M.TECH IN NETWORK AND INTERNET ENGINEERING (LNI)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER -I

MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

Course Code	20LNI11, 20SCS11, 20SCE11, 20SFC11, 20SCN11, 20SSE11, 20SIT11, 20SAM11, 20SIS11	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Vector Spaces: Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; coordinate vectors-Illustrative examples. Linear transformations, Representation of transformations by matrices;
(RBT Levels: **L1 & L2)** (Textbook:1)

Module-2

Orthogonality and least squares: Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves).
(RBT Levels: **L2 & L3)** (Textbook:1)

Module-3

Symmetric and Quadratic Forms: Diagonalization, Quadratic forms, Constrained Optimization, The Singular value decomposition. Applications to image processing and statistics, Principal Component Analysis
(RBT Levels: **L2 & L3)** (Textbook:1)

Module-4

Statistical Inference: Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non-linear)
(RBT Levels: **L2 & L3)** (Textbook:3)

Module-5

ProbabilityTheory: Random variable (discrete and continuous), Probability mass function (pmf), Probability density function (pdf), Mathematical expectation, Sampling theory: testing of hypothesis by ***t***-test, χ^2- test.
(RBT Levels: **L1 & L2)** (Textbook:3)

Course Outcomes:

On completion of this course, students are able to:

1. Understand the numerical methods to solve and find the roots of the equations.
2. Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems
3. Understand vector spaces and related topics arising in magnification and rotation of images.
4. Utilize the statistical tools in multi variable distributions.
5. Use probability formulations for new predictions with discrete and continuous RV's.

Question Paper Pattern:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question consisting of 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Linear Algebra and its Applications	David C. Lay, Steven R. Lay and J. J. McDonald	Pearson Education Ltd	5th Edition 2015.
2	Numerical methods for Scientific	M K Jain, S.R.K	New Age	6th Ed., 2014

	and Engg. Computation	Iyengar, R K. Jain	International	
3	Probability, Statistics and Random Process	T. Veerarajan	Tata Mc-Graw Hill Co	3rd Edition 2016
Reference books:				
Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Optimization: Theory & Applications Techniques	Rao. S.S	Wiley Eastern Ltd New Delhi.	
2	Signals, Systems, and Inference	Alan V. Oppenheim and George C. Verghese	Spring	2010.
3	Foundation Mathematics for Computer Science	John Vince	Springer International	
4	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Ed.,2017

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER –I

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	**20SCS12**, 20SSE254, 20SAM12, 20SIS31	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, problem Solving: state space search and control strategies

Module-2

Problem reduction and Game playing, Logic concepts and logic programming

Module-3

Advanced problem-solving paradigm: planning Knowledge representation

Module-4

Uncertainty Measure: Probability Theory, Bayesian Belief Networks,
Machine Learning Paradigms: Machine learning system, supervised and unsupervised learnings, Inductive, deductive learning, Clustering

Module-5

Support vector Machine, case-based reasoning and learning.
ANN: Single Layer, Multilayer. RBF, Design issues in ANN, Recurrent Network

Course outcomes: At the end of the course the student will be able to:

- Define Artificial intelligence and identify problems for AI. Characterize the search techniques to solve problems and recognize the scope of classical search techniques
- Define knowledge and its role in AI. Demonstrate the use of Logic in solving AI problems
- Demonstrate handling of uncertain knowledge and reasoning in probability theory.
- Understanding of Learning methods

Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**

1	Artificial Intelligence:	SarojKaushik	Cengage Learning	2014 Edition
Reference Books				
1	Artificial Intelligence: Structures and Strategies for Complex Problem Solving	George F Luger	Pearson Addison Wesley	6th Ed, 2008
2	Artificial Intelligence	E Rich, K Knight, and S B Nair	Tata Mc-Graw Hill	3rd Ed, 2009
3	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Prentice Hall	3rd, 2009

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER -I

ADVANCES IN DATA BASE MANAGEMENT SYSTEM

Course Code	**20SCS13,** 20SCE252, 20SIT14, 20SSE15,	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Review of Relational Data Model and Relational Database Constraints:
Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations.

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

Module-2

Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures:
Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures.

Distributed Database Concepts:
Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases,Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems , Distributed Database Architectures, Distributed Catalogue Management.

Module-3

NOSQL Databases and Big Data Storage Systems:
Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j.

Big Data Technologies Based on MapReduce and Hadoop:
What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion

Module-4

Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases: Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Introduction to Deductive Databases.

Introduction to Information Retrieval and Web Search: Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text pre-processing, Inverted Indexing, Evaluation Measures of Search relevance, web Search and Analysis. Trends in Information Retrieval

Module-5

Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, Approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools

Overview of Data Warehousing and OLAP: Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modelling for Data Warehouses, building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.

Course outcomes:
At the end of the course the student will be able to:

- Select the appropriate high-performance database like parallel and distributed database
- Infer and represent the real-world data using object-oriented database
- Interpret rule set in the database to implement data warehousing of mining
- Discover and design database for recent applications database for better interoperability

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Fundamentals of Database Systems	Elmasri and Navathe	Pearson Education	2013
2	Database Management Systems	Raghu Ramakrishnan and Johannes Gehrke	McGraw-Hill	3rd Edition, 2013.
Reference Books				
1	Database System Concepts	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw Hill	6th Edition, 2010

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – I

ADVANCED ALGORITHMS

Course Code	**20SCS14,** 20SSE244, 20SIS321	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

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

Module-2

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

Module-3

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

Module-4

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

Module-5

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

Course outcomes:

At the end of the course the student will be able to:

- Design and apply iterative and recursive algorithms.
- Design and implement optimization algorithms in specific applications.
- Design appropriate shared objects and concurrent objects for applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Introduction to Algorithms	T. H Cormen, C E Leiserson, R L Rivest and C Stein	PHI	3rd Edition, 2010
2	Algorithms	Kenneth A. Berman	Cengage Learning	2002.

Reference Books

1	Fundamentals of Computer Algorithms	Ellis Horowitz, SartajSahni, S.Rajasekharan	Universities press	2nd Edition, 2007

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – I

INTERNET OF THINGS AND APPLICATIONS

Course Code	**20SCS15**, 20LNI22, 20SCE23, 20SCN14, 20SAM323, 20SIS14	CIE Marks	20+20 (IA test+ Mini project)
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Note: CIE marks can be distributed as: IA test (20 marks) + Mini project (individual/Group) 20 Marks

Module-1

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

Module -2

Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards-Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF Ipv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO

Module – 3

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 Tunnelling, Ipsec in Ipv6,Header Compression Schemes, Quality of Service in Ipv6, Migration Strategies to Ipv6.

Module-4

Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.

Module-5

Data Analytics for IoT – Introduction, Apache Hadoop, Using HadoopMapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study.

Note: CIE marks can be distributed as: IA test (20 marks) + Mini project (individual/Group) 20 Marks

Course outcomes:

At the end of the course the student will be able to:

- Develop schemes for the applications of IOT in real time scenarios
- Manage the Internet resources
- Model the Internet of things to business
- Understand the practical knowledge through different case studies

Understand data sets received through IoT devices and tools used for analysis

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Building the Internet of Things with Ipv6 and MIPv6:The Evolving World of M2M Communications	Daniel Minoli	Wiley	2013
2	Internet of Things: A Hands-on Approach	ArshdeepBahga, Vijay Madisetti	Universities Press	2015
Reference Books				
1	The Internet of Things	Michael Miller	Pearson	2015 First Edition
2	Designing Connected Products	Claire Rowland,Elizabeth Goodman et.al	O'Reilly	First Edition, 2015

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – I

ALGORITHMS AND DATABASE MANAGEMENT SYSTEMS LABORATORY

Course Code	**20SCSL16**	CIE Marks	40
Teaching Hours/Week (L:P:S)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

PART A: Algorithms Laboratory

List of Experiments:

1. Program to implement Ford-Fulkerson method.

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

PART B: ADBMS Laboratory

List of Experiments

Note: The following experiments may be implemented on MySQL/ORACLE or any other suitable RDBMS with support for Object features

1. **Develop a database application to demonstrate storing and retrieving of BLOB and CLOB objects.**
   a. Write a binary large object (BLOB) to a database as either binary or character (CLOB) data, depending on the type of the field in your data source. To write a BLOB value to the database, issue the appropriate INSERT or UPDATE statement and pass the BLOB value as an input parameter. If your BLOB is stored as text, such as a SQL Server text field, pass the BLOB as a string parameter. If the BLOB is stored in binary format, such as a SQL Server image field, pass an array of type byte as a binary parameter.
   b. Once storing of BLOB and CLOB objects is done, retrieve them and display the results accordingly.

2. **Develop a database application to demonstrate the representation of multi valued attributes, and the use of nested tables to represent complex objects. Write suitable queries to demonstrate their use.**

   Consider Purchase Order Example: This example is based on a typical business activity: managing customer orders. Need to demonstrate how the application might evolve from relational to object-relational, and how you could write it from scratch using a pure object-oriented approach.
   a. Show how to implement the schema -- Implementing the Application under the Relational Model -- using only Oracle's built-in data types. Build an object-oriented application on top of this relational schema using object views

3. **Design and develop a suitable Student Database application by considering appropriate attributes. Couple of attributes to be maintained is the Attendance of a student in each subject for which he/she has enrolled and Internal Assessment Using TRIGGERS, write active rules to do the following:**
   a. Whenever the attendance is updated, check if the attendance is less than 85%; if so, notify the Head of the Department concerned.
   b. Whenever, the marks in an Internal Assessment Test are entered, check if the marks are less than 40%; if so, notify the Head of the Department concerned.

Use the following guidelines when designing triggers:

- Use triggers to guarantee that when a specific operation is performed, related actions are performed.
- Use database triggers only for centralized, global operations that should be fired for the triggering statement, regardless of which user or database application issues the statement.
- Do not define triggers that duplicate the functionality already built into Oracle. For example, do not define triggers to enforce data integrity rules that can be easily enforced using declarative integrity constraints.
- Limit the size of triggers (60 lines or fewer is a good guideline). If the logic for your trigger requires much more than 60 lines of PL/SQL code, it is better to include most of the code in a stored procedure, and call the procedure from the trigger.
- Be careful not to create recursive triggers. For example, creating an AFTER UPDATE statement trigger on the EMP table that itself issues an UPDATE statement on EMP causes the trigger to fire recursively until it has run out of memory.

1. **Design, develop, and execute a program to implement specific Apriori algorithm for**

mining association rules. Run the program against any large database available in the public domain and discuss the results.

Association rules are if/then statements that help uncover relationships between seemingly unrelated data in a relational database or other information repository. An example of an association rule would be "If a customer buys a dozen eggs, he is 80% likely to also purchase milk."

Course outcomes:
At the end of the course the student will be able to:

- Work on the concepts of Software Testing and ADBMS at the practical level
- Compare and pick out the right type of software testing process for any given real-world problem
- Carry out the software testing process in efficient way
- Establish a quality environment as specified in standards for developing quality software
- Model and represent the real-world data using object-oriented database
- Embed the rules set in the database to implement various features of ADBMS
- Choose, design and implement recent applications database for better interoperability

Conduction of Practical Examination:
All laboratory experiments (nos) are to be included for practical examination.
Students to pick one experiment from **each part and execute both**
Strictly follow the instructions as printed on the cover page of answer script for breakup of marks
Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.

RESEARCH METHODOLOGY AND IPR			
Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEE Marks	60
Credits	02	Exam Hours	03

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.
Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.
Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.
Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.
Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.
Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Course outcomes:
At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbooks

(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.

(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.

(3) Study Material (For the topic Intellectual Property under module 5),
Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books

(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – II

DATA SCIENCE

Course Code	**20SCS21,** 20SAM14, 20SIS22	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets. NeededStatistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model, - Introduction to R

Module-2

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA,The Data Science Process, Case Study: RealDirect (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k-NN), k-means

Module-3

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web

Module-4

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests. Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system

Module-5

Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighbourhood properties in graphs, Data Visualization: Basic principles, ideas and tools for data visualization. Data Science and Ethical Issues, Discussions on privacy, security, ethics, Next-generation data scientists

Course outcomes:
At the end of the course the student will be able to:

- Define data science and its fundamentals
- Demonstrate the process in data science
- Explain machine learning algorithms necessary for data sciences
- Illustrate the process of feature selection and analysis of data analysis algorithms
- Visualize the data and follow of ethics

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Doing Data Science	Cathy O'Neil and Rachel Schutt	Straight Talk from The Frontline.O'Reilly	2014
2	Mining of Massive Datasets. V2.1	Jure Leskovek, AnandRajaraman and Jeffrey Ullman	Cambridge University Press	2014
Reference Books				
1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy		2013
2	Data Mining: Concepts and Techniques	Jiawei Han, MichelineKamber and Jian Pei	ThirdEdition	2012.
3	Practical Statistics for Data Scientists	Peter Bruce and Andrew Bruce	O'reilly series	

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – II

SEMANTIC WEB AND SOCIAL NETWORKS

Course Code	**20SCS22,** 20LNI12, 20SAM332	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Web Intelligence Thinking and Intelligent Web Applications, The Information age,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

Module 2

Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

Module 3

Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

Module 4

Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

Module 5

Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate the semantic web technologies like RDF Ontology and others
- Learn the various semantic web applications
- Identify the architectures and challenges in building social networks
- Analyse the performance of social networks using electronic sources

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Thinking on the Web	Berners Lee, Godel and Turing	Wiley inter science	2008
2	Social Networks and the Semantic Web	Peter Mika	Springer	2007
Reference Books				
1	Semantic Web and Semantic Web Services	Liyang Lu Chapman and Hall	CRC Publishers	
2	Semantic Web Technologies, Trends and Research in Ontology Based Systems.			
3	Programming the Semantic Web	T.Segaran, C.Evans, J.Taylor	O'Reilly.	

M.TECH IN **COMPUTER NETWORK ENGINEERING (SCN), COMPUTER SCIENCE & ENGINEERING(SCS) ARTIFICIAL INTELLIGENCE & MACHINE LEARNING(SAM)**

Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - I

BLOCKCHAIN TECHNOLOGY

Course Code	20SCN15, 20SCS23, 20SAM254,	CIE Marks	40
Teaching Hours/Wee(L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

The blockchain technology course allows the students to explore the driving force behind the cryptocurrency Bitcoin. Along with the Decentralization, Cryptography, Bitcoins with its alternative coins, Smart contracts and outside of currencies.

Module-1

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

Module-2

Decentralization and Cryptography:
Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys

Module-3

Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins, Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Module-4

Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts. Ethereum 101:Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.

Module-5

Alternative Blockchains: Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media

Course outcomes:

At the end of the course the student will be able to:

1. Understand the types, benefits and limitation of blockchain.
2. Explore the blockchain decentralization and cryptography concepts.
3. Enumerate the Bitcoin features and its alternative options.
4. Describe and deploy the smart contracts
5. Summarize the blockchain features outside of currencies.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.
-

Textbook/ Textbooks

1 Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017

Reference Books

1 Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016

2 Blockchain Basics: A Non-Technical Introduction in 25 Steps, Author- Daniel Drescher, Apress, First Edition, 2017

3 Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**			
ADVANCED CRYPTOGRAPHY			
Course Code	**20SCS241**, 20LNI254	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Number Theory: Introduction to number theory, Overview of modular arithmetic, discrete logarithms, and primality/factoring, Euclid's algorithm, Finite fields, Prime numbers, Fermat's and Euler's theorem-Testing for primality.			
Module-2			
Symmetric & Asymmetric Cryptography: Classical encryption techniques, Block cipher design principles and modes of operation, Data encryption standard, Evaluation criteria for AES, AES cipher, Principles of public key cryptosystems, The RSA algorithm, Key management – Diffie Hellman Key exchange, Elliptic curve arithmetic-Elliptic curve cryptography.			
Module-3			
Authentication functions:MAC,Hash function, Security of hash function and MAC,MD5,SHA,HMAC, CMAC, Digital signature and authentication protocols, DSS,EI Gamal – Schnorr.			
Module-4			
Authentication applications: Kerberos & X.509 Authentication services Internet Firewalls for Trusted System: Roles of Firewalls , Firewall related terminology-,Types of Firewalls ,Firewall designs, Intrusion detection system , Virus and related threats, Countermeasures , Firewalls design principles ,Trusted systems, Practical implementation of cryptography and security.			
Module-5			
Quantum Cryptography and Quantum Teleportation: Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, local vs. nonlocal interactions,			

entanglements, EPR paradox, Bell's theorem, Bell basis, teleportation of a single qubit theory and experiments.

Course outcomes:

At the end of the course the student will be able to:

- Understand OSI security architecture and classical encryption techniques.
- Acquire fundamental knowledge on the concepts of finite fields and number theory.
- Understand various block cipher and stream cipher models.
- Describe the principles of public key cryptosystems, hash functions and digital signature.
- Compare various Cryptographic Techniques
- Design Secure applications
- Inject secure coding in the developed applications

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Cryptography and Network Security Principles And Practice	William Stallings	Pearson Education	Fourth Edition
2	A Course in Number Theory and Cryptology	Neal Koblitz	Springer	1987
Reference Books				
1	Cryptography and Network Security	Behrouz A Forouzan, DebdeepMukhopadhyay	Mc-GrawHill	3rd Edition, 2015
2	Applied Cryptography and Network Security	Damien Vergnaud and Michel Abdalla	7th International Conference, ACNS 2009, Paris-Rocquencourt, France	June 2-5, 2009, Proceedings
3	**Quantum Computation and Quantum Information**	**Michael A. Nielsen and Issac L Chuang**	**Cambridge University Press**	**10th Anniversary Edition Hardcover – Illustrated 2010**

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - II

NATURAL LANGUAGE PROCESSING

Course Code	**20SCS242**, 20SCE243, 20SAM23	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

OVERVIEW AND LANGUAGE MODELING: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.

Module -2

WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite-

State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

Module - 3

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.

Module-4

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modelling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically based Text Mining: Related Work, A Semantically Guided Model for Effective Text mining.

Module-5

INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

Course outcomes:

At the end of the course the student will be able to:

- Analyse the natural language text.
- Generate the natural language.
- Demonstrate Text mining.
- Apply information retrieval techniques.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Natural Language Processing and Information Retrieval	TanveerSiddiqui, U.S. Tiwary	Oxford University Press	2008
2	Anne Kao and Stephen R. Potee	Natural LanguageProcessing andText Mining	Springer-Verlag London Limited	2007

Reference Books

1	Speech and Language Processing: Anintroduction to Natural Language Processing, Computational Linguistics and SpeechRecognition	Daniel Jurafsky and James H Martin	Prentice Hall	2008 2nd Edition
2	Natural Language Understanding	James Allen	Benjamin/Cummingsp ublishing company	2nd edition, 1995
3	Information Storage and Retrieval systems	Gerald J. Kowalski and Mark.T.	Kluwer academic Publishers	2000.

		Maybury		
4	Natural Language Processing with Python	Steven Bird, Ewan Klein, Edward Loper	O'Reilly Media	2009
5	Foundations of Statistical Natural Language Processing	Christopher D.Manning and HinrichSchutze	MIT Press	1999

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – II

CLOUD COMPUTING

Course Code	**20SCS243**, 20LNI15, 20SCE14, 20SIT22, 20SSE251, 20SCN31, 20SIS12	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, 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, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.

Module 2

Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.

Module 3

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems

Module 4

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, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.

Module 5

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.

Course outcomes:
At the end of the course the student will be able to:

- Compare the strengths and limitations of cloud computing

- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player
- Address the core issues of cloud computing such as security, privacy and interoperability
- Design Cloud Services
- Set a private cloud

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Cloud Computing Theory and Practice	Dan C Marinescu	Elsevier(MK)	2013.
Reference Books				
1	RajkumarBuyya , James Broberg, AndrzejGoscinski	Computing Principles and Paradigms	Willey	2014
2	Cloud Computing Implementation, Management and Security	John W Rittinghouse, James F Ransome	CRC Press	2013

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - II

PATTERN RECOGNITION

Course Code	**20SCS244**, 20SCE242, 20SAM253	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems

Module -2

Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation

Module – 3

Nearest Neighbour based classifiers & Bayes classifier: Nearest neighbour algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network

Module-4

Naive Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, Over fitting & Pruning, Examples , Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM

Module-5

Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition

Course outcomes:
At the end of the course the student will be able to:

- Explain pattern recognition principals
- Develop algorithms for Pattern Recognition.
- Develop and analyse decision tress.
- Design the nearest neighbour classifier.
- Apply Decision tree and clustering techniques to various applications

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Pattern Recognition (An Introduction)	V Susheela Devi, M Narsimha Murthy	Universities Press	2011
2	Pattern Recognition & Image Analysis	Earl Gose, Richard Johnsonbaugh, Steve Jost	PH	1996.
Reference Books				
1	Pattern Classification	Duda R. O., P.E. Hart, D.G. Stork	John Wiley and sons	2000.

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - II

IMAGE PROCESSING AND MACHINE VISION

Course Code	**20SCS251**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction and Digital Image Fundamentals
Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image 20% Processing, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels

Module-2

Image Enhancement in the Spatial and Frequency Domain
Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Grey Level 20% Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering

Module-3

Image Restoration and Image Compression
Model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.

Module-4

Image Segmentation and Morphological Image Processing

Discontinuity based segmentation, similaritybased segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Some basic Morphological Algorithms

Module-5

Object Representation and description and Computer Vision Techniques

Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications

Course outcomes:

At the end of the course the student will be able to:

- Explain the fundamentals of image processing and computer vision
- Illustrate the image enhancement techniques
- Illustrate Image restoration and image compression technique
- Tell about image segmentation and morphological image processing
- Summarize computer vision techniques and its uses

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Digital Image Processing	Rafael C. Gonzalez & Richard E. Woods	Pearson Education	3rd edition
2	Computer Vision: A Modern Approach	David A. Forsyth, Jean Ponce	Prentice Hall	
3	Fundamental of Digital Image Processing	A.K. Jain	PHI	
Reference Books				
1	Digital Image Processing	W.K. Pratt		

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - II

OBJECT ORIENTED DESIGN

Course Code	**20SCS252,** 20SCN254M 20SIS242	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

The Motivation for Object-Oriented Programming, Classes and Objects: The Building Blocks of the Object-Oriented ParadigmTopologies of Action-Oriented Versus Object-Oriented Applications,

Module-2

The Relationships Between Classes and ObjectsThe Inheritance Relationship

Module-3

Multiple Inheritance, The Association Relationship,

Module-4
Class-Specific Data and Behaviour, Physical Object-Oriented Design,
Module-5
The Relationship Between Heuristics and Patterns, The Use of Heuristics in Object-Oriented Design
Course outcomes: At the end of the course the student will be able to: • Identify the heuristics of the object-oriented programming • Explain the fundamentals of OOP • Examine fine object-oriented relations • Explain the role of Physical Object-Oriented Design, • Make use of Heuristics in The Use of Heuristics in Object-Oriented Design
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • The question paper will have ten full questions carrying equal marks. • Each full question is for 20 marks. • There will be two full questions (with a maximum of four sub questions) from each module. • Each full question will have sub question covering all the topics under a module. • The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Object Oriented Design Heuristics	Arthur J Riel	Addison-Wesley	1996
Reference Books				
1	Elements of Reusable Object-Oriented Software	Ralph Johnson, Erich Gamma, Richard Helm, John Vlissides	Pearson	
2	Object - Oriented Modeling and Design With UM	Paperback, Michael R. Blaha)	Pearson	2007

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)** **SEMESTER - II**			
SOFTWARE DEFINED NETWORKS			
Course Code	**20SCS253**, 20LNI31, 20SCE333, 20SCN243, 20SAM324, 20SIS243	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Introduction, Centralized and Distributed Control and Data Planes, OpenFlow			
Module-2			
SDN Controllers, Network Programmability,			
Module-3			
Data Centre Concepts and Constructs, Network Function Virtualization			
Module-4			
Network Topology and Topological Information Abstraction, Building an SDN Framework			
Module-5			
Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions			
Course outcomes:			

At the end of the course the student will be able to:

- Explain the fundamentals of SDN and make use of open flow tool
- Illustrate the concepts of controllers and network programmability
- Explain data centre and NFV
- Build an SDN framework
- Report use case

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	SDN: Software Defined Networks	Ken Gray, Thomas D. Nadeau	O'Reilly	2013
Reference Books				
2	Software Defined Networks	Paul Goransson Chuck Black Timothy Culver	Elsevier	2nd Edition 2016

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - II

MODERN COMPUTER ARCHITECTURE

Course Code	**20SCS254**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Fundamentals of Computer Design, Pipelining, ILP Introduction; Classes of computers; Defining computer architecture; Trends in Technology, power in Integrated Circuits and cost; Dependability; Measuring, reporting and summarizing Performance; Quantitative Principles of computer design. Introduction; Pipeline hazards; Implementation of pipeline; What makes pipelining hard to implement? Instruction –Level Parallelism – 1 ILP: Concepts and challenges; Basic Compiler Techniques for exposing ILP; Reducing Branch costs with prediction; Overcoming Data hazards with Dynamic scheduling; Hardware-based speculation. Instruction –Level Parallelism – 2 Exploiting ILP using multiple issue and static scheduling; Exploiting ILP using dynamic scheduling, multiple issue and speculation; Advanced Techniques for instruction delivery and Speculation; The Intel Pentium 4 as example.

Module-2

Review of Memjory Hierarchy, Memory Hierarchy design Introduction; Cache performance; Cache Optimizations, Virtual memory, Introduction; Advanced optimizations of Cache performance; Memory technology and optimizations; Protection: Virtual memory and virtual machines.

Module-3

Theory of Parallelism Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multivector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws. For all Algorithm or mechanism any one example is sufficient.

Module-4

Hardware Technologies Processors and Memory Hierarchy, Advanced Processor Technology,

Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology. For all Algorithms or mechanisms any one example is sufficient. Bus Systems, Cache Memory Organizations, Shared Memory Organizations, Sequential and Weak Consistency Models, Pipelining and Superscalar Techniques, Linear Pipeline Processors, Nonlinear Pipeline Processors. For all Algorithms or mechanisms any one example is sufficient

Module-5

Parallel and Scalable Architectures Multiprocessors and Multicomputers, Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, MessagePassing Mechanisms, Multivector and SIMD Computers, Vector Processing Principles, Multivector Multiprocessors, Compound Vector Processing, Scalable, Multithreaded, and Dataflow Architectures, Latency-Hiding Techniques, Principles of Multithreading, FineGrainMulticomputers. For all Algorithms or mechanisms any one example is sufficient.

Course outcomes:

At the end of the course the student will be able to:

- Explain the fundamentals of Fundamentals of Computer Design, Pipelining, ILP
- Summarize the concept of memory
- Abstracting the concept of parallelism
- Summarize the hardware technologies
- Outlineparallel and scalable architectures

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability	Kai Hwang and NareshJotwani	McGraw Hill Education	3/e. 2015
2	Computer Architecture: A quantitative approach	John L. Hennessy and David A. Patterson	Morgan Kaufmann Elseveir	5th edition 2013
Reference Books				
1	Computer Systems and Design and Architecture	Vincent Heuring, et al	Pearson Education	2nd edition, 2009

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – II

DATA SCIENCE LABORATORY

Course Code	**20SCSL26**	CIE Marks	40
Teaching Hours/Week (L:P:S)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

The purpose of this laboratory is to get you acquainted with Python/R and use them in implementing Data Science and Algorithms.

Data Sets

Iris

Iris is a particularly famous *toy dataset* (i.e. a dataset with a small number of rows and columns, mostly used for initial small-scale tests and proofs of concept). This specific dataset contains information about the Iris, a genus that includes 260-300 species of plants. The Iris dataset contains measurements for 150 Iris flowers, each belonging to one of three species: Virginica, Versicolor and Setose. (50 flowers for each of the three species). Each of the 150 flowers contained in the Iris dataset is represented by 5 values:

- Sepal length, in cm
- Sepal width, in cm
- petal length, in cm
- petal width, in cm

Iris species, one of: iris-setose, iris-versicolor, iris-virginica. Each row of the dataset represents a distinct flower (as such, the dataset will have 150 rows). Each row then contains 5 values (4 measurements and a species label). The dataset is described in more detail on the UCI Machine Learning Repository website. The dataset can either be downloaded directly from there (iris.data file), or from a terminal, using the *wget* tool. The following command downloads the dataset from the original URL and stores it in a file named iris.csv.

```
$ wget "https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.data" -O iris.csv
```

Citybik.es

Citybik.es is a website that offers an Application Programming Interface (or API, for short) for the usage of bike-sharing services throughout the world. Among the others, data for one of Turin's bike sharing system is available. The information available is at a "station" granularity. This means that all the data available regards the bike stations: some of the useful information available is the station name, its position (in terms of latitude and longitude), the number of available bikes and the number of free docks. The data is offered in near real-time (i.e. it is updated every 15-30 minutes).

The API endpoint to request the data about for the Bike service is the following: http://api.citybik.es/v2/networks/to-bike. This dataset is in the JSON (JavaScript Object Notation) format.

MNIST

The MNIST dataset is another particularly famous dataset as CSV file. It contains several thousands of hand-written digits (0 to 9). Each hand-written digit is contained in a 28 × 28 8-bit grayscale image. This means that each digit has 784 (28^2) pixels, and each pixel has a value that ranges from 0 (black) to 255 (white). The dataset can be downloaded from the following URL: https://raw.githubusercontent.com/dbdmg/data-science-lab/master/datasets/mnist_test.csv. Each row of the MNIST datasets represents a digit. For the sake of simplicity, this dataset contains only a small fraction (10,000 digits out of 70,000) of the real MNIST dataset, which is known as the MNIST test set. For each digit, 785 values are available.

Exercises

1. **Iris dataset**

Load the Iris dataset as a list of lists (each of the 150 lists should have 5 elements). Compute and print the mean and the standard deviation for each of the 4 measurement columns (i.e. sepal length and width, petal length and width). Compute and print the mean and the standard deviation for each of the 4 measurement columns, separately for each of the three Iris species (Versicolor, Virginica and Setose). Which measurement would you consider "best", if you were to guess the Iris species based only on those four values?

2. **Citybik.es dataset**

Load the Citybik.es dataset as a Python dictionary. Use of the json module. Count and print the number of active stations (a station is active if its extra.status field is "online"). Count and print the total number of

bikes available (field free_bikes) and the number of free docks (field empty_slots) throughout all stations. Given the coordinates (latitude, longitude) of a point (e.g. 45.074512, 7.694419), identify the closest bike station to it that has available bikes. For computing the distance among two points (given their coordinates), you can use the function distance_coords() defined in the code snippet below (which is an implementation of the great-circle distance):

```
from math import cos, acos, sin
defdistance_coords(lat1, lng1, lat2, lng2):
    """Compute the distance among two points."""
    deg2rad = lambda x: x * 3.141592 / 180
    lat1, lng1, lat2, lng2 = map(deg2rad, [ lat1, lng1, lat2, lng2 ])
    R = 6378100 # Radius of the Earth, in meters
    return R * acos(sin(lat1) * sin(lat2) + cos(lat1) * cos(lat2) * cos(lng1 - lng2))
```

3. **MNIST dataset**

Load the MNIST dataset. Create a function that, given a position $1 \leq k \leq 10,000$, prints the k^{th}digit of the dataset (i.e. thek^{th}row of the csv file) as a grid of 28×28 characters. More specifically, you should map each range of pixel values to the following characters:

[0, 64) → " "
[64, 128) → "."
[128, 192) → "*"
[192, 256) → "#"

Compute the Euclidean distance between each pair of the 784-dimensional vectors of the digits at the following positions: 26^{th}, 30^{th}, 32^{nd}, 35^{th}. Based on the distances computed in the previous step and knowing that the digits listed are 7, 0, 1, 1, can you assign the correct label to each of the digits ?

4. **Tips dataset**

Read the dataset "Tips.csv" as a dataframe "Data". Extract the columns in the following sequence - Time, TotalBill, Tips. Plot a histogram for the variable 'TotalBill' to check which range has the highest frequency. Draw a bar chart for the variable "Day". Identify the category with the maximum count. Demonstrate the data distributions using box, scatter plot, histogram, and bar chart on iris dataset. Demonstrate the correlation plot on iris dataset and perform exploratory visualization giving an overview of relationships among data with covariance analysis.

5. Split the **Iris** dataset into two the datasets - **IrisTest_TrainData.csv, IrisTest_TestData.csv.** Read them as two separate data frames named Train_Data and Test_Data respectively.

   Answer the following questions:
   - How many missing values are there in **Train_Data**?
   - What is the proportion of Setosa types in the **Test_Data**?
   - What is the accuracy score of the K-Nearest Neighbor model (model_1) with 2/3 neighbors using **Train_Data** and **Test_Data**?
   - Identify the list of indices of misclassified samples from the '**model_1**'.
   - Build a logistic regression model (model_2) keeping the modelling steps constant. Find the accuracy of the model_2

6. Import a dataset from **http://www.ats.ucla.edu/stat/data/binary.csv**. Do the Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. Apply regression Model techniques to predict the data on above dataset

7. Demonstrate Decision tree classification model and Evaluate the performance of classifier on **Iris**

dataset. **8.** Demonstrate any of the Clustering model and Evaluate the performance on **Iris dataset**.
Course outcomes: At the end of the course the student will be able to:
• Demonstration of data visualization methods • Understanding and implementation of data science algorithms
Conduction of Practical Examination: All laboratory experiments (nos) are to be included for practical examination. Students are allowed to pick one experiment from **the list** Strictly follow the instructions as printed on the cover page of answer script for breakup of marks **Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.**

TECHNICAL SEMINAR			
Course Code	20SCS27	CIE Marks	100
Number of contact Hours/week (L:P:SDA)	0:0:2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20XXX27 seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

Question and Answer:20 marks

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

DEEP LEARNING

Course Code	**20SCS31,** 20SAM31, 20SIS334	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

Module-2

Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation. **Regularization:** Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.

Module-3

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. **Convolutional Networks:** The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Module-4

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory

Module-5

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. **Applications:** Vision, NLP, Speech.

Course outcomes:
At the end of the course the student will be able to:

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.
- Execute performance metrics of Deep Learning Techniques.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Deep Learning	Lan Good fellow and YoshuaBengio	MIT Press https://www.deeplearningbook.org/	2016.

		and Aaron Courville		
Reference Books				
1	Neural Networks:Asystematic Introduction	Raúl Rojas		1996.
2	Pattern Recognition and machine Learning	Chirstopher Bishop		2007.

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

ENGINEERING ECONOMICS

Course Code	**20SCS321**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Economic Decisions Making, Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits. Case Study - Price and Income Elasticity of Demand in the real world

Module-2

Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal & Effective Interest.

Module-3

Cash Flow & Rate Of Return Analysis Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks. Case Study – Tata Motors

Module-4

Inflation and Price Change Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes in Engineering Economic Analysis, Cash Flows that inflate at different Rates.
Case Study – Competition in the Advertise Segment in India

Module-5

Present Worth Analysis: End-Of-Year Convention, Viewpoint of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.

Course outcomes:
At the end of the course the student will be able to:

- Describe the principles of economics that govern the operation of any organization under diverse market conditions
- Comprehend macroeconomic principles and decision making in diverse business set up
- Explain the Inflation & Price Change as well as Present Worth Analysis
- Apply the principles of economics through various case studies

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each

	module.			
Textbook/ Textbooks				
Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Economics for Engineers	James L.Riggs,David D. Bedworth, Sabah U. Randhawa	Tata McGraw-Hill	
2	Engineering Economics Analysis	Donald Newnan, Ted Eschembach, Jerome Lavelle	OUP	
3	Principle of Engineering Economic Analysis	John A. White, Kenneth E.Case,DavidB.Pratt	John Wiley	
4	Engineering Economy	Sullivan and Wicks	Pearson	
Reference Books				
1	Engineering Economics	Riggs James	TMG	

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)** **SEMESTER - III**			
VIRTUAL REALITY			
Course Code	**20SCS322,** 20SAM321	,CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Definition of VR, modern experiences, historical perspective. Hardware, sensors, displays, software, virtual world generator, game engines, human senses, perceptual psychology, psychophysics. Geometric modelling, transforming rigid bodies, yaw, pitch, roll, axis-angle representation, quaternions, 3D rotation inverses and conversions, homogeneous transforms, transforms to displays, look-at and eye transforms, canonical view and perspective transforms, viewport transforms.			
Module-2			
Light propagation, lenses and images, diopters, spherical aberrations, optical distortion; more lens aberrations; spectral properties; the eye as an optical system; cameras; visual displays. Parts of the human eye, photoreceptors and densities, scotopic and photopic vision, display resolution requirements, eye movements, neural vision structures, sufficient display resolution, other implications of physiology on VR. Depth perception, motion perception, vection, stroboscopic apparent motion, color perception, combining information from multiple cues and senses, implications of perception on VR.			
Module-3			
Graphical rendering, ray tracing, shading, BRDFs, rasterization, barycentric coordinates, VR rendering problems, anti-aliasing, distortion shading, image warping (time warp), panoramic rendering. Velocities, acceleration, vestibular system, virtual world physics, simulation, collision detection, avatar motion, vection			
Module-4			
Tracking systems, estimating rotation, IMU integration, drift errors, tilt and yaw correction, estimating position, camera-feature detection model, perspective n-point problem, sensor fusion, lighthouse			

approach, attached bodies, eye tracking, inverse kinematics, map building, SLAM.

Remapping, locomotion, manipulation, social interaction, specialized interaction mechanisms.

Module-5

Sound propagation, ear physiology, auditory perception, auditory localization; Fourier analysis; acoustic modelling, HRTFs, rendering, auralization.

Perceptual training, recommendations for developers, best practices, VR sickness, experimental methods that involve human subjects

Touch, haptics, taste, smell, robotic interfaces, telepresence, brain-machine interfaces.

Course outcomes:
At the end of the course the student will be able to:

- Explain fundamentals of virtual reality systems
- Summarize the hardware and software of the VR
- Analyse the applications of VR

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	VIRTUAL REALITY http://vr.cs.uiuc.edu/book.html	Steven M. LaValle.	Cambridge University Press	2016
Reference Books				
1	HANDBOOK OF VIRTUAL ENVIRONMENTS: Design, Implementation, and Applications	Kelly S. Hale Kay M. Stanney	CRC Press	2nd Edition, 2015

M.TECH COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – III

SOFT AND EVOLUTIONARY COMPUTING

Course Code	**20SCS323,** 20SSE31 20SAM22	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to Soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications.
Introduction to classical sets and fuzzy sets: Classical relations and fuzzy relations, Membership functions.

Module 2

Defuzzification, Fuzzy decision making, and applications.

Module 3

Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, The schema theorem, Genetic programming, applications.

Module 4

Swarm Intelligence System: Introduction, background of SI, Ant colony system
Working of ant colony optimization, ant colony for TSP.
(Textbook 2)

Module 5

Unit commitment problem, particle Swarm Intelligence system
Artificial bee colony system, Cuckoo search system.
(Textbook 2)

Course outcomes:
At the end of the course the student will be able to:

- Implement machine learning through neural networks.
- Design Genetic Algorithm to solve the optimization problem.
- Develop a Fuzzy expert system.

Model Neuro Fuzzy system for clustering and classification

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Principles of Soft computing	Shivanandam, Deepa S. N	Wiley India	2011
2	Soft Computing with MATLAB Programming	N. P. Padhy S.P. Simon	Oxford	2015
Reference Books				
1	Neuro-fuzzy and soft computing	.S.R. Jang, C.T. Sun, E. Mizutani	Phi (EEE edition),	2012
2	Soft Computing	SarojKaushik SunitaTiwari	McGrawHill	2018

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

MULTICORE ARCHITECTURE AND PROGRAMMING

Course Code	**20SCS324,** 20SCE22, 20SIS251	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Classes of Computers, Trends in Technology, Power, Energy and Cost – Dependability –Measuring, Reporting and Summarizing Performance.
Single core to Multi-core architectures: Limitations of Single Core Processors - The Multi core era – Case Studies of Multi core Architectures.
System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading,

Module-2

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion.
Threading and Parallel Programming Constructs: Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

Module-3

TLP AND MULTIPROCESSORS : Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues -Performance Issues – Synchronization Issues – Models of Memory Consistency - Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

Module-4

A Portable Solution for Threading : Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution.
OpenMP: OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

Module-5

Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture.

Course outcomes:
At the end of the course the student will be able to:

- Identify the limitations of single core architecture and the need for multicore architectures
- Define fundamental concepts of parallel programming and its design issues
- Solve the issues related to multiprocessing and suggest solutions
- Demonstrate the role of OpenMP and programming concept
- Make out the salient features of different multicore architectures and how they exploit parallelism

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Multicore Programming, Increased Performance through Software Multi-threading	ShameemAkhter and Jason Roberts	Intel Press	2006
2	An Introduction to Parallel Programming	Peter S Pacheco	Morgan/Kuffman, Elsevier	2011
3	Multicore Application Programming for Windows, Linux, Oracle, Solaris	Darryl Gove	Pearson	2011

Reference Books

1	Parallel Programming in C with MPI and OpenMP	Michael J Quinn	Tata McGraw Hill	2003

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

BUSINESS INTELLIGENCE AND ITS APPLICATIONS

Course Code	**20SCS331**, 20SIT252	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Development Steps, BI Definitions, BI Decision Support Initiatives, Development Approaches, Parallel Development Tracks, BI Project Team Structure, Business Justification, Business Divers, Business Analysis Issues, Cost – Benefit Analysis, Risk Assessment, Business Case Assessment Activities, Roles Involved In These Activities, Risks Of Not Performing Step, Hardware, Middleware, DBMS Platform, Non Technical Infrastructure Evaluation

Module -2

Managing The BI Project, Defining And Planning The BI Project, Project Planning Activities, Roles And Risks Involved In These Activities, General Business Requirement, Project Specific Requirements, Interviewing Process

Module – 3

Differences in Database Design Philosophies, Logical Database Design, Physical Database Design, Activities, Roles And Risks Involved In These Activities, Incremental Rollout, Security Management, Database Backup And Recovery

Module-4

Growth Management, Application Release Concept, Post Implementation Reviews, Release Evaluation Activities, The Information Asset and Data Valuation, Actionable Knowledge – ROI, BI Applications, The Intelligence Dashboard

Module-5

Business View of Information technology Applications: Business Enterprise excellence, Key purpose of using IT, Type of digital data, basics f enterprise reporting, BI road ahead.

Course outcomes:
At the end of the course the student will be able to:

- Explain the complete life cycle of BI/Analytical development
- Illustrate technology and processes associated with Business Intelligence framework
- Demonstrate a business scenario, identify the metrics, indicators and make recommendations to achieve the business goal.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Business Intelligence Roadmap: The Complete Project Lifecycle for Decision Support Applications	Larissa T Moss and ShakuAtre	Addison Wesley Information Technology Series	2003.

2	Fundamentals of Business Analytics	R N Prasad, SeemaAcharya	Wiley India	2011.
Reference Books				
1	Business Intelligence: The Savvy Manager's Guide	David Loshin	Morgan Kaufmann	
2	Delivering Business Intelligence with Microsoft SQL Server 2005	Brian Larson	McGraw Hill	2006
3	Foundations of SQL Server 2008 Business Intelligence	Lynn Langit	Apress	2011

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

ROBOTICS AND AUTOMATION

Course Code	**20SCS332,** 20SAM251, 20SIS253	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies Automated Manufacturing Systems: Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS.

Module-2

Definition of Robot, History of robotics, Robotics market and the future prospects, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration. Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and gripper

Module-3

Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers. Control system and analysis.
Robot actuation and feedback components Position sensors – Potentiometers, resolvers, encoders, velocity sensors. Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems

Module-4

Robot Sensors and Machine vision system Sensors in Robotics - Tactile sensors, Proximity and Range sensors, use of sensors in robotics. Machine Vision System: Introduction to Machine vision, the sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems.

Module-5

Robots Technology of the future: Robot Intelligence, Advanced Sensor capabilities, Telepresence and related technologies, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking. Artificial Intelligence: Goals of AI research, AI techniques – Knowledge representation, Problem representation and problem solving, LISP programming, AI and Robotics, LISP in the factory.

Course outcomes:
At the end of the course the student will be able to:

- Classify various types of automation & manufacturing systems
- Discuss different robot configurations, motions, drive systems and its performance parameters.
- Describe the basic concepts of control systems, feedback components, actuators and power transmission systems used in robots.
- Explain the working of transducers, sensors and machine vision systems

- Discuss the future capabilities of sensors, mobility systems and Artificial Intelligence in the field of robotics.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Automation, Production Systems and Computer Integrated Manufacturing	M.P. Groover	Pearson Education	2nd Edition, 2007
Reference Books				
1	Robotics, control vision and Intelligence	Fu, Lee and Gonzalez	McGraw Hill International	2nd Edition, 2007.
2	Robotic Engineering - An Integrated approach	Klafter, Chmielewski and Negin	Prentice Hall of India	1st Edition, 2009.

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

SPEECH PROCESSING

Course Code	**20SCS333** 20SAM334	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, Fundamentals of Digital Speech Processing

Module-2

Digital models for the speech signals, Time domain models for speech processing

Module-3

Digital representation of the speech waveform, short term Fourier analysis

Module-4

Homomorphic speech processing, Linear predictive coding of speech: Introduction, Basic principles of LP analyse, Computation of gain for the model, solution of LPC equation, Comparison between the methods of solution of the LPC analysis equation, the prediction error signal.

Module-5

Linear predictive coding of speech: Frequency domain interpretation of LP analysis, Relation of LP analysis, Relations between various speech parameters, applications

Digital speech for man machine communication by voice

Course outcomes:
At the end of the course the student will be able to:

- Explain the fundamentals of speech processing
- Summarize the models of speech processing
- Infer the linear predictive coding
- Illustrate the application of speech processing

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to

60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Digital Processing of Speech Signals	Lawrence R. Rabiner , Ronald W. Schafer	Pearson	
Reference Books				
1	Speech and Audio Signal Processing	Paperback, A.R. JAYAN	PHI	
2	Speech and Audio Processing	Apte Shaila D	Wiley India Pvt. Ltd	

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

WIRELESS SENSOR NETWORKS

Course Code	**20SCS334**, 20LNI324, 20SCE251, 20SCN251,20SIS13	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

CHARACTERISTICS OF WSN
Characteristic requirements for WSN - Challenges for WSNs – WSN vsAdhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Module-2

MEDIUM ACCESS CONTROL PROTOCOLS
Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts – Contention based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

Module-3

ROUTING AND DATA GATHERING PROTOCOLS
Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

Module-4

EMBEDDED OPERATING SYSTEMS
Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

Module-5

APPLICATIONS OF WSN

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

Course outcomes:

At the end of the course the student will be able to:

- Know the basics , characteristics and challenges of Wireless Sensor Network
- Apply the knowledge to identify appropriate physical and MAC layer protocol
- Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement
- Be familiar with the OS used in Wireless Sensor Networks and build basic modules
- Understand the applications of WSN in various fields

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have a sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Wireless Sensor Networks Technology, Protocols, and Applications	KazemSohraby, Daniel Minoli and TaiebZnati	John Wiley & Sons	2007
2	Protocols and Architectures for Wireless Sensor Network	Holger Karl and Andreas Willig	John Wiley & Sons, Ltd.	2005
Reference Books				
1	A survey of routing protocols in wireless sensor networks	K. Akkaya and M. Younis	Elsevier Ad Hoc Network Journal	Vol. 3, no. 3, pp. 325--349
2	TinyOS Programming	Philip Levis		
3	Wireless Sensor Network Designs	Anna Ha´c	John Wiley & Sons Ltd.	

PROJECT WORK PHASE – 1			
Course Code	20SCS34	CIE Marks	100
Number of contact Hours/Week	2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT			
Course Code	20SCS35	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	02	Exam Hours/Batch	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

INTERNSHIP / PROFESSIONAL PRACTICE			
Course Code	20SCSI36	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	06	Exam Hours	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

To put theory into practice.

To expand thinking and broaden the knowledge and skills acquired through course work in the field.

To relate to, interact with, and learn from current professionals in the field.

To gain a greater understanding of the duties and responsibilities of a professional.

To understand and adhere to professional standards in the field.

To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.

To identify personal strengths and weaknesses.

To develop the initiative and motivation to be a self-starter and work independently.

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

PROJECT WORK PHASE -2			
Course Code	20SCS41	CIE Marks	40
Number of contact Hours/Week	4	SEE Marks	60
Credits	20	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.