory, Stefan M. Moser, Po-Ning Chen, Cambridge University Press, 2012. 1st Edition, ISBN-13: 978-1107684577 , ISBN-10: 1107684579.
3.	Digital Communication, Amitabha Bhattacharya, TMH 2006, Fred Halsall, Multimedia Communications: Applications, Networks, Protocols and Standards, Pearson Education Asia, 2011. ISBN-10: 0070591172
4*.	Technical Journal papers, white papers, manuals

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

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

SEMESTER : I						
WIRELESS NETWORKS SECURITY (Professional Elective-B3)						
Course Code	**:**	**18MCN1B3**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I — **11 Hrs**

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

Unit – II — **10 Hrs**

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

Unit – III — **10 Hrs**

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

Unit – IV — **11 Hrs**

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

Unit –V — **10 Hrs**

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

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.	Guide to Wireless Network security , John R.Vacca, 1st edition, 2006, Springer Publishers, ISBN 978-0-387-29845-0
2.	A Guide to Computer Network Security , Joseph Migga Kizza, Springer, 2009, ISBN: 978-1-84800-916-5

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

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

Scheme of Semester End Examination (SEE) for 100 marks

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

SEMESTER : II						
WIRELESS COMMUNICATION TECHNOLOGIES (Theory and Practice)						
Course Code	**:**	**18MCN21**		**CIE Marks**	**:**	**100+50**
Credits L: T: P	**:**	**3:1:1**		**SEE Marks**	**:**	**100+50**
Hours	**:**	**39L+26T+26P**		**SEE Duration**	**:**	**3 + 3 Hrs**

Unit – I	**08 Hrs**

Modern Wireless Communication Systems

Second generation (2G) cellular networks, Evolution of 2.5G wireless networks and standards, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL) and LMDS, Wireless Local Area Networks (WLANs), Bluetooth and Personal Area Networks (PANS), duplexing methods, Introduction to Fourth Generation (4G) and Fifth Generation (5G) Wireless Networks, Wireless Interoperability for Microwave Access (WiMAX) – Physical and MAC layer.

Unit – II	**08 Hrs**

The Cellular Concept-System Design Fundamentals

Introduction, Frequency reuse, channel assignment strategies, handoff strategies – prioritizing handoffs, Practical Handoff considerations, Interference and system capacity, co-channel interference and system capacity, channel planning for wireless systems, adjacent channel interference, power control for reducing interference, Capacity of cellular systems (FDMA and TDMA), Capacity of cellular CDMA systems.

Unit – III	**09 Hrs**

Mobile Radio Propagation and fading

Introduction to radio wave propagation, Free space propagation model, Three basic propagation mechanisms, Reflection, Diffraction- Fresnel Zone geometry, knife edge diffraction model, Scattering, Practical Link budget design- Log distance path loss model, log normal shadowing, Outdoor propagation models – Longley-Rice model, Durkins model, Okumura model, Small scale multipath propagation- factors influencing small scale fading, Doppler shift, Types of small scale Fading- Fading effects due to multipath time delay spread and Doppler spread.

Unit – IV	**07 Hrs**

Modulation Techniques for Mobile Radio

Frequency modulation Vs amplitude modulation, Digital Modulation – an overview, Factors that influence the choice of digital modulation, Bandwidth and Power Spectral Density of digital signal, Linear Modulation techniques –Binary phases shift keying (BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying(QPSK), Constant envelope modulation – Binary Frequency Shift Keying, Minimum Shift Keying(MSK)

Multiple Access Techniques: Introduction, Narrowband channelized systems, Spectral Efficiency, Wideband systems

Unit –V	**07 Hrs**

Security in Wireless Systems

Needs, Privacy definitions, Privacy requirements, Theft resistance, Radio System and Physical requirements, Law enforcement requirements

Wireless Personal Area Network:

ZigBee Technology- Components and topologies, IEEE 802.15.4 LR-WPAN device architecture, IEEE 802.15.3a- Ultra wideband, Radio Frequency Identification (RFID)

Tools: Wi-Fi Scanner, Aircrack, Kismet

UNIT-VI (Lab Component)	**2 Hrs/ Week**

Implement using MATLAB

1. Using MATLAB implement the Phase Shift Keying (8-PSK and 16-PSK) algorithms and compare their performance. Compute the Bit Error Rate (BER) for different bit rates.
2. Using MATLAB implement the Quadrature Amplitude Modulation (32-QAM and 64-QAM) algorithms and compare their performance. Compute the Bit Error Rate (BER) for different bit

rates.

3. Compare the performance of 16-PSK with 16-QAM for symbol error rate.

Simulation using QUALNET/NS3 tool

1 Setup a WLAN network with atleast two access points. Apply the CBR, VBR applications between stations belonging to same access points and different access points. Vary the number of access points and stations. Find out the delay in MAC layer, packet drop, and packet delivery ratio.

2. Setup a UMTS networks with atleast two eNodeB. Apply the UMTS call between two pairs of mobile devices and observe the performance by varying the distance. Provide roaming of any mobile station. Vary the number of eNodeB and mobile stations. Find out the delay in call establishment, call drop probability and call disconnection during handoff.

3. Setup a WiMAX network with atleast two base stations. Apply the CBR, VBR applications between subscriber stations belonging to same base station and different base stations. Provide roaming of any subscriber station. Vary the number of base stations and subscriber stations. Find out the delay in MAC layer, packet drop probability.

4. Setup a wireless sensor networks with atleast two device coordinators and nodes. Provide Constant Bit Rate (CBR), Variable Bit Rate (VBR) application between several nodes. Increase the number of coordinators and nodes in the same area and observe the performance at physical and MAC layers.

5. Setup a simple wireless sensor networks with atleast two device coordinators. Provide CBR, VBR application between several nodes. Apply different energy models and observe the performance at application and physical layers.

Course Outcomes

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

CO1	Describe the existing wireless networks and issues
CO2	Analyze the range of signals and path loss models in real world scenarios
CO3	Apply different mechanisms to test the medium access protocols and energy management at different levels
CO4	Design wireless network and frameworks for different applications.

Reference Books

1.	Wireless Communications, Principles and Practice, Theodore S Rappaport, Pearson Education Asia, 2nd edition, 2009, ISBN: 9780133755367
2.	Wireless Communications and Networking, Vijay K.Garg, Morgan Kaufmann Publishers, Indian Reprint, 2009,ISBN: 978-81-312-1889-1
3.	Wireless Communications and Networks, William Stallings: Pearson Education Asia, 2nd edition, 2005, ISBN 13: 9780131918351
4.	LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies, Sassan Ahmadi, Elsevier, 2014

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

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

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

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

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

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

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

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

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

SEMESTER : II						
ADVANCES IN NETWORK MANAGEMENT						
Course Code	**:**	**18MCN22**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**3:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**39L+26T**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **08 Hrs**

Network Management Overview

Data and Telecommunication Network, Distributed Computing Environments, Case Studies of Networking and Management, Networks Systems and Services, Challenges of Information Technology Managers**,** Network Management Goals, Organization and Functions, Goal of Network Management, Network Provisioning, Network Operations and the NOC, Network Installation and Maintenance, Network Management Architecture and Organization, Network Management Perspectives.

Unit – II **08 Hrs**

Basic Foundations: Standards, Models, and Language

Network Management Standards, Network Management Models, Organizational Model, Information model, Management Information Tree (MIT), Managed Object Perspective, Communication Model, Abstract Syntax Notation One: Terminology, Symbols and Conventions, Objects and Data Types, Object Names, An example of ASN.1 from ISO 8824, Encoding Structure, Macros, Functional Model

.

Unit – III **09 Hrs**

SNMPv1,v2,v3- Network Management

The SNMP Model, The Organization Model, System Overview, Information model, Introduction, The structure of Management Information, Managed Objects, Management Information Base (MIB). SNMP Communication Model, The SNMP Architecture, The Administrative Model, SNMP Protocol Specifications, SNMP Operations, The SNMP MIB Group, Functional Model. SNMPv2 System architecture, SNMPv3 Key features, Architecture, SNMPv3 applications, SNMPv3 Management Information base, Security, SNMPv3 User based Security Model, Access Control

Unit – IV **07 Hrs**

Remote Network Monitoring: RMON1, RMON2

RMON1 Textual Conventions, RMON1Groups and Functions, RMON1 Common and Ethernet Groups, RMON Token-Ring Extension Groups, RMON2 Management Information Base, RMNO2 Conformance Specifications, ATM Remote Monitoring, WAN Monitoring, Data Center Monitoring, Cloud Monitoring, Case Studies.

Unit –V **07 Hrs**

Network Management Tools, Systems and Engineering

System Utilities for management, SNMP Tools, Protocol Analyzer, Network Statistics Measurement Systems, Traffic Load Monitoring, Protocol Statistics, Data and Error Statistics, MIB Engineering, NMS Design, Network Management Systems, System and Application Management, Enterprise Management, Case Studies.

Web Based Network Management

NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop Management Interface, Web-Based Enterprise Management, XML Based NM Technology.

Course Outcomes

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

CO1	Apply various Network Management Protocols to Manage Practical Networks.
CO2	Identify and describe the different types of Network Management Protocols.
CO3	Analyze the issues and challenges pertaining to management of emerging Network Technologies.
CO4	Examine the various components of network and tools required to formulate the scheme for managing Enterprise and Complex networks.

Reference Books	
1.	Network Management – Principles and Practice , Mani Subramanian, 2nd Edition, Person Education Publication, 2012, ISBN-10: 8131727599, ISBN-13: 978-8131727591
2.	Network management Concepts and Practices: a Hands-On Approach , J. Richard Burke 1st Edition, PHI, 2008, ISBN-10: 8131718492, ISBN-13: 978-8131718490
3.	*Network management* , Stephen B. Morris, 1st Edition, Pearson Education, 2008, ISBN-10: 0131011138, ISBN-13: 978-0131011137
4.	Telecom Network Management , Terplan, 2nd Edition, PHI, 1998, ISBN-9780131687288

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

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

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

Scheme of Semester End Examination (SEE) for 100 marks

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

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

Unit – I **08 Hrs**

Overview of Research

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

Unit – II **08 Hrs**

Data and data collection

Overview of probability and data 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

Unit – III **08 Hrs**

Processing and analysis of Data

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

Unit – IV **08 Hrs**

Advanced statistical analyses

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

Unit-V **07 Hrs**

Essentials of Report writing and Ethical issues

Significance of Report Writing , Different Steps in Writing Report, Layout of the Research Report , Ethical issues related to Research, Publishing, Plagiarism

Case studies: Discussion of case studies specific to the domain area of specialization

Course Outcomes

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

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

Reference Books

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

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

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

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

Scheme of Semester End Examination (SEE) for 100 marks

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

SEMESTER : II						
MINOR PROJECT						
Course Code	**:**	**18MCN24**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**0:0:2**		**SEE Marks**	**:**	**100**
Hours/Week	**:**	**4**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

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

Course 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						
NETWORK ROUTING AND PROTOCOLS (Professional Elective-C1)						
Course Code	**:**	**18MCN2C1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **11 Hrs**

IP Traffic Engineering

Traffic, Stochasticity, Delay and Utilization, Applications View, An Architectural Framework, Traffic Engineering, IGP Metric, Determining IGP Link Weights via Duality of MCNF Problems, Illustration of Link Weight Determination Through Duality, Link Weight Determination, Large Networks, IP Traffic Engineering of PoP-to-Datacenter Networks.

Unit – II **09 Hrs**

IP Packet Filtering and Classification

Importance of Packet Classification, Packet Classification Problem, Packet Classification Algorithms, Naive Solutions, Two-Dimensional Solutions, Approaches for d Dimensions, Extending Two-Dimensional Solutions, Divide and Conquer Approaches, Tuple Space Approaches, Decision Tree Approaches, Hardware based Solutions

Unit – III **10 Hrs**

Routing in Reservation-Oriented Networks

Hierarchical Call Routing, The Road to Dynamic Routing, Dynamic Non-Hierarchical Routing(DNHR) Dynamically Controlled led Routing, Dynamic Alternate Routing, Real-Time Network Routing, Classification of Dynamic Call Routing Schemes, Maximum Allowable Residual Capacity Routing, Dynamic Routing and its Relation to Other Routing, Network Control for Traffic Engineering, Analysis of Dynamic Routing, Performance for Heterogeneous Services.

Unit – IV **11 Hrs**

GSTN and VOIP Call Routing

E.164 Addressing for GSTN, Provider identifier, Signaling System, SS7 Protocol Stack, SS7 ISUP and Call Processing, Call Routing, Call Routing with Multiple Service Providers, Number Portability, Non-Geographic or Toll-Free Number Portability, Multiple Provider Environment with Local number Portability, GSTN Call Routing using Internet, IP-GSTN Internetworking for VOIP, IP Multimedia Subsystems(IMS), All- IP Environment for VoIP services.

Unit –V **11 Hrs**

Routing and Traffic Engineering in Software Defined Networks and Data Center Networks

An Overview, Open Flow, Routing Decisions, Traffic Engineering for Aggregated Flow Routing, Flow management Approaches, Cloud Services and Data Center Applications, Data Center Network, Routing, Forwarding Requirements, Fat-Tree Data Center Topology, Port Land Approach for the Fat-Tree Topology, Multipath Routing and Traffic Engineering for Fat-Tree Topology, Software Defined Networking for Data Center Networks.

Course Outcomes

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

CO1	Explore different types of routing algorithms adopted in an Internet based applications.
CO2	Apply various routing protocols and standards used to optimize the routing in large networks.
CO3	Analyze the issues related to routing in an IP traffic engineering of complex networks.
CO4	Examine the various algorithms of routing used in VoIP call services and Traffic Engineering.

Reference Books

1.	Network Routing: Algorithms, Principles and Architectures, Deep Medhi, Karthik Ramasamy, Second Edition, Morgan Kaufmann publications, 2018, ISBN: 978-0-12-800737-2.
2.	IP Routing, Ravi Malhotra, First Edition, Oreilly Publication, 2002, ISBN: 81-7366-337-8
3.	Designing Large-Scale LANs, Kevin Dooley, First Edition, Oreilly Publication, 2002, ISBN: 81-7366-337-2.
4.	Technical and Research Papers on Traffic Engineering and Routing.

Sl. No.	Open ended experiments / Tutorial Questions
1.	Consider policy-based routing for accessing Internet from a flying aircraft. Identify various challenges and address these issues to make routing work for this service.
2.	Examine various router products from different vendors and determine which of them fall into four router architecture classification. Also investigate the router architecture and its classifications for 100 routers to manage the network resources.
3.	Consider a three-node network numbered 1,2 and 3. Suppose that the voice circuit capacity of the links and the pair-wise offered load are given as follows: **Link-ID Capacity Pair-ID Offered Load** 1-2 50 1:2 40 1-3 40 1:3 20 2-3 60 2:3 60 Determine the link call blocking probability and pair-wise call blocking capability. Trace if this problem has the bi-stability problem and scale up this for more link-ids, capacity as-well. For this load and capacity, does the network need to invoke any of the control scheme? If so address these schemes implementations.
4.	A Router needs to be designed using a shared memory switch with 8 line cards. Each line card is capable of 10 Gbps. The minimum size of the packet is 64 bytes. Assuming an interleaved memory design is used. How many memory banks will be required if the memory access time is 50nanosec, if the electrical loading on the bus is 0.6?. What should be the width of the bus? Generate the sequence of packets and its corresponding memory access time require when packet size increases in terms of binary value position.

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

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

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

Scheme of Semester End Examination (SEE) for 100 marks

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

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

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

Course Outcomes

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

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

Reference Books

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

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

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

SEMESTER : II						
CLOUD SECURITY (Professional Elective-C3)						
Course Code	**:**	**18MCN2C3**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I — **11 Hrs**

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

Unit – II — **10 Hrs**

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

Unit – III — **10 Hrs**

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

Unit – IV — **10 Hrs**

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

Unit –V — **11 Hrs**

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.

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	Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly Media; 1st Edition, 2009, ISBN: 0596802765
2	Securing the Cloud: Cloud Computer Security Techniques and Tactics Vic (J.R.) Winkler, **Imprint:** Syngress, 1st Edition, 2011, **ISBN:** 9781597495929
3	Cloud Security: A Comprehensive Guide to Secure Cloud Computing,Ronald L. Krutz, Russell Dean Vine, 1st Edition, 2010, ISBN-13: 978-0470589878, 2010, ISBN-10: 0470589876
4	Cloud Computing: Implementation, Management, and Security, John Rittinghouse, James Ransome, 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

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

Scheme of Semester End Examination (SEE) for 100 marks

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

SEMESTER : II						
INTERNET OF THINGS AND APPLICATIONS (Professional Elective-D1)						
Course Code	**:**	**18MCN2D1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**11 Hrs**

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

Unit – II	**11 Hrs**

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.

Unit – III	**10 Hrs**

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.

Unit – IV	**10 Hrs**

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

Unit –V	**10 Hrs**

***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.

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.	Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications,Daniel Minoli, student edition ,Wiley, 2013. ISBN: 978-1-118-47347-4.
2.	6LoWPAN: The Wireless Embedded Internet, Zach Shelby Sensinode , Carsten Bormann, 1st Edition, John Wiley & Sons Ltd, 2009 , ISBN 9780470747995
3.	Internet of Things: A Hands on Approach , ArshdeepBahga, Vijay Madisetti, 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

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

SEMESTER : II						
ADVANCES IN ALGORITHMS (Professional Elective-D2)						
Course Code	**:**	**18MCN2D2**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I — **12 Hrs**

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.

Heapsort
Heaps, Maintaining the heap property, Building a Heap, The Heap sort algorithm, priority queues

Sorting in Linear Time
Lower bounds for sorting, Counting sort, Radix sort, Bucket sort

Unit – II — **09 Hrs**

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

Unit – III — **09 Hrs**

Graph Algorithms
Bellman-Ford Algorithm, Shortest paths in a DAG, Dijkstra algorithm, Johnson's Algorithm for sparse graphs.

Maximum Flow:
Flow networks, Ford Fulkerson method and Maximum Bipartite Matching

Unit – IV — **11 Hrs**

Advanced Data structures
Definition of B-trees, Basic operations on B-trees, Deleting a key from B-tree, 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

Unit –V — **11 Hrs**

Multithreaded Algorithms
The basics of dynamic multithreading, Multithreaded matrix multiplication, Multithreaded merge sort

Approximation Algorithms
The vertex-cover problem, The traveling-salesman problem, The set-covering problem

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	Analyse algorithms for time and space complexity for various applications
CO3	Apply appropriate mathematical techniques to construct robust algorithms.
CO4	Demonstrate the ability to critically analyse and apply suitable algorithm for any given problem.

Reference Books

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

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

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

SEMESTER : II						
SECURITY ENGINEERING (Professional Elective-D3)						
Course Code	**:**	**18MCE2D3**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **11 Hrs**

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.

Unit – II **10 Hrs**

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.

Unit – III **10 Hrs**

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.

Unit – IV **10 Hrs**

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.

Unit –V **11 Hrs**

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.

Course Outcomes

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

CO1	Analyze attacks based on psychology, attacks on network and defines 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 Migga Kizza, 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

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

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

Unit – I **08 Hrs**

Business analytics

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

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

Unit – II **08 Hrs**

Trendiness and Regression Analysis

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

Unit – III **08 Hrs**

Organization Structures of Business analytics

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

Unit – IV **08 Hrs**

Forecasting Techniques

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

Unit –V **07 Hrs**

Decision Analysis

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

Course Outcomes

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

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

Reference Books

1	Business analytics Principles, Concepts, and Applications FT Press Analytics, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, 1st Edition, 2014, ISBN-13: 978-0133989403, ISBN-10: 0133989402
2	The Value of Business Analytics: Identifying the Path to Profitability, Evan Stubs , John Wiley & Sons, ISBN:9781118983881 |DOI:10.1002/9781118983881,1st Edition 2014
3	Business Analytics, James Evans, Pearsons Education 2nd Edition, ISBN-13: 978-0321997821 ISBN-10: 0321997824
4	Predictive Business Analytics Forward Looking Capabilities to Improve Business, Gary Cokins and Lawrence Maisel, 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks

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

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

UNIT – I	**7 Hrs**
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.	
UNIT – II	**9 Hrs**
Occupational health and safety: Introduction, Health, Occupational health: definition, Interaction between work and health, Health hazards, workplace, economy and sustainable development, Work as a factor in health promotion. Health protection and promotion Activities in the workplace: National governments, Management, Workers, Workers' representatives and unions, Communities, Occupational health professionals. Potential health hazards: Air contaminants, Chemical hazards, Biological hazards, Physical hazards, Ergonomic hazards, Psychosocial factors, Evaluation of health hazards: Exposure measurement techniques, Interpretation of findings recommended exposure limits. Controlling hazards: Engineering controls, Work practice controls, Administrative controls. Occupational diseases: Definition, Characteristics of occupational diseases, Prevention of occupational diseases.	
UNIT – III	**9 Hrs**
Hazardous Materials characteristics and effects on health: Introduction, Chemical Agents, Organic Liquids, Gases, Metals and Metallic Compounds, Particulates and Fibers, Alkalies and Oxidizers, General Manufacturing Materials, Chemical Substitutes, Allergens, Carcinogens, Mutagens, Reproductive Hazards, Sensitizers and Teratogens, Recommended Chemical Exposure Limits. Physical Agents, Noise and Vibration, Temperature and Pressure, Carcinogenicity, Mutagenicity and Teratogenicity. Ergonomic Stresses: Stress-Related Health Incidents, Eyestrain, Repetitive Motion, Lower Back Pain, Video Display Terminals.	
UNIT – IV	**7 Hrs**
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	
UNIT – V	**7 Hrs**
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, over hauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	

Course Outcomes **After successful completion of this course the student will be able to:**	
CO1	Explain the Industrial and Occupational health and safety and its importance.
CO2	Demonstrate the exposure of different materials, occupational environment to which the employee can expose in the industries.
CO3	Characterize the different type materials, with respect to safety and health hazards of it.
CO4	Analyze the different processes with regards to safety and health and the maintenance required in the industries to avoid accidents.

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

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

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

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

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

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

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

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

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

CO1	Explain the various Linear Programming models and their areas of application.
CO2	Formulate and solve problems using Linear Programming methods.
CO3	Develop models for real life problems using Linear Programming techniques.
CO4	Analyze solutions obtained through Linear Programming techniques.

Reference Books

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

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

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

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

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

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

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

Reference Books

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

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

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

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

Unit-I	**08 Hrs**

Energy conservation:
Principles of energy conservation, Energy audit and types of energy audit, Energy conservation approaches, Cogeneration and types of cogeneration, Heat Exchangers and classification.

Unit-II	**08 Hrs**

Wet Biomass Gasifiers:
Introduction, Classification of feedstock for biogas generation, Biomass conversion technologies: Wet and dry processes, Photosynthesis, Biogas generation, Factors affecting bio-digestion, Classification of biogas plants, Floating drum plant and fixed dome plant their advantages and disadvantages

Unit –III	**08 Hrs**

Dry Biomass Gasifiers :
Biomass energy conversion routes, Thermal gasification of biomass, Classification of gasifiers, Fixed bed systems: Construction and operation of up draught and down draught gasifiers.

Unit –IV	**08Hrs**

Solar Photovoltaic:
Principle of photovoltaic conversion of solar energy, Types of solar cells and fabrication.
Wind Energy: Classification, Factors influencing wind, WECS & classification.

Unit –V	**07 Hrs**

Alternative liquid fuels:
Introduction, Ethanol production: Raw materials, Pre-treatment, Conversion processes with detailed flow sheet. Gasification of wood: Detailed process, Gas purification and shift conversion, Biofuel from water hyacinth.

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

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

Reference Books

1	Nonconventional energy, Ashok V Desai, 5th Edition, 2011, New Age International (P) Limited, ISBN 13: 9788122402070.
2	Biogas Technology - A Practical Hand Book, 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

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

Scheme of Semester End Examination (SEE) for 100 marks

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

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

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

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

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

Reference Books

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

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

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

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

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

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

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

Reference Books

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

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

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

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

Unit-I — **08 Hrs**

Introduction to composite materials

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

Unit – II — **08 Hrs**

Polymer matrix composites (PMC)

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

Unit -III — **08 Hrs**

Ceramic matrix composites and special composites

Engineering ceramic materials – properties – advantages – limitations – 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.

Unit –IV — **07 Hrs**

Metal matrix composites

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder 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.

Unit –V — **08 Hrs**

Polymer nano composites

Introduction and Significance of polymer Nano composites. Intercalated And Exfoliated Nanocomposites. Classification of Nano fillers- nanolayers, nanotubes, nanoparticles. Preparation of Polymer Nano composites by Solution, In-situ Polymerization and melt mixing techniques. Characterization Of polymer nanocomposites- XRD, TEM, SEM and AFM. Mechanical and Rheological properties of Polymer Nano composites. Gas barrier,

Chemical-Resistance, Thermal and Flame retardant properties of polymer nanocomposites. Optical properties and Biodegradability studies of Polymer nanocomposites, Applications of polymer nano-composites.	
Course Outcomes **After completing the course, the students will be able to:**	
CO1	Understand the purpose and the ways to develop new materials upon proper combination of known materials.
CO2	Identify the basic constituents of a composite materials and list the choice 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, 3rdEdition Springer-verlag Gmbh,2012 , ISBN: 978-0387743646
2	The Science and Engineering of Materials, K Balani, Donald R Askeland, 6th Edition-Cengage, Publishers,2013, ISBN: 13: 978-8131516416
3	Polymer Science and Technology, Joel R Fried , 2nd Edition, Prentice Hall, 2014, ISBN: 13: 978-0137039555
4	Nanomaterials and nanocomposites, Rajendra Kumar Goyal , 2nd Edition, CRC Press-Taylor & Francis, 2010, ISBN: 10-9781498761666, 1498761666

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

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

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

Scheme of Semester End Examination (SEE) for 100 marks

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

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

Unit – I — **08 Hrs**

Crystal Structure

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

Unit – II — **08 Hrs**

Dielectric Materials

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

Unit – III — **08 Hrs**

Magnetic Materials

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

Unit – IV — **07 Hrs**

Semiconducting Materials

Semiconductors-Direct and Indirect band gap semiconductors, Importance of Quantum confinement-quantum wires and dots, size dependent properties, Top down approach, Fabrication process by Milling and Lithography, Bottom up approach, fabrication process by vapour phase expansion and vapor phase condensation, Polymer semi-conductors-Photo conductive polymers, Applications.

Unit –V — **08 Hrs**

Novel Materials

Smart materials-shape memory alloys, Austenite and Martensite phase, Effect of temperature and mechanical load on phase transformation, Pseudoeleasticity, Transformation hysteresis, Superelasticity, Characterization technique-Differntial Scanning calorimetry, Preparation technique-spin coating, Nitinol, CuAlNi alloy and applications. Biomaterials-Metallic, ceramic and polymer biomaterials, Titanium and Titanium alloys, Carbon nanotubes, Graphene- Properties and Applications.

Course Outcomes

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

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

Reference Books

1. Solid State Physics, S O Pillai, 6th Edition, New Age International Publishers, ISBN 10-8122436978.

2.	Introduction to Solid State Physics, C.Kittel, 7th Edition, 2003, John Wiley & Sons, ISBN 9971-51-780
3.	Engineering Physics, Dr.M N Avadhanulu, Dr. P G Kshirsagar, S Chand Publishing, Reprint 2015.
4.	The Science and Engineering of Materials, Askeland, Fulay, Wright, Balanai, 6th 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). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

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

Scheme of Semester End Examination (SEE) for 100 marks

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

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

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

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

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

Reference Books

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

4.	Regression Analysis: Concepts and Applications, F. A. Graybill and H. K. Iyer, Belmont, Calif,1994, Duxbury Press, ISBN-13: 978-0534198695.

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

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

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

Scheme of Semester End Examination (SEE) for 100 marks

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

SYLLABUS

FOR

SEMESTER III & IV

SEMESTER : III						
HIGH SPEED NETWORKS (Theory)						
Course Code	**:**	**18MCN31**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L+26T**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**12 Hrs**

High-Speed Networks: Packet Switching Networks, Frame Relay Networks, The Emergence of High Speed LANs, Ethernet, Fiber Channel, Wireless LANs, Emerging Passive Optical Network Technologies (EPONs), Gigabit Ethernet, 10 Gigabit Ethernet: 802.3ae Emerging Standard, Fiber Optic and the Magic of Light, Wave Length Division Multiplexing (WDM), Dense Wavelength Division Multiplexing (DWDM).

Unit – II	**11 Hrs**

Broadband ISDN architecture and Protocols:
Service Capabilities, Bearer Services and Teleservices, Basic and Supplementary services, SS7 Architecture, Protocol Architecture, B-ISDN standards, Broadband services, Requirements, Architecture, B-ISDN Protocol Reference Model, B-ISDN Physical Layer, SONET/ SDH.

Unit – III	**10 Hrs**

ATM Traffic and Congestion Control:
Asynchronous Transfer Mode, ATM Protocol Architecture, ATM Logical Connections, Transmission of ATM Cells, ATM Adaption Layers, Requirements for ATM Traffic and Congestion control, ATM Service Categories, ATM Traffic-Related Attributes, Traffic management Framework, Traffic management, ABR Traffic Management.

Unit – IV	**9 Hrs**

Congestion and Traffic Management:
Effects of Congestion, Congestion and control, Traffic Management, Congestion Control in packet-Switching Networks, Frame Relay Congestion Control, the need for Flow and Error Control, ARQ Performance, TCP Traffic Control: TCP Flow Control, TCP Congestion Control, Performance of TCP over ATM.

Unit-V	**10 Hrs**

Performance Modelling and Estimation:
Probability, Random Variables, Stochastic Processes, Queuing Models, Single-Server Queues, Multi-Server Queues, Queues with Priorities, Networks of Queues, Other Queuing Models, Self Similarity, Self-Similar Data traffic, Performance Implications of Self-Similarity, Modelling and Estimation of Self-Similar Data Traffic.

Course Outcomes:
CO1**:** Apply the principles and concepts of high speed networks in performance computing.
CO2: Analyze the basics of high speed network technologies and its components.
CO3: Analyze the cause of congestion, traffic slow down and related factors for Quality of Service.
CO4: Discover and solve the challenges of high Speed Networks and its related performance.

Reference Books:

1	ISDN and Broadband ISDN with Frame Relay and ATM, William Stallings, 4th Edition, Pearson Education Asia, 2006, ISBN:0-13-243310-9.
2	High-speed Networks and Internets, William Stallings, 2nd Edition, Pearson education, 2006, ISBN-13-9788177585698.
3	Broad band Networking, Glen Carty, Tata McGraw-Hill Edition 2002, ISBN: 0-07-052911-6.
4	IEEE / ACM Transactions on : Networking / Computers / Communications

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

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

SEMESTER : III						
INTERNSHIP						
Course Code	**:**	**18MCN32**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

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

Course Outcomes

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

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

Scheme of Continuous Internal Evaluation (CIE):

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

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

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

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

SEMESTER : III						
MAJOR PROJECT : PHASE-I						
Course Code	**:**	**18MCN33**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

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

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

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

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

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

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

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

SEMESTER : III						
SOFTWARE DEFINED SYSTEMS (Professional Elective-E1)						
Course Code	**:**	**18MCE3E1**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**
Unit – I						**10 Hrs**
Introduction. Centralized and Distributed Control and Data Planes. Introduction -Evolution versus Revolution. What Do They Do? - The Control Plane, Data Plane, Moving Information Between Planes, Why Can Separation Be Important? Distributed Control Planes - IP and MPLS, Creating the IP Underlay, Convergence Time, Load Balancing, High Availability, Creating the MPLS Overlay, Replication. Centralized Control Planes - Logical Versus Literal, ATM/LANE, Route Servers, Segment routing, Overlays – VXLAN, NVERGE.						
Unit – II						**10 Hrs**
OpenFlow. Introduction - Wire Protocol, Replication, FAWG (Forwarding Abstraction Workgroup), Config and Extensibility, Architecture. Hybrid Approaches - Ships in the Night, Dual Function Switches. **SDN Controllers.** Introduction. General Concepts – Vmware, Nicira, Vmware/Nicira, OpenFlow-Related, Mininet, NOX/POX. Trema, Ryu, Big Switch Networks/Floodlight. Layer 3 Centric - L3VPN, Path Computation Element Server. OF-CONFIG.						
Unit – III						**10 Hrs**
Network Programmability. Introduction. The Management Interface. The Application-Network Divide - The Command-Line Interface, NETCONF and NETMOD, SNMP. Modern Programmatic Interfaces - Publish and Subscribe Interfaces, XMPP. Google's Protocol Buffers - Thrift. JSON, I2RS. Modern Orchestration - OpenStack. CloudStack, Puppet.						
Unit – IV						**10 Hrs**
***Network Function Virtualization.** Introduction. Virtualization and Data Plane I/O - Data Plane I/O, I/O Summary. Services Engineered Path. Service Locations and Chaining – Metadata, An Application Level Approach, Scale, NFV at ETSI. Non-ETSI NFV Work - Middlebox Studies, Embrane/Line Rate, Platform Virtualization. Add OVS, OVN, OPNFV, Openstack						
Unit – V						**12 Hrs**
Building an SDN Framework. Introduction. Build Code First; Ask Questions Later. The Juniper SDN Framework. IETF SDN Framework(s) – SDN (P), ABNO. Open Daylight Controller/Framework – API, High Availability and State Storage, Analytics. Policy, MD-SAL, VTN, OVSDB. ONOS **Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring.** Introduction. Bandwidth Calendaring - Base Topology and Fundamental Concepts, Open Flow and PCE Topologies, Example Configuration, Open Flow Provisioned Example, Enhancing the Controller. Overlay Example Using PCE Provisioning, Expanding your reach: Barbarians at the gate. Big Data and Application Hyper-virtualization for Instant CSPF expanding topology.						
Course Outcomes **After going through this course the student will be able to:**						
CO1:	Differentiate between traditional networks and Software defined networks					
CO2:	Analyze the characteristics of Open Flow and SDN Controller					
CO3:	Explore and apply SDN concepts for network programmability and service virtualization.					
CO4:	Design application in SDN eco-system.					
Reference Books:						
1.	SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, 1st Edition. August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2.					
2.	Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, 1st Edition. June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844					

3.	Software defined networks: Design and Deployment, Particia A. Morreale and James M. Anderson. CRC Press, 1st edition, December 2014, ISBN: 9781482238631
4.	*Network function virtualization: Challenges and opportunities for innovation" by B Han et al, IEEE Communication Magazines, 2015

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

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

SEMESTER : III						
DATA STORAGE TECHNOLOGY AND NETWORKS (Professional Elective-E2)						
Course Code	**:**	**18MCN3E2**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Credits	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs.**

Unit – I	**10 Hrs**

Introduction to Storage Area Networks

What is storage area Network, SAN Components, SAN Connectivity, SAN storage, SAN Servers, Server centric and storage centric architecture, Architecture of Intelligent Disk sub systems, Hard disks and Internal I/O Channels, JBOD, Storage virtualization using RAID, RAID levels(All), Caching, Intelligent Disk Subsystems. Storage technologies: Direct Attached Storage(DAS), Network Attached Storage(NAS), Storage Area Network(SAS).

Unit – II	**10Hrs**

Fiber Channel Internals and Technologies

Fiber Channel, Layers, Optical Cables, Classes of service, Fiber channel Data movement, Data Transport, Flow Control, Addressing, Fiber Channel Topologies, Port Types, Fiber Channel arbitrated loop Protocols, Fiber Channel Login, Fiber Channel Fabric Services, Routing Mechanisms, Zoning. Gigabit Transport Technology, Inter- switch links

Unit – III	**11Hrs**

Storage Virtualization and Basic Software for Storage Networking

Storage Virtualization, Implementation Considerations, Storage Virtualization in Server, Storage Devices, Network, Symmetric and Asymmetric Storage Virtualization in the Network. Software for SANs, Shared Access Data Managers, Computer System I/O Performance, Volumes: Resilience, Performance and flexibility, File Systems and Application Performance

Unit – IV	**11Hrs**

Advanced Software for storage Networking

Data Replication, Different types of data replication, Synchronous and Asynchronous Replication, Using data Replication, Clusters, Data Center Clusters, Cluster Data Models, Cluster File Systems, Disaster Recovery and Global Clusters, Clusters and Storage Area Networks, Backup Management for SANs, Enterprise Data Protection and Backup Architecture.

Unit-V	**10Hrs**

Application and Management of Storage Networks

Application of Storage Networks, Storage Sharing, Availability of Data, Adaptability and Scalability of IT Systems, Capacity Planning, NAS Case Study: The International Image Processing, SAN Case study: The Import Auto Industry, SAN/NAS Management Case Study: The Southwestern CD Company

Course Outcomes:

At the end of this course graduates will be able to:

CO1:	Identify the different storage Technologies and protocols used for storage networks.
CO2:	Design and architect the storage solution for different application scenarios.
CO3:	Analyze the issues of different data storage techniques and data access methods in SAN.
CO4**:**	Examine the software technologies used to build the storage area networks.

Reference Books:

1.	Storage Networks Explained, Ulf Troppens, Wolfgang Muller-Freidt, Rainer Wolafka, John Wiley Publishers, 2nd Edition, 2009, ISBN: 978-81-265-1832-6.
2.	Storage Networks: The complete Reference, Robert Spalding, TataMcGraw, 1st Edition, 2003,ISBN:0-07-053292-3.
3.	Storage Area Network Essentials-A Complete Guide to Understanding and Implementing SANs, Richard Barker Paul Massiglia, John Wiley Publisher,2008, ISBN:978-0471034452.
4.	IEEE/ACM/Elsevier/SpringerTransactions:Networking/Communication and Information Networks / Cloud Computing / Network and Computer Applications / Transactions on Storage.

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

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

SEMESTER : III						
CYBER SECURITY (Professional Elective-E3)						
Course Code	**:**	**18MCE3E3**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Credits	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit–I	**10 Hrs**

Cyber Security Fundamentals

Network and Security Concepts, Information Assurance Fundamentals, Basic Cryptography, Symmetric Encryption, Public Key Encryption, The Domain Name System (DNS), Firewalls, Virtualization, Radio-Frequency Identification, Microsoft Windows Security Principles, Windows Tokens, Window Messaging, Windows Program Execution, The Windows Firewall

Unit–II	**10 Hrs**

Attacker Techniques and Motivations

How Hackers Cover Their Tracks (Anti-forensics), How and Why Attackers Use Proxies, Tunneling Techniques, Fraud Techniques, Phishing, Smishing, Vishing and Mobile Malicious Code, Rogue Anti-Virus, Click Fraud, Threat Infrastructure, Botnets, Fast-Flux, Advanced Fast-Flux.

Unit–III	**10 Hrs**

Exploitation

Techniques to Gain a Foothold, Shell code, Integer Overflow, Vulnerabilities, Stack-Based Buffer Overflows, Format-String Vulnerabilities, SQL Injection, Malicious PDF Files, Race Conditions, Web Exploit Tools, *DoS Conditions, Cross-Site Scripting (XSS).

Unit–IV	**10 Hrs**

Malicious Code

Self-Replicating Malicious Code, Worms, Viruses, Evading Detection and Elevating Privileges ,Obfuscation ,Virtual Machine Obfuscation ,Persistent Software Techniques, Rootkits, Spyware, Attacks against Privileged User Accounts and Escalation of Privileges, Stealing Information and Exploitation, Form Grabbing, Man-in-the-Middle Attacks.

Unit–V	**12 Hrs**

Defence and Analysis Techniques

Memory Forensics ,Why Memory Forensics Is Important, Capabilities of Memory Forensics ,Memory Analysis Frameworks, Dumping Physical Memory, Installing and Using Volatility, Finding Hidden Processes, Volatility Analyst Pack, Honeypots, Malicious Code Naming, Automated Malicious Code Analysis Systems, Passive Analysis, Active Analysis, Physical or Virtual Machines.

Course Outcomes:

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

CO1:	Apply the concepts of cyber security to various applications.
CO2:	Analyze the patterns and techniques used by attackers.
CO3:	Analyze various types of malicious codes and exploit to attack the system resources.
CO4:	Develop a defence mechanism to handle attacks.

Reference Books

1	Cyber Security Essentials, James Graham, Richard Howard, Ryan Olson- CRC Press, 2011 by Taylor and Francis Group. ISBN13: 978-1-4398-5126-5.
2	Cyber security: turning national solutions into international cooperation, James A. Lewis, Volume 25, Number 4, 2003 by center for strategic and international studies, ISBN: 0-89206-426-9.
3	Cyber security: The Essential Body of Knowledge, Dan Shoemaker, Ph.D., William Arthur Conklin, Wm Arthur Conklin 2012 by cengage learning, ISBN13:978-1-4354-8169-5.
4*	A Survey of Defense Mechanisms Against Distributed Denial of Service (DDoS) Flooding Attacks, S. T. Zargar, J. Joshi and D. Tipper, in IEEE Communications Surveys & Tutorials,

	vol. 15, no. 4, pp. 2046-2069, Fourth Quarter 2013.doi: 10.1109/SURV.2013.031413.00127

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

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

SEMESTER: IV						
MAJOR PROJECT : PHASE-II						
Course Code	**:**	**18MCN41**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:20**		**SEE Marks**	**:**	**100**
Hours/Week	**:**	**40**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

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

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

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

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

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

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

Scheme for Semester End Evaluation (SEE):
Major Project Phase-II SEE shall be conducted in two stages. This is initiated after fulfilment of submission of project report and CIE marks.

Stage-1 Report Evaluation
Evaluation of Project Report shall be done by guide and an external examiner.

Stage-2 Project Viva-voce
Major Project Viva-voce examination is conducted after receipt of evaluation reports from guide and external examiner.

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

SEE procedure is as follows:

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

SEMESTER : IV						
TECHNICAL SEMINAR						
Course Code	**:**	**18MCN42**		**CIE Marks**	**:**	**50**
Credits L:T:P	**:**	**0:0:2**		**SEE Marks**	**:**	**50**
Hours/Week	**:**	**4**		**SEE Duration**	**:**	**30 Mins**

GUIDELINES

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

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

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

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

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

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

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