Faculty of Engineering & Technology

Syllabus

For

Master of Technology (M.Tech.)

in

Computer Science & Engineering

(Program Code: MT0151CS)

(2023-24)

****Approved by the Academic Council vide resolution no ……***

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1. INTRODUCTION

The quality of higher education in M. Tech. should be improved in such a manner that post graduates are able to compete in this field globally in terms of their knowledge and skills, for this purpose Learning Outcome-based Curriculum Framework (LOCF) is developed.

Incorporation of Learning Outcome-based Curriculum Framework (LOCF) in the Post Graduate M. Tech. programme makes it student-centric, interactive and outcome-oriented to achieve well-defined aims, objectives and goals. The learning outcomes are attained by students through skills acquired during a programme of study. Programme learning outcomes will include subject-specific skills and generic skills, including transferable global skills and competencies. It would also focus on knowledge and skills that prepare students for further study, employment and society development. LOCF help ensure comparability of learning levels and academic standards across colleges/universities.

At present, the goal of higher education in M. Tech. may be achieved using the following measures:

i. Curriculum reform based on learning outcome-based curriculum framework (LOCF).
ii. Improving learning environment and academic resources.
iii. Elevating the quality of teaching and research.
iv. Involving students in discussions, problem-solving and out of box thinking about various ideas and their applicability, which may lead to empowerment and enhancement of the social welfare.
v. Motivating the learners to understand various concepts of their educational programme keeping in view the regional context.
vi. Enabling learners to create research atmosphere in their colleges/ institutes/ universities.
vii. Teach courses based on Choice Based Credit System (CBCS).

2. LEARNING OUTCOME-BASED APPROACH TO CURRICULUM PLANNING

The Master's Degree is awarded to the students on the basis of knowledge, understanding, skills, values and academic achievements. Hence, the learning outcomes of this programme are aimed at facilitating the learners to acquire these attributes, keeping in view of their preferences and aspirations for knowledge.

The LOCF have designed courses of M. Tech. in the light of post graduate attributes, description of qualifications, courses and program learning outcomes. It may lead to all round development and delivery of complete curriculum planning. Hence, it provides specific guidelines to the learners to acquire sufficient knowledge during this program.

The programme has been planned in such manner that there is scope of flexibility and innovation in

i. Modifications of prescribed syllabi.
ii. Teaching-learning methodology.
iii. Assessment technique of students and knowledge levels.
iv. Learning outcomes of courses.
v. Addition of new elective courses subject to availability of experts in colleges/ institutes/ universities across the country.

2.1. Nature and Extent of Master's Programme

As a part of effort to enhance employability of M. Tech. Post Graduates expected learning outcomes are very essential in present day perspective. Therefore, higher education degrees must formulate Post Graduate Attributes (PGAs), qualification descriptors, learning outcomes and course learning outcomes which will help in curriculum planning and development in the form of design and delivery of courses. The overall formulation of the degree programme must equip learner to have competencies to provide deliverables to the industry. It also delivers exhibit analytical, decision making and problem solving skills by applying research principles for handling real life problems with realistic constraint. Analyze, design and create computing solutions for scientific and multidisciplinary engineering challenges, also communicate effectively and observes ethical behavior. Demonstrate an exceptional involvement and active participation in Research and Development leading to new innovations and optimized solutions.

2.2. Aims of Master's programme in M. Tech.

The overall aims of M. Tech are to

i. Exhibit analytical, decision making and problem solving skills by applying research principles for handling real life problems with realistic constraint.Develop broad and balanced knowledge and understanding of definitions, concepts and principles.

ii. Familiarize the students with suitable tools related to M. Tech programme.

iii. Enhance the ability of learners to apply the knowledge and skills acquired by them during the M.Techprogramme to solve specific problems of their courses.

iv. Provide learners sufficient knowledge and skills enabling them to undertake further studies in M. Tech. and its allied areas.

v. Encourage the students to develop a range of generic skills helpful in employment, internships and social activities.

2.3. Motive behind curriculum planning and development

The committee considered and discussed the following factors for LOCF for the graduates:

i. Framing of syllabi

ii. Learners attributes

iii. Qualification descriptors

iv. Programme learning outcomes

v. Course learning outcomes

vi. Necessity of having elective courses

vii. Academic standards

3. PROGRAM EDUCATIONAL OBJECTIVES(PEO'S):

1. To provide students with a foundation in engineering areas required to formulate, solve and analyse engineering problems. **(Fundamental Knowledge)**
2. To analyse real life problems; apply the knowledge gained from modern design methodologies to address issues in a manner i.e., technically sound, economically feasible and socially acceptable. **(Professional Skill & Society).**

3. To inculcate ethical attitude, effective communication skills, teamwork in their profession and adapt to current trends by engaging in lifelong learning needed for a successful professional career. **(Ethics & Lifelong Learning)**

4. POST GRADUATE ATTRIBUTES (PGAs)

The post graduate attributes in M. Tech. are the summation of the expected course learning outcomes mentioned in the end of each course. Some of them are stated below:

PGA1: Discipline-specific Knowledge:

Capability of demonstrating comprehensive knowledge of MCA program and understanding of core branch so that it forms a foundation for a Post Graduate program of study.

PGA2: Research-related skills:

To develop a sense of inquiry and capability for asking relevant and intelligent questions, problem identification, synthesizing and articulating; ability to recognize and establish cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

PGA3: Critical Thinking & Analytical Reasoning:

Ability to employ critical thinking in understanding the concepts relevant to the various branches of technical courses. Analytical reasoning refers to the ability to look at information, be it qualitative or quantitative in nature, and discern patterns within the information.

PGA4: Problem Solving:

Capability to solve problems by using research-based knowledge and research methods including innovative thinking, design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PGA5: Usage of Modern Tools (Information/digital literacy)& Self-directed learning:

To create, select, and apply appropriate techniques, resources, and modern science and IT tools including prediction and modeling to complex science activities with an understanding of the limitations. Self – directed learning is to provide ability to work independently and do in-depth study of various problems and requirements of society.

PGA6: Communication skills:

i. Ability to communicate various concepts of technical education effectively using practical approach and their geometrical visualizations.
ii. Ability to use courses as a precise language of communication in other branches of human knowledge.
iii. Ability to resolve unsolved problems and requirements of industries and societies.
iv. Ability to show the importance of their technical knowledge as precursor to various scientific developments since the beginning of the civilization.

PGA7. Leadership Readiness/Qualities and Employability Options:

Capability for mapping out the tasks in a team or an organization, self-motivating and inspiring team members to engage with the team objectives/vision and using management skills to follow the mapped path to the destination in a smooth and efficient way. This program will also help students to enhance their employability through self employment (Entrepreneur) or by opting jobs in various sectors like industries, Government offices, PSUs, corporate etc.

PGA8. Multicultural Competence:

Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

PGA9: Moral and ethical awareness/reasoning:

Ability to identify unethical behavior such as falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects of their program.

PGA10: Lifelong learning:

Life-long learning provides the ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

5. QUALIFICATION DESCRIPTORS (QDs)

The qualification descriptor suggests the generic outcomes and attributes to be obtained while obtaining the degree of M. Tech. The qualification descriptors indicate the academic standards on the basis of following factors:

i. Level of knowledge
ii. Understanding
iii. Skills
iv. Competencies and attitudes
v. Values.

These parameters are expected to be attained and demonstrated by the learners after becoming graduates in this programme. The learning experiences and assessment procedures should be so designed that every graduate may achieve the programme learning outcomes with equal opportunity irrespective of the class, gender, community and regions. Each post graduate should be able to:

i. Demonstrate fundamental systematic knowledge and its applications. It should also enhance the subject specific knowledge and help in creating jobs in various sectors.
ii. Demonstrate educational skills in areas of their programme.
iii. Apply knowledge, understanding and skills to identify the difficult/unsolved problems in courses of their programme and to collect the required information in possible range of sources and try to analyse and evaluate these problems using appropriate methodologies.
iv. Apply one's disciplinary knowledge and skills in newer domains and uncharted areas.
v. Identify challenging problems and obtain well-defined solutions.

vi. Exhibit subject-specific transferable knowledge relevant to job trends and employment opportunities.

6. PROGRAMME OUTCOMES (PO)

Students post graduating with the M. Tech degree should be able to acquire with following **POs**

PO1. Apply knowledge, skills, and current tools, recent computing technologies of Engineering innovatively to different applications

PO2. Enhance thinking skills to design and conduct experiments, as well as to analyze and interpret data and address the research gaps to produce solutions with the help of tools, technology and products.

PO3. Understand the contemporary research, security issues in the different areas of engineering.

PO4. An ability to identify, analyze, design, develop, implement and integrate based systems.

PO5. Enhance critical thinking by acquiring the skills in modern techniques, methodologies and tools to be innovative and creative.

PO6. An ability to communicate effectively, express /present ideas in an impressive and professional manner, both in written and verbal forms.

PO7. An ability to work in multidisciplinary and multicultural environment, become entrepreneur.

PO8. An ability to understand leadership and entrepreneurship qualities.

PO9. An ability to understand health, ethical, legal, financial, and professional responsibilities.

PO10. To recognizes the need for self-motivation and ability to engage in lifelong learning through continuing education, research and professional development.

Mapping of Graduate Attributes (PGAs) and Programme Outcomes (PLOs):

PO/PGA	PGA1	PGA2	PGA3	PGA4	PGA5	PGA6	PGA7	PGA8	PGA9	PGA10
PO1	■									
PO2		■								
PO3			■							
PO4				■						
PO5					■					
PO6						■				
PO7							■			
PO8								■		
PO9									■	

PO10										

7. PROGRAM SPECIFIC OUTCOMES (PSO's) :

PSO1: Engage in sustainable development and to demonstrate engineering skills for effective interpretation and decision to solve real world problems.

PSO2: To make a strong combination of technical and leadership qualities for successful professional career in industry or in entrepreneurship.

8. TYPES OF COURSES:

1. Courses in a program may be of four kinds: Core, Elective, Open Elective and Audit Courses. Details of the Courses are available with respective discipline.

a) Core Course:-

There may be a Core Course in every semester. This is the course which is to be compulsorily studied by a student as a requirement to complete the programme in a said discipline of study.

b) Elective Course:-

Elective course is a course which can be chosen from a pool of papers. It may be

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

c) Ability Enhancement Compulsory Courses (AECC):-

AECC courses are based upon the content that leads to knowledge enhancement, for example: English Communication, Environment Science/ Studies, etc.

Audit course: Audit Courses provide value based and/or skill based knowledge and may content both Theory and Lab/Training/Field Work. The main purpose of these courses is to provide students life- skills in hands- on mode so as to increase their employability.

d) Skill Enhancement Courses (SEC):-

SEC Courses provide value based and/or skill based knowledge and may content both Theory and Lab/Training/Field Work. The main purpose of these courses is to provide students life- skills in hands- on mode so as to increase their employability.

2. List of Courses (M.Tech. CSE)

Core Courses

- Mathematical foundations of Computer Science
- Advanced Data Structures
- Research Methodology and IPR
- Advanced Data Structures Lab
- Distributed Systems Lab
- Information Security System
- Soft Computing
- Information Security System Lab

- Advanced Communication Network Lab
- Mini Project with Seminar
- Dissertation-I /Industrial Project
- Dissertation II

Elective Courses (Discipline Centric)

- Machine Learning
- Wireless Sensor Networks
- Introduction to Intelligent Systems
- Data Science
- MTCSCS 104A
- Advanced Wireless and Mobile Networks
- Data Preparation and Analysis
- Secure Software Design & Enterprise Computing
- Computer Vision
- Advanced Communication Network
- GPU Computing
- Digital Forensics
- Mobile Applications and Services
- Compiler for HPC
- Optimization Techniques
- Business Analytics
- Industrial Safety
- Operations Research
- Cost Management of Engineering Projects
- Composite Materials
- Waste to Energy

Ability Enhancement Compulsory Course (AECC)

Audit Courses:

- English for Research Paper Writing
- AUDIT 1 and 2: Disaster Management
- AUDIT 1 and 2 : Sanskrit For Technical Knowledge
- AUDIT 1 and 2 : Value Education
- AUDIT 1 and 2 : Constitution Of India
- AUDIT 1 and 2: Personality Development through Life Enlightenment Skills

Skill Enhancement Course (SEC)

Computation of Workload:

Lecture (L) : 1 Credit = 1 Theory period of one hour duration

Tutorial (T) : 1 Credit = 1 Tutorial period of one hour duration

Practical (P) : 1 Credit = 1 Practical period of two hour duration

9. PROGRAM STRUCTURE M. Tech. (CSE)

Semester - I

Code	Title of Subject	Type	L	T	P	IA	EA	Total	Credits
MTCSCS 101	Mathematical foundations of Computer Science	Core	3	0	0	50	100	150	3
MTCSCS 102	Advanced Data Structures	Core	3	0	0	50	100	150	3
MTCSCS 103A	Machine Learning	Elective	3	0	0	50	100	150	3
MTCSCS 103B	Wireless Sensor Networks	Elective	3	0	0	50	100	150	3
MTCSCS 103C	Introduction to Intelligent Systems	Elective	3	0	0	50	100	150	3
MTCSCS 104A	Data Science	Elective	3	0	0	50	100	150	3
MTCSCS 104B	Distributed Systems	Elective	3	0	0	50	100	150	3
MTCSCS 104C	Advanced Wireless and Mobile Networks	Elective	3	0	0	50	100	150	3
MTCSCS 105	Research Methodology and IPR	Core	2	0	0	50	100	150	2
MTCSCS 106	Audit Course –**1** AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	AECC	2	0	0	0	0	0	0
Practical/Viva Voce		**Type**	**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
MTCSCS 107	Advanced Data Structures Lab	Core	0	0	2	60	40	100	2
MTCSCS 108A MTCSCS 108B	Data Science Lab / Distributed Systems Lab	Core	0	0	2	60	40	100	2
Total			**16**	**0**	**4**	**370**	**580**	**950**	**18**

Semester – II

Code	Subject	Type	L	T	P	IA	EA	Total	Credits
MTCSCS 201	Information Security System	Core	3	0	0	50	100	150	3
MTCSCS 202	Soft Computing	Core	3	0	0	50	100	150	3
MTCSCS 203A	Data Preparation and Analysis	Elective	3	0	0	50	100	150	3
MTCSCS 203B	Secure Software Design & Enterprise Computing	Elective	3	0	0	50	100	150	3
MTCSCS 203C	Computer Vision	Elective	3	0	0	50	100	150	3
MTCSCS 204A	Advanced Communication Network	Elective	3	0	0	50	100	150	3
MTCSCS 204B	GPU Computing	Elective	3	0	0	50	100	150	3
MTCSCS 204C	Digital Forensics	Elective	3	0	0	50	100	150	3
MTCSCS 205	Audit Course –2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	AECC	2	0	0	0	0	0	0
Practical/Viva Voce									
MTCSCS 206	Information Security System Lab	Core	0	0	2	60	40	100	2
MTCSCS 207	Advanced Communication Network Lab	Core	0	0	2	60	40	100	2
MTCSCS 208	Mini Project with Seminar	Core	2	0	0	60	40	100	2
Total			**16**	**0**	**4**	**380**	**520**	**900**	**18**

Semester - III

Code	Subject	Type	L	T	P	IA	EA	Total	Credits
MTCSCS 301A	Mobile Applications and Services	Elective	3	0	0	50	100	150	3
MTCSCS 301B	Compiler for HPC	Elective	3	0	0	50	100	150	3
MTCSCS 301C	Optimization Techniques	Elective	3	0	0	50	100	150	3
MTCSCS 302A	Business Analytics	Elective	3	0	0	50	100	150	3
MTCSCS 302B	Industrial Safety	Elective	3	0	0	50	100	150	3
MTCSCS 302C	Operations Research	Elective	3	0	0	50	100	150	3
MTCSCS 302D	Cost Management of Engineering Projects	Elective	3	0	0	50	100	150	3
MTCSCS 302E	Composite Materials	Elective	3	0	0	50	100	150	3
MTCSCS 302F	Waste to Energy	Elective	3	0	0	50	100	150	3
Practical/Viva Voce		**Type**	**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
MTCSCS 303	Dissertation-I/ Industrial Project	Core	0	0	10	60	40	100	10
Total			**6**	**0**	**10**	**160**	**240**	**400**	**16**

Semester - IV

Code	Subject	Type	L	T	P	IA	EA	Total	Credits
MTCSCS 401	Dissertation II	Core	0	0	16	300	400	700	16
Total			**0**	**0**	**16**	**300**	**400**	**700**	**16**

Note:

- A student is required to obtain min. 40% marks in individual paper & 50% in aggregate to pass.
- The total credit of M.Tech. (CSE) Programme is 68. However, the minimum credit required for award of degree shall be 62.
- The credit relaxation will be applicable only on the elective course (i.e. the student can opt out only elective subject).
- Out of the total credits, 20% of the credits may be earned by the student through MOOCs (SWAYAM, NPTEL, Coursera etc.). However, the choice of online courses to be approved in advance by Dean/ HoD and Coordinator SWAYAM keeping in view the latest guidelines of the UGC/ respective regulatory body guidelines.

10. COURSE-WISE LEARNING OBJECTIVES, STRUCTURES AND OUTCOMES (CLOSOs)

Course learning outcomes of each course in M.Tech. (CSE) as a subject have been enshrined in the end of course contents of each course with their objectives those are in the beginning of the every course.

Semester - I

Code	Title of Subject	Type	L	T	P	IA	EA	Total	Credits
MTCSCS 101	Mathematical foundations of Computer Science	Core	3	0	0	50	100	150	3
MTCSCS 102	Advanced Data Structures	Core	3	0	0	50	100	150	3
MTCSCS 103A	Machine Learning	Elective	3	0	0	50	100	150	3
MTCSCS 103B	Wireless Sensor Networks	Elective	3	0	0	50	100	150	3
MTCSCS 103C	Introduction to Intelligent Systems	Elective	3	0	0	50	100	150	3
MTCSCS 104A	Data Science	Elective	3	0	0	50	100	150	3
MTCSCS 104B	Distributed Systems	Elective	3	0	0	50	100	150	3
MTCSCS 104C	Advanced Wireless and Mobile Networks	Elective	3	0	0	50	100	150	3
MTCSCS 105	Research Methodology and IPR	Core	2	0	0	50	100	150	2
MTCSCS 106	Audit Course –**1** AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	AECC	2	0	0	0	0	0	0
Practical/Viva Voce		**Type**	**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
MTCSCS 107	Advanced Data Structures Lab	Core	0	0	2	60	40	100	2
MTCSCS 108A MTCSCS 108B	Data Science Lab/ Distributed Systems Lab	Core	0	0	2	60	40	100	2
Total			**16**	**0**	**4**	**370**	**580**	**950**	**18**

Mathematical Foundation of Computer Science (MTCSCS101)

Course Objective

- To understand the mathematical fundamentals that is prerequisites for avariety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
- To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

Course Content:

Unit 1: Probability mass, density, and cumulative distribution functions, parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Unit 2: Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Unit 3: Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, and The problem of over fitting model assessment.

Unit 4: **Graph Theory**: Isomorphism, Planar graphs, graph colouring, Hamilton circuits and Euler cycles.Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems

Unit 5: **Computer science and engineering applications** Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.

Unit 6: **Recent Trends** in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

Text Books:

- John Vince, Foundation Mathematics for Computer Science, Springer.
- K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications.Wiley.

References:

- M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
- Alan Tucker, Applied Combinatory, Wiley

Course Outcomes

At the end of the course, students will be able to:

CO1: Apply the concepts learned in fundamental courses such as Discrete Mathematics, in a theoretical setting; in particular, the application of proof techniques.

CO2: Demonstrate abstract models of computing, including deterministic (DFA), non-deterministic (NFA) and their power to recognize the languages.

CO3: Construct pushdown automata and the equivalent context free grammars.

CO4: Understand the concept of different types of graphs and their uses.

CO5: Compute probabilities of interesting events and other vital characteristics, and make appropriate conclusions and forecasts

CO6: Apply linear algebra concepts in two-dimensional graphics transformations in various applications

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping between Objectives and Outcomes

Course Outcome	**Bloom Level**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**-**	**L**	**M**
CO2	**L3**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L6**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**H**	**H**	**H**	**M**	**M**	**M**	**-**	**M**	**L**	**L**
CO5	**L3**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**-**	**M**	**M**
CO6	**L3**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**-**	**L**	**-**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5, CO6
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5 , CO6
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Advanced Data Structures (MTCSCS102)

Course Objective

- To choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- To understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems
- To come up with analysis of efficiency and proofs of correctness.

Course Content:

Unit 1: **Dictionaries:** Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Unit 2: **Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit 3: **Trees:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit 4: **Text Processing:** Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Unit 5: **Computational Geometry:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.

Unit 6: Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem

Text Books:

- Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
- M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Understand the implementation of symbol table using hashing techniques.

CO 2: Develop and analyze algorithms for red-black trees, B-trees and Splay trees, algorithms for text processing applications.

CO 3: Apply the algorithms and design techniques to solve problems; analyze the complexities of various problems in different domains.

CO 4: Study and Solve Problem using Dynamic Programming and Greedy Method Algorithms.

CO 5: Study and Summarize concept of Lower Bound, NP Hard and NP Complete Problems

CO 6: Identify suitable data structures and develop algorithms for computational geometry problems.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**-**	**H**	**M**
CO2	**L6**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**M**	**H**	**H**	**M**	**-**	**M**	**-**	**M**	**H**	**M**
CO5	**L2**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**-**	**M**	**M**
CO6	**L2**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**-**	**L**	**-**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5, CO6
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5 , CO6
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Machine Learning (MTCSCS103A)

Course Objective

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- To explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content:

Unit 1: **Supervised Learning (Regression/Classification)**

Basic methods: Distance-based methods, Nearest- Neighbours, Decision Trees, Naïve Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Unit 2: **Unsupervised Learning**

Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)

Unit 3: Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Unit 4: Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Unit 5: Scalable Machine Learning (Online and Distributed Learning)

A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Unit 6: Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications

References:

- Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press,2012
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
- Christopher Bishop, Pattern Recognition and Machine Learning, Springer,2007.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Solve complicated problems using biological neuron system & calculate equation of terminal network.

CO 2: Recognize the characteristics of machine learning that make it useful to real-worldproblems. Characterize machine learning algorithms as supervised, semi-supervised, andunsupervised.

CO 3: Understand algorithms for learning Bayesiannetworks. Understand reinforcement learningalgorithms.

CO 4: Design and implement neural network systems.

CO 5: Describe the relation between real brains and simple artificial neural network models.

CO 6: Explain and contrast the most common architectures and learning algorithms for Multi-Layer Perceptrons, Radial-Basis Function Networks and Kohonen Self-Organising Maps.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**-**	**H**	**M**
CO2	**L2**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**H**	**M**	**H**	**H**	**-**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L6**	**H**	**H**	**M**	**H**	**H**	**M**	**-**	**M**	**-**	**M**	**H**	**M**
CO5	**L2**	**H**	**H**	**H**	**M**	**H**	**L**	**L**	**-**	**L**	**-**	**M**	**M**
CO6	**L2**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**-**	**L**	**-**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5, CO6
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5 , CO6
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Wireless Sensor Networks (MTCSCS103B)

Course Objective

- To understand the architect of sensor networks for various application setups.
- To devise appropriate data dissemination protocols and model links cost.
- To understand the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
- To evaluate the performance of sensor networks and identify bottlenecks.

Course Content:

Unit 1: **Introduction to Wireless Sensor Networks:** Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors

Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture

Hardware Platforms: Motes, Hardware parameters

Unit 2: **Introduction to ns-3: I**ntroduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

Unit 3: **Medium Access Control Protocol design:** Fixed Access, Random Access, WSN protocols: synchronized,duty-cycled

Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis

MAC Protocol Analysis: Asynchronous duty-cycled. X-MACAnalysis (Markov Chain)

Unit 4: **Security**: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution

Unit 5: **Routing protocols:** Introduction, MANET protocols, **Routing protocols for WSN**: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast, **Opportunistic Routing Analysis**: Analysis of opportunistic routing (Markov Chain), Advanced topics in wireless sensor networks.

Unit 6: **ADVANCED TOPICS**

Recent development in WSN standards, software applications.

References:

- W. Dargie and C. Poellabauer, “Fundamentals of Wireless Sensor Networks –Theory and Practice”, Wiley2010
- KazemSohraby, Daniel Minoli and TaiebZnati, “wireless sensor networks -Technology, Protocols, and Applications”, Wiley Interscience2007
- Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, “Wireless Sensor Network Technologies for the Information Explosion Era”, springer2010

Course Outcomes

At the end of the course, students will be able to:

CO 1: Understand and demonstrate the principles of SensorDesign, Sensors with its applications

CO 2: Learn the architecture and placement strategies of Sensors, wireless sensornetworks

CO 3: Select and apply appropriate principles for data collection and aggregation methodsfor problemsolving, routing and congestion algorithms

CO 4: Design, develop , and carry out performance analysis of sensors on specific applications

CO 5: Explore and implement solutions to real world problems using sensor devices, enumerating its principles of working

CO 6: Apply the advance engineering principles for the critical analysis of sensordesign

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping between Objectives and Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**-**	**L**	**L**
CO2	**L4**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L3**	**H**	**H**	**M**	**H**	**H**	**-**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L3**	**H**	**H**	**M**	**H**	**H**	**M**	**-**	**M**	**-**	**M**	**H**	**H**
CO5	**L4**	**H**	**H**	**H**	**M**	**H**	**L**	**L**	**-**	**L**	**-**	**M**	**M**
CO6	**L1**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**-**	**L**	**-**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5, CO6
CD2	Tutorials/Assignments	CO1,CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO1,CO2,CO3, CO4, CO5
CD4	Project Discussions	CO1,CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5, CO6

Introduction to Intelligent Systems (MTCSCS103C)

Course Objective

- To introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach.
- To explore the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty learning from experience and following problem solving strategies found in nature.

Course Content:

Unit 1: Biological foundations to intelligent systems I: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

Unit 2: Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit 3: Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill- climbing search. Optimisation and search such as stochastic annealing andgenetic algorithm.

Unit 4: Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs.Formal logic and logical inference.Knowledge-based systems structures, its basic components.IdeasofBlackboardarchitectures.

Unit 5: Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of

Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.

Unit 6: Recent trends in Fuzzy logic, Knowledge Representation

References:

- Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6thedition.
- Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Analyze and compare the relative merits of a variety of AI problem and solving techniques

CO 2: Formulate problems so that exploratory search can beapplied, Able to Demonstrate knowledge of the fundamental principles of intelligent systems.

CO 3: Implement optimal, heuristic and memory bounded searchtechniques.

CO 4: Represent knowledge using formal logic and design algorithms to work in a semi-observable environment using logicalreasoning.

CO 5: Design and develop practical algorithms for solving real-life planningproblems.

CO 6: Implement probabilistic reasoning techniques to work in uncertainenvironments.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping between Objectives and Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**H**	**L**	**M**	**L**	**L**	**-**	**-**	**-**	**L**	**L**	**M**	**M**
CO2	**L3**	**H**	**L**	**L**	**M**	**-**	**-**	**-**	**-**	**L**	**-**	**M**	**M**
CO3	**L3**	**L**	**M**	**M**	**-**	**M**	**-**	**-**	**-**	**-**	**L**	**L**	**M**
CO4	**L6**	**M**	**-**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**H**	**H**
CO5	**L6**	**H**	**H**	**M**	**L**	**M**	**-**	**-**	**-**	**-**	**M**	**M**	**M**
CO6	**L3**	**H**	**M**	**L**	**M**	**H**	**-**	**-**	**-**	**-**	**L**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5, CO6
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5 , CO6
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Data Science (MTCSC104A)

Course Objective

- To attain the knowledge and expertise to become a proficient data scientist.
- To demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- To produce Python code to statistically analyse a dataset;
- To critically evaluate data visualisations based on their design and use for communicating stories from data;

Course Content:

Unit 1: Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit 2: Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

Unit 3: Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit 4: Data visualization: Introduction, Types of data visualization,Data for visualization:Data types, Data encodings, Retinal variables, mapping variables to encodings, Visualencodings.

Unit 5: Applications of Data Science,Technologies for visualization, Bokeh (Python)

Unit 6: Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

References:

- Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline.O'Reilly.
- Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge UniversityPress.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Apply knowledge of data science process and its tool kit.

CO 2: Explain how data is collected, managed and stored for data science;

CO 3: Understand the concept of statistics and distribution.

CO 4: Understand the Data visualization, their types and encoding decoding.

CO 5: Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists

CO 6: Implement data collection and management scripts using Python on Spyder (Anaconda3).

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**H**	**L**	**M**	**L**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**M**
CO2	**L3**	**H**	**H**	**L**	**-**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**M**
CO3	**L2**	**H**	**-**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**
CO4	**L2**	**M**	**L**	**H**	**H**	**H**	**-**	**-**	**-**	**-**	**L**	**L**	**M**
CO5	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**-**	**-**	**-**	**M**	**L**	**M**
CO6	**L6**	**L**	**H**	**M**	**M**	**L**	**-**	**-**	**-**	**-**	**L**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5,CO6
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5,CO6
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4, CO5

Distributed Systems (MTCSCS104B)

Course Objective

- To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

Course Content:

Unit 1: Introduction

Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problemareas; Overview of database and computer network concepts

Distributed database management System Architecture

Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

Unit 2: Distributed Database Design

Alternative design strategies; Distributed design issues; Fragmentation; Data allocation

Semantics Data Control

View management; Data security; Semantic Integrity Control

Query Processing Issues

Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

Unit 3: Distributed Query Optimization

Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms

Transaction Management

The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models

Concurrency Control

Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

Unit 4: Reliability

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

Unit 5: Parallel Database Systems

Parallel architectures; parallel query processing and optimization; load balancing

Unit 6: Advanced Topics

Mobile Databases, Distributed Object Management, Multi-databases

References:

- Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall,1991.
- Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley,1992.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Identify the advantages and challenges in designing distributed algorithms for different primitives like mutual exclusion, deadlock detection, agreement,etc.

CO 2: Examine the fundamental principles of distributedsystems

CO 3: Design and develop distributed programs using sockets andRPC/RMI.

CO 4: Differentiate between different types of faults and fault handling techniques in order to implement fault tolerantsystems.

CO 5: Analyze different algorithms and techniques for the design and development of distributed systems subject to specific design and performanceconstraints.

CO 6: Abe to understand relational database management systems, normalization to make efficient retrieval from database and query.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**H**	**L**	**M**	**L**	**L**	**-**	**-**	**-**	**L**	**L**	**M**	**M**
CO2	**L3**	**H**	**L**	**L**	**M**	**-**	**-**	**-**	**-**	**L**	**-**	**M**	**M**
CO3	**L3**	**L**	**M**	**M**	**-**	**M**	**-**	**-**	**-**	**-**	**L**	**M**	**M**
CO4	**L6**	**M**	**-**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**H**	**H**
CO5	**L6**	**H**	**H**	**M**	**L**	**M**	**-**	**-**	**-**	**-**	**M**	**H**	**M**
CO6	**L3**	**H**	**M**	**L**	**M**	**H**	**-**	**-**	**-**	**-**	**L**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5, CO6
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5, CO6
CD5	Self- learning advice using internets	CO2, CO4, CO5

Advanced Wireless and Mobile Networks (MTCSCS104C)

Course Objective

- The students should get familiar with the wireless/mobile market and the future needs and challenges.
- To get familiar with key concepts of wireless networks, standards, technologies and their basic operations
- To learn how to design and analyse various medium access
- To learn how to evaluate MAC and network protocols using network simulation software tools.
- The students should get familiar with the wireless/mobile market and the future needs and challenges.

Course Content:

Unit 1: Introduction:

Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modelling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc.

Wireless Local Area Networks:

IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs.

Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues

Unit 2: Wireless Cellular Networks:

1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improvingcoverage and capacity in cellular systems, Spread spectrum Technologies.

Unit 3: WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22

Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview

Wireless Sensor Networks

Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

Unit 4: Wireless Pans

Bluetooth AND Zigbee, Introduction to Wireless Sensors.

Unit 5: Security

Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.

Unit 6: Advanced Topics

IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks

References:

- Schiller J., Mobile Communications, Addison Wesley2000
- Stallings W., Wireless Communications and Networks, Pearson Education2005
- Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc2002
- Yi Bing Lin and ImrichChlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc2000
- Pandya Raj, Mobile and Personal Communications Systems and Services, PHI200

Course Outcomes

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

CO 1: Demonstrate advanced knowledge of networking and wireless networking

CO 2: Understand various types of wireless networks, standards, operations and use cases.

CO 3: Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.

CO 4: Demonstrate knowledge of protocols used in wireless networks and

CO 5: Learn simulating wireless networks.

CO 6: Design wireless networks exploring trade-offs between wire line and wireless links. Develop mobile applications to solve some of the real world problems.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**H**	**L**	**M**	**L**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**M**
CO2	**L3**	**H**	**H**	**L**	**-**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**M**
CO3	**L2**	**H**	**-**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**L**
CO4	**L2**	**M**	**L**	**H**	**H**	**H**	**-**	**-**	**-**	**-**	**L**	**L**	**L**
CO5	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**-**	**-**	**-**	**M**	**L**	**L**
CO6	**L6**	**L**	**H**	**M**	**M**	**L**	**-**	**-**	**-**	**-**	**L**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5, CO6
CD5	Self- learning advice using internets	CO2, CO4, CO5, CO6

Research Methodology and IPR (MTCSCS 105**)**

Course Objective

1. To understand research problem formulation.
2. To analyze research related information
3. To follow research ethics
4. To understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. To understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. To understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Content:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper
Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &engineeringstudents'"
- Wayne Goddard and Stuart Melville, "Research Methodology: AnIntroduction"
- Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide forbeginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
- Mayall , "Industrial Design", McGraw Hill,1992.
- Niebel , "Product Design", McGraw Hill,1974.
- Asimov , "Introduction to Design", Prentice Hall,1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age",2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand,2008

Course Outcomes

At the end of the course, students will be able to:

CO1: Understand research problem formulation. Analyze research related information & Follow research ethics.

CO2: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO3: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

CO4: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcomes	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L1**	M	M	H	M	L	L	M	L	M	L	**M**	**M**
CO2	**L3**	M	M	M	L	M	-	L	M	M	M	**M**	**M**
CO3	**L2**	H	H	L	M	M	M	L	-	M	-	**L**	**L**
CO4	**L3,L4**	M	M	L	L	M	-	-	-	M	L	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

Advanced Data Structures Lab (MTCSCS107)

Course Objective

- To choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- To understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems
- To come up with analysis of efficiency and proofs of correctness.
- To perform various operations such as insertion, deletion, display on single linked lists.
- To perform different types of searching techniques on a given list
- To perform different types of sorting on a given list
- To convert the given infix expression to postfix expression
- To perform various operations on graphs
- To implement dictionaries using hashing technique
- To perform various operations on binary heap.
- To perform various operations on Binary search tree.
- To perform operations on AVL trees.
- To perform various operations on B-tree.

Course Outcomes :

At the end of the course, students will be able to:

CO1: Understand the implementation of symbol table using hashing techniques.

CO2: Develop and analyze algorithms for red-black trees, B-trees and Splay trees, algorithms for text processing applications.

CO3: Apply the algorithms and design techniques to solve problems; analyze the complexities of various problems in different domains.

CO4: Study and Solve Problem using Dynamic Programming and Greedy Method Algorithms.

CO5: Study and Summarize concept of Lower Bound, NP Hard and NP Complete Problems

CO6: Identify suitable data structures and develop algorithms for computational geometry problem.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**-**	**M**	**M**
CO2	**L6**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**-**	**M**	**-**	**L**	**L**	**L**
CO4	**L2**	**H**	**H**	**M**	**H**	**H**	**M**	**-**	**M**	**-**	**M**	**M**	**M**
CO5	**L2**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**-**	**L**	**L**
CO6	**L2**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**-**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5, CO6
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5, CO6
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Data Science Lab ((MTCSCS108A)

Course Objectives:

- To Describe what Data Science is and the skill sets needed to be a data scientist

List of Experiments:

1. Write an R script, to create R objects for calculator application and save in a specified location in disk.
2. Write an R script to find basic descriptive statistics using summary, str, quartile function on sample datasets.
3. Write an R script to find subset of dataset by using subset (), aggregate () functions on sample dataset.
4. Write an R script for Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location.
5. Write an R script for Reading Excel data sheet and XML dataset.
6. Find the data distributions using box and scatter plot of sample dataset.
   a. Find the outliers using plot.
   b. Plot the histogram, bar chart and pie chart on same data.
7. How to find a corelation matrix and plot the correlation on sample data set.
   a. Plot the correlation plot on dataset and visualize giving an overview of relationships among data
   b. Analysis of covariance: variance (ANOVA), if data have categorical variables
8. Import a data from web storage. Name the dataset and now do 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. require (foreign), require(MASS).

Course Outcomes:

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

CO1: Install and use R for simple programming tasks. Extend the functionality of R by using add-on packages.

CO2: Implement page replacement and memory management algorithms. Extract data from files and other sources and perform various data manipulation tasks on them. 4. Code statistical functions in R.

CO3: Use R Graphics and Tables to visualize results of various statistical operations on data.

CO4: Apply the knowledge of R gained to data Analytics for real life applications.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**L**	**L**	**L**	**L**	**M**
CO2	**L6**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**M**	**M**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**M**	**L**	**L**	**M**	**M**
CO5	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**L**	**L**	**L**	**L**	**L**
CO6	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**M**	**L**	**L**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO5
CD3	Seminars	-
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	-

Distributed Systems Lab (MTCSCS108B)

Course Objective

- To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

Syllabus

- Accessing the Database: The first laboratory exercise is to connect to a database, populate it with data, and run very simple SQL queries. (Data Definition, Table Creation, Constraints, Insert, Select Commands, Update & Delete Commands.)
- Basic SQL: This lab covers simple SQL queries. (Inbuilt functions in RDBMS.)
- Intermediate SQL: This lab covers more complex SQL queries. (Nested Queries & Join Queries, Control structures)
- Advanced SQL: This lab covers even more complex SQL queries. (Procedures and Functions, .PL/SQL, Cursors and Triggers)
- Database Access from a Programming Language: This lab introduces you to database access from a programming language such as Java or C#. Although phrased using Java/JDBC, the exercise can be done using other languages, OBDC or ADO.NET APIs.
- Building Web Applications: This lab introduces you to construction of Web applications. Although phrased using the Java Servlet API, the exercise can be done using other languages such as C# or PHP.
- Project: Each student is assigned with a problem. The student is to develop a logical and physical database design for the problem and develop Forms, Menu design and Reports.
- The logical design performs the following tasks:
- Map the ER/EER diagrams to a relational schema. Be sure to underline all primary keys, include all necessary foreign keys and indicate referential integrity constraints.
- Identify the functional dependencies in each relation
- Normalize to the highest normal form possible B. Perform physical design based above logical design using Oracle/MSSQL on Windows platform and MySQL/Postgre SQL on Linux platform.

Course Outcomes

At the end of the course, students will be able to:

CO1: Identify the advantages and challenges in designing distributed algorithms for different primitives like mutual exclusion, deadlock detection, agreement,etc.

CO2: Examine the fundamental principles of distributedsystems

CO3: Design and develop distributed programs using sockets andRPC/RMI.

CO4: Differentiate between different types of faults and fault handling techniques in order to implement fault tolerantsystems.

CO5: Analyze different algorithms and techniques for the design and development of distributed systems subject to specific design and performanceconstraints.

CO6: Able to understand relational database management systems, normalization to make efficient retrieval from database and query.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**L**	**L**	**L**	**L**	**M**
CO2	**L6**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**M**	**M**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**M**	**L**	**L**	**M**	**M**
CO5	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**L**	**L**	**L**	**L**	**L**
CO6	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**M**	**L**	**L**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5, CO6
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5, CO6
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Semester – II

Code	Subject	Type	L	T	P	IA	EA	Total	Credits
MTCSCS 201	Information Security System	Core	3	0	0	50	100	150	3
MTCSCS 202	Soft Computing	Core	3	0	0	50	100	150	3
MTCSCS 203A	Data Preparation and Analysis	Elective	3	0	0	50	100	150	3
MTCSCS 203B	Secure Software Design & Enterprise Computing	Elective	3	0	0	50	100	150	3
MTCSCS 203C	Computer Vision	Elective	3	0	0	50	100	150	3
MTCSCS 204A	Advanced Communication Network	Elective	3	0	0	50	100	150	3
MTCSCS 204B	GPU Computing	Elective	3	0	0	50	100	150	3
MTCSCS 204C	Digital Forensics	Elective	3	0	0	50	100	150	3
MTCSCS 205	Audit Course –2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	AECC	2	0	0	0	0	0	0
Practical/Viva Voce									
MTCSCS 206	Information Security SystemLab	Core	0	0	2	60	40	100	2
MTCSCS 207	Advanced Communication Network Lab	Core	0	0	2	60	40	100	2
MTCSCS 208	Mini Project with Seminar	Core	2	0	0	60	40	100	2
Total			**16**	**0**	**4**	**380**	**520**	**900**	**18**

INFORMATION SECURITY SYSTEMS (MTCSCS201)

Course Objective

- This course will cover the concept of security , types of attack experienced, encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression

Course Content:

Unit I: Multi level model of security, Cryptography, Secret Key Cryptography, Modes of Operation, Hashes and Message Digest, Public Key Algorithm, Security Handshake Pitfall, Strong Password Protocol; Case study of real time communication security;

Unit II: Introduction to the Concepts of Security, Security Approaches, Principles of security, Types of attacks; Cryptographic Techniques: Plain text and Cipher text, Substitution Techniques, Transposition Techniques Encryption and Decryption, Symmetric and Asymmetric Key Cryptography. Computer-based symmetric Key Cryptographic;

Unit III: Algorithms: Algorithm Types and Modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), Advanced Encryption Standard (AES);

Computer-based Asymmetric Key Cryptographic Algorithms; Cryptography, An Overview of Asymmetric Key Cryptography, The RSA algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm;

Unit IV: Public Key Infrastructure (PKI) Digital Certificates, Private Key Management , The PKI Model, Public Key Cryptography Standards (PKCS); Internet Security Protocols Secure Socket Layer (SSL) , Secure Hyper Text Transfer Protocol (SHTTP) , Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), SSL versus SET, 3-D Secure Protocol , Electronic Money , Email Security;

Unit V: User Authentication Mechanisms : Authentication Basics, Passwords, Authentication Tokens, Certificate-based Authentication; Practical Implementations of Cryptography/Security: Cryptographic Solutions Using Java, Cryptographic Solutions Using Microsoft, Cryptographic Toolkits, Security and Operating Systems; Network Security: Brief Introduction to TCP/IP, Firewalls, IP Security, Virtual Private Networks (VPN); Case Studies on Cryptography and Security:

Reference Books:

1. AtulKahate "Cryptography and Network Security" Tata McGraw-Hill
2. Charlie Kaufman,RadiaPerlman,MikeSpeciner" Network Securities" Pearson,
3. J. A. Coopeer "Computer Communication Securities"TMH,
4. D.W. Davies W. L. Price "securities For computer Networks"
5. John Wiley Sons, L.Stein "Web Securities A step by step Guide " Addison Wesley.

Course Outcomes

At the end of the course, students will be able to:

CO 1: apply knowledge of plaintext, cipher text, RSA and other cryptographic algorithm, Key Distribution to various Network Models

CO 2: Apply Communication Model in Computer Engineering Domain

CO 3: Study Various models for data compression

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**M**	**M**
CO2	**L3**	**H**	**H**	**H**	**H**	**M**	**M**	**M**	**L**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**H**	**H**	**H**	**M**	**L**	**-**	**L**	**M**	**L**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3
CD2	Tutorials/Assignments	CO2, CO3
CD3	Seminars / Presentations	CO3
CD4	Project Discussions	CO2, CO3
CD5	Self- learning advice using internets	CO2

SOFT COMPUTING (MTCSCS202)

Course Objective

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To implement soft computing based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
- To provide student a hand-on experience on MATLAB to implement various strategies.

Course Content:

Unit 1: **Introduction to Soft Computing and Neural Networks:** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Unit 2: **Fuzzy Logic:** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit 3: **Neural Networks:** Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

Unit 4: **Genetic Algorithms:** Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Unit 5: **Matlab/Python Lib:** Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Unit 6: Recent Trands in deep learning, various classifiers, neural networks and genetic algorithm.

References:

- Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing®, Prentice:Hall of India,2003.
- George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications®, Prentice Hall, 1995.
- MATLAB ToolkitManual

Course Outcomes

At the end of the course, students will be able to:

CO 1: Identify and describe soft computing techniques and their roles in building intelligent machines

CO 2: Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.

CO 3: Apply genetic algorithms to combinatorial optimization problems.

CO 4: Evaluate and compare solutions by various soft computing approaches for a given problem.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**-**	**L**	**M**	**L**	**-**	**L**	**M**	**M**
CO2	**L3**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**-**	**L**	**M**	**M**
CO3	**L3**	**H**	**H**	**H**	**H**	**-**	**M**	**L**	**L**	**-**	**L**	**L**	**L**
CO4	**L5**	**H**	**H**	**H**	**H**	**L**	**M**	**M**	**L**	**-**	**L**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

DATA PREPARATION AND ANALYSIS (MTCSCS203A)

Course Objective

- To prepare the data for analysis and develop meaningful Data Visualizations

Course Content:

Unit1-I: Data Gathering and Preparation:
Data formats, parsing and transformation, Scalability and real-time issues

Unit-II: Data Cleaning:
Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

Unit-III: Exploratory Analysis:
Descriptive and comparative statistics, Clustering and association, Hypothesis generation

Unit-IV: Visualization:
Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity

References:

1. Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, by GlennJ. Myatt

Course Outcomes

At the end of the course, students will be able to:

CO 1: Extract the data for performing the Analysis.

CO 2: Work with Big Data platforms and explore the techniques

CO 3: Designing the efficient algorithms for mining the data from large volumes.

CO 4: Understand the basics of various big data analytics techniques.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**-**	**L**	**L**	**L**	**L**
CO2	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**-**	**L**	**L**	**L**	**L**
CO3	**L3**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**-**	**M**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**-**	**L**	**L**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

SECURE SOFTWARE DESIGN & ENTERPRISE COMPUTING (MTCSCS203B)

Course Objective

- To fix software flaws and bugs in various software.
- To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
- Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
- To understand the methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

Course Content:

Unit 1: Secure Software Design

Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security designconcepts, Perform security testing and quality assurance.

Unit 2: Enterprise Application Development

Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprisesystem, Present software solution.

Unit 3: Enterprise Systems Administration

Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services(DNS/DHCP/Terminal Services/Clustering/Web/Email).

Unit 4: Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

Unit 5: Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

Unit 6: Case study of DNS server, DHCP configuration and SQL injection attack.

References:

- Theodor Richardson, Charles N Thies, Secure Software Design, Jones &Bartlett
- Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, AddisonWesley.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Differentiate between various software vulnerabilities.

CO 2: Software process vulnerabilities for an organization.

CO 3: Monitor resources consumption in a software.

CO 4: Inter-relate security and software development process.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**M**	**-**	**-**	**L**	**L**	**L**	**L**
CO2	**L2**	**H**	**H**	**H**	**H**	**H**	**L**	**-**	**-**	**L**	**L**	**L**	**L**
CO3	**L2**	**H**	**H**	**H**	**H**	**M**	**M**	**-**	**-**	**M**	**L**	**M**	**M**
CO4	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**-**	**L**	**L**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

COMPUTER VISION (MTCSCS203C)

Course Objective

- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks.

Course Content:

Unit 1: Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis

Unit 2: Edge detection, Edge detection performance, Hough transform, corner detection

Unit 3: Segmentation, Morphological filtering, Fourier transform

Unit 4: Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data pre-Processing

Unit 5: **Pattern Analysis:**

Clustering: K-Means, K-Medoids, Mixture of GaussiansClassification: Discriminant Function, Supervised, Un-supervised, Semi- supervisedClassifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

Unit 6: Recent trends inActivity Recognition, computational photography, Biometrics.

References:

- Computer Vision: Algorithms and Applications by RichardSzeliski.
- Deep Learning, by Goodfellow, Bengio, andCourville.
- Dictionary of Computer Vision and Image Processing, by Fisher etal.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Review the fundamental concepts of a digital image processing system and Analyze images in the frequency domain using various transforms.

CO 2: Evaluate the techniques for Image enhancement used in digital image processing

CO 3: Developed the practical skills necessary to build computer vision applications.

CO 4: have exposure to object and scene recognition and categorization from images.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**-**	**L**	**L**	**L**	**L**
CO2	**L5**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**-**	**L**	**L**	**M**	**M**
CO3	**L3**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**-**	**M**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**-**	**L**	**L**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

ADVANCED COMMUNICATION NETWORK (MTCSCS204A)

Course Objective

- To have complete knowledge of networking concepts and functioning of all networking layers and have knowledge of various protocols associated with them.

Course Content:

Unit-I: Introduction: Introduction to Network models-ISO-OSI, SNA, Appletalk and TCP/IP models. Review of Physical layer and Data link layers, Review of LAN (IEEE 802.3, 802.5, 802.11b/a/g, FDDI) and WAN (Frame Relay, ATM, ISDN) standards.

Unit-II: Network layer:ARP, RARP, Internet architecture and addressing, internetworking, IPv4, overview of IPv6, ICMP, Routing Protocols- RIP, OSPF, BGP, IP over ATM.

Unit-III: Transport layer:Design issues, Connection management, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Finite state machine model.

Unit-IV: Application layer:WWW, DNS, e-mail, SNMP, RMON

Unit-V: Network Security: Cryptography, Firewalls, Secure Socket Layer (SSL) and Virtual Private Networks (VPN).

Case study

Study of various network simulators, Network performance analysis using NS2

Textbooks:

- Behrouz A. Forouzan, “TCP/IP Protocol Suit”, TMH, 2000.
- Tananbaum A. S., “Computer Networks”, 3rd Ed., PHI, 1999.

References:

- Black U, “Computer Networks-Protocols, Standards and Interfaces”, PHI, 1996.
- Stallings W., “Data and Computer Communications”, 6th Ed., PHI, 2002.
- Stallings W., “SNMP, SNMPv2, SNMPv3, RMON 1 & 2”, 3rd Ed., Addison Wesley, 1999.
- Laurra Chappell (Ed), “Introduction to Cisco Router Configuration”, Techmedia, 1999.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Understand advanced concepts in CommunicationNetworking

CO 2: Design and develop protocols for Communication Networks.

CO 3: Understand the mechanisms in Quality of Service in networking.

CO 4: Optimize the Network Design.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**-**	**L**	**L**	**L**	**L**
CO2	**L6**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**-**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**H**	**H**	**H**	**M**	**-**	**L**	**-**	**M**	**L**	**L**	**L**
CO4	**L3**	**H**	**H**	**H**	**H**	**H**	**L**	**M**	**-**	**L**	**L**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

GPU COMPUTING (MTCSCS204B)

Course Objective

- To learn parallel programming with Graphics Processing Units (GPUs).

Course Content:

Unit 1: **Introduction**: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, SimplePrograms

Unit 2: **Memory**: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Unit 3: **Synchronization**: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU

Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Unit 4: **Support**: Debugging GPU Programs. Profiling, Profile tools, Performance aspects **Streams**: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Unit 5: **Case Studies**: Image Processing, Graph algorithms, Simulations, Deep Learning

Unit 6: **Advanced topics**: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

References:

- Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN:978-0123814722)
- CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN:978-0124159334)

Course Outcomes

At the end of the course, students will be able to:

CO 1: Learn concepts in parallel programming

CO 2: Implementation of programs on GPUs,

CO 3: Debug of the programs

CO 4: Apply parallel programs.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**L**	**M**	**-**	**L**	**L**	**L**	**L**
CO2	**L5**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**-**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**H**	**H**	**H**	**M**	**-**	**L**	**-**	**M**	**L**	**L**	**L**
CO4	**L3**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**-**	**M**	**L**	**M**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

DIGITAL FORENSICS (MTCSCS204C)

Course Objective

- To provide an in-depth study of the rapidly changing and fascinating field of computer forensics.
- To combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
- To have knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
- To have e-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics

Course Content:

Unit 1: **Digital Forensics Science:** Forensics science, computer forensics, and digital forensics. **Computer Crime:** Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics

Unit 2: **Cyber Crime Scene Analysis:** Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what courtdocuments would be required for a criminal investigation.

Unit 3: **Evidence Management & Presentation:** Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

Unit 4: **Computer Forensics:** Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, **Network Forensics:** open-source security tools for network forensic analysis, requirements for preservation of network data.

Unit 5: **Mobile Forensics:** mobile forensics techniques, mobile forensics tools **Legal Aspects of Digital Forensics:** IT Act 2000, amendment of IT Act 2008.

Unit 6: Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

References:

- John Sammons, The Basics of Digital Forensics,Elsevier
- John Vacca, Computer Forensics: Computer Crime Scene Investigation, LaxmiPublications

Course Outcomes

At the end of the course, students will be able to:

CO 1: Understand relevant legislation and codes of ethics

CO 2: Understand Computer forensics and digital detective and various processes, policies and procedures

CO 3: Apply process of E-discovery, guidelines and standards, E-evidence, tools and environment.

CO 4: Understand Email and web forensics and network forensics.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**-**	**L**	**L**	**L**	**L**
CO2	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**-**	**L**	**L**	**L**	**L**
CO3	**L3**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**-**	**M**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**H**	**H**	**M**	**-**	**L**	**-**	**M**	**L**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

Information Security System LAB(MTCSCS206)

Course Objective

- To cover the concept of security , types of attack experienced, encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression

Note: The following programs can be executed on Turbo C++ IDE (TurboC3), Borland Turbo C++

1. Study of Network Security fundamentals - Ethical Hacking, Social Engineering practices.
2. Study of System threat attacks - Denial of Services.
3. Study of Sniffing and Spoofing attacks
4. Study of Techniques uses for Web Based Password Capturing.
5. Study of Different attacks causes by Virus and Trojans.
6. Study of Anti-Intrusion Technique –Honey pot.
7. Study of Symmetric Encryption Scheme –RC4.
8. Implementation of S-DES algorithm for data encryption
9. Implementation of Asymmetric Encryption Scheme –RSA.
10. Study of IPbased Authentication.

Course Outcomes

At the end of the course, students will be able to:

CO1: Apply knowledge of plaintext, cipher text, RSA and other cryptographic algorithm, Key Distribution to various Network Models

CO2: Apply Communication Model in Computer Engineering Domain

CO3: Understand Various models for data compression

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**M**	**M**
CO2	**L3**	**H**	**H**	**H**	**H**	**M**	**M**	**M**	**L**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3
CD2	Tutorials/Assignments	CO2, CO3
CD3	Seminars / Presentations	CO3
CD4	Project Discussions	CO2, CO3
CD5	Self- learning advice using internets	CO2

Advanced Communication Network LAB (MTCSCS207)

Course Objective

- To have complete knowledge of networking concepts and functioning of all networking layers and have knowledge of various protocols associated with them.

Syllabus

1. Write two programs in C: hello_client and hello_server
   - The server listens for, and accepts, a single TCP connection; it reads all the data itcan from that connection, and prints it to the screen; then it closes the connection
   - The client connects to the server, sends the string “Hello, world!”, then closes theConnection
2. Write an Echo_Client and Echo_server using TCP to estimate the round trip timefrom client to the server. The server should be such that it can accept multipleconnections at any given time.
3. Repeat Exercises 1 & 2 for UDP.
4. Repeat Exercise 2 with multiplexed I/O operations
5. Simulate Bellman-Ford Routing algorithm in NS2
6. Write client/server applications involving unix sockets involving TCP or UDPinvolving iterative or concurrent server.
7. Understand IPV4 & IPV6 interoperability issues

Course Outcomes

At the end of the course, students will be able to:

CO1: Understand advanced concepts in CommunicationNetworking

CO2: Design and develop protocols for Communication Networks.

CO3: Understand the mechanisms in Quality of Service in networking.

CO4: Optimize the Network Design.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**L**	**L**	**L**	**L**	**L**
CO2	**L6**	**H**	**H**	**H**	**H**	**H**	**L**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**H**	**H**	**H**	**M**	**-**	**L**	**L**	**M**	**L**	**L**	**M**
CO4	**L3**	**H**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**M**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

Mini Project and Seminar(MTCSCS208)

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Course Outcomes

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	M	H
CO2	L4	M	M	H	L	M	M	-	-	-	L	H	H
CO3	L6	H	L	M	M	H	L	-	-	-	M	H	H
CO4	L3	H	-	M	H	H	H	-	-	-	L	M	M
CO5	L3	H	-	M	H	M	H	-	-	-	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Semester - III

Code	Subject	Type	L	T	P	IA	EA	Total	Credits
MTCSCS 301A	Mobile Applications and Services	Elective	3	0	0	50	100	150	3
MTCSCS 301B	Compiler for HPC	Elective	3	0	0	50	100	150	3
MTCSCS 301C	Optimization Techniques	Elective	3	0	0	50	100	150	3
MTCSCS 302A	Business Analytics	Elective	3	0	0	50	100	150	3
MTCSCS 302B	Industrial Safety	Elective	3	0	0	50	100	150	3
MTCSCS 302C	Operations Research	Elective	3	0	0	50	100	150	3
MTCSCS 302D	Cost Management of Engineering Projects	Elective	3	0	0	50	100	150	3
MTCSCS 302E	Composite Materials	Elective	3	0	0	50	100	150	3
MTCSCS 302F	Waste to Energy	Elective	3	0	0	50	100	150	3
Practical/Viva Voce		**Type**	**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
MTCSCS 303	Dissertation-I/ Industrial Project	Core	0	0	10	60	40	100	10
Total			**6**	**0**	**10**	**160**	**240**	**400**	**16**

MOBILE APPLICATIONS AND SERVICES (MTCSCS301A)

Course Objective

- To presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.
- To explore emerging technologies and tools used to design and implement feature-rich mobile applications for smartphones and tablets
- To understand both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile

Course Content:

Unit 1: Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI DevelopmentAndroid User

Unit 2: More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting theModel Right, Android Storing and Retrieving Data, Working with a Content Provider

Unit 3: Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android TelephonyNotifications and Alarms: Performance, Performance and Memory Management,Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics

Unit 4: Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia

Unit 5: Platforms and Additional Issues: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking , Active Transactions, More on Security, Hacking Android

Unit 6: Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT

References:

- Wei- Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

Course Outcomes

At the end of the course, students will be able to:

CO 1: Identify the target platform and users and be able to define and sketch a mobile application

CO 2: Understand the fundamentals, frameworks of mobile Application Platforms

CO 3: Development lifecycle of mobile application platforms including iOS, Android, and Phone Gap

CO 4: Design and develop a mobile application prototype in one of the platform (challenge project)

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**M**	**-**	**L**	**L**	**L**	**L**
CO2	**L2**	**H**	**H**	**H**	**H**	**H**	**-**	**L**	**-**	**L**	**L**	**L**	**L**
CO3	**L3**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**-**	**L**	**L**	**M**	**M**
CO4	**L6**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**-**	**L**	**L**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

COMPILER FOR HPC (MTCSCS301B)

Course Objective

- To introduce structure of compilers and high performance compiler design for students. Concepts of cache coherence and parallel loops in compilers are included.

Course Content:

Unit1: **High Performance Systems,** Structure of a Compiler, Programming Language Features, Languages for High Performance.

Unit2: **Data Dependence:** Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph. **Scalar Analysis with Factored Use-Def Chains:** Constructing Factored Use- Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.

Unit3: Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis.

Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations.

Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

Unit4: **Concurrency Analysis:** Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers.

Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, andDebuggers, Multi-vector Computers.

Unit5: **Message-Passing Machines:** SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics.

Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Unit 6: Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

References:

- Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

Course Outcomes

At the end of the course, students will be able to:

CO 1: Familiar with the structure of compiler.

CO 2: Understand Parallel loops

CO 3: Identify Data dependency

CO 4: Understand Exception handling and debugging in compiler.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**M**	**L**	**-**	**-**	**L**	**-**	**-**	**L**	**L**	**L**	**L**
CO2	**L2**	**H**	**M**	**M**	**-**	**-**	**M**	**-**	**-**	**M**	**-**	**L**	**L**
CO3	**L3**	**M**	**H**	**L**	**-**	**--**	**L**	**-**	**-**	**L**	**L**	**M**	**M**
CO4	**L2**	**H**	**-**	**M**	**-**	**-**	**M**	**-**	**-**	**M**	**L**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

OPTIMIZATION TECHNIQUES (MTCSCS301C)

Course Objective

- To provide insight to the mathematical formulation of real world problems.
- To optimize these mathematical problems using nature based algorithms. And the solution is useful specially for NP-Hard problems.

Course Content:

Unit 1: Engineering application of Optimization, Formulation of design problems as mathematical programming problems.

Unit 2: General Structure of Optimization Algorithms, Constraints, The Feasible Region.

Unit 3: Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

Unit 4: OptimizationAlgorithmslikeGeneticOptimization,ParticleSwarmOptimization,Ant Colony Optimization etc.

Unit 5: Real life Problems and their mathematical formulation as standard programming problems.

Unit 6: Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.

References:

- LaurenceA.Wolsey(1998).Integerprogramming.Wiley.ISBN978-0-471-28366-9.
- Practical Optimization Algorithms and EngineeringApplications Andreas Antoniou.
- An Introduction to Optimization Edwin K., P. Chong & Stanislaw h.Zak.
- Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN978-0-9759146-2-5.
- John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493- 1914-3.
- H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN978-0-387-92279-9.
- Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3- 540-68274-5.
- Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming:
- Modeling and Solution. John Wiley and Sons. ISBN978-0-470-37306-4.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Formulate optimization problems.

CO 2: Understand and apply the concept of optimality criteria for various types of optimization problems.

CO 3: Solve various constrained and unconstrained problems in Single variable as well as multivariable.

CO 4: Apply the methods of optimization in real life situation.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L6**	**H**	**H**	**H**	**H**	**H**	**L**	**M**	**M**	**M**	**L**	**M**	**M**
CO2	**L2**	**H**	**H**	**H**	**M**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L3**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**M**	**L**	**M**	**M**
CO4	**L3**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**L**	**M**	**L**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars / Presentations	CO3, CO4
CD4	Project Discussions	CO2, CO3, CO4
CD5	Self- learning advice using internets	CO2, CO4

Business Analytics (MTCSCS302A)

Course Objective

1. To understand the role of business analytics within an organization.
2. To analyze data using statistical and data mining techniques and understand relationships
3. To understand the underlying business processes of an organization.
4. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
5. To become familiar with processes needed to develop, report, and analyze business data.
6. To use decision-making tools/Operations research techniques.
7. To manage business process using analytical and management tools. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Content:

Unit-I: Business analytics: Overview of Business analytics, Scope of Businessanalytics, Business Analytics Process, Relationship of Business Analytics**,** Process and organisation, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods, Reviewof probability distribution and data modelling, sampling and estimationmethods overview.

Unit-II: Trendiness and Regression Analysis: Modelling Relationships and Trends inData, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models forBusiness analytics, problem solving, Visualizing and Exploring Data, BusinessAnalytics Technology.

Unit-III: Organization Structures of Business analytics, Team management,Management Issues, Designing Information Policy, Outsourcing, EnsuringData Quality, Measuring contribution of Business analytics, ManagingChanges.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictiveanalytics analysis, Data Mining, Data Mining Methodologies, Prescriptiveanalytics and its step in the business analytics Process, Prescriptive Modelling,nonlinear Optimization.

Unit-IV: Forecasting Techniques: Qualitative and Judgmental Forecasting, StatisticalForecasting Models, Forecasting Models for Stationary Time Series,Forecasting Models for Time Series with a Linear Trend, Forecasting TimeSeries with Seasonality, Regression Forecasting with Casual Variables,Selecting Appropriate Forecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation UsingAnalytic Solver Platform, New-Product Development Model, NewsvendorModel, Overbooking Model, Cash Budget Model.

Unit-V: Decision Analysis: Formulating Decision Problems, Decision Strategies withthe without Outcome Probabilities, Decision Trees, The Value of Information,Utility and Decision Making.

Unit-VI: Recent Trends in: Embedded and collaborative business intelligence, Visualdata recovery, Data Storytelling and Data journalism.

References:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

Course Outcomes

At the end of the course, students will be able to:

CO1: Understand the role of business analytics within an organization.

CO2: Analyze data using statistical and data mining techniques and understandrelationships between the underlying business processes of an organization.

CO3: To become familiar with processes needed to develop, report, and analyzebusiness data.

CO4: Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

CO5: Use decision-making tools/Operations research techniques.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**M**	**-**	**M**	**L**	**M**	**-**	**M**	**L**	**-**	**-**	**L**	**-**
CO2	**L3**	**M**	**L**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L6**	**M**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**-**	**M**	**M**	**L**
CO4	**L3**	**-**	**M**	**-**	**M**	**-**	**L**	**H**	**L**	**H**	**L**	**L**	**-**
CO5	**L3**	**M**	**L**	**H**	**M**	**L**	**-**	**H**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Industrial Safety (MTCSCS302B)

Course Objective

1. To know about Industrial safety
2. To know about fundamental concepts of maintenance engineering.
3. To know about preventive measures to be taken.

Course Content:

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

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

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

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need andapplications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

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

References:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcomes

At the end of the course, students will be able to:

CO1: Understand the role industrial safety.
CO2: Understand fundamentals of maintenance engineering.
CO3: Learn different methods of Wearing and Corrosion and their prevention.
CO4: Trace out the faults occurring in various electrical systems.
CO5: Know about Periodic and preventive maintenance of various systems.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**M**	**M**	**H**	**-**	**L**	**M**	**L**	**H**	**M**	**L**	**-**
CO2	**L2**	**-**	**L**	**M**	**-**	**M**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L2**	**H**	**H**	**L**	**H**	**M**	**H**	**M**	**M**	**L**	**M**	**L**	**L**
CO4	**L5**	**H**	**-**	**-**	**M**	**-**	**H**	**H**	**H**	**M**	**L**	**M**	**-**
CO5	**L6**	**H**	**L**	**L**	**-**	**L**	**-**	**-**	**M**	**-**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Operations Research (MTCSCS302C)

Course Objective

1. To know about the optimization Techniques.
2. To know about Competitive Models.
3. To learn about Formulation of a LPP.

Course Content:

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008
- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes

At the end of the course, students will be able to:

CO1: Should able to carry out sensitivity analysis.

CO2: Should able to model the real world problem and simulate it.

CO3: Should able to apply the dynamic programming to solve problems of discreet and continuous variables.

CO4: Should able to apply the concept of non-linear programming

CO5: Should be able to formulate optimization techniques.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**M**	**-**	**L**	**M**	**-**	**M**	**M**	**M**	**-**	**M**	**L**	**-**
CO2	**L6**	**H**	**L**	**M**	**H**	**L**	**H**	**H**	**H**	**-**	**H**	**M**	**L**
CO3	**L3**	**M**	**M**	**L**	**M**	**L**	**M**	**M**	**-**	**M**	**M**	**L**	**L**
CO4	**L3**	**-**	**M**	**L**	**-**	**M**	**H**	**-**	**H**	**H**	**L**	**M**	**-**
CO5	**L6**	**L**	**-**	**L**	**M**	**L**	**-**	**-**	**L**	**L**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Cost Management of Engineering Projects (MTCSCS302D)

Course Objective

1. To know about Cost concepts in decision-making
2. To know about Project making.
3. To know about Cost Behavior and Profit Planning Marginal Costing

Course Content:

Unit 1: Introduction and Overview of the Strategic Cost Management ProcessCost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit 2: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution : conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team : Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit 3: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement

Unit 4: Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit 5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcomes

At the end of the course, students will be able to:

CO1: Should able to do cost management for various projects.
CO2: Should able to understand the meaning of cost management.
CO3: Should able to analyze Cost Behavior and Profit Planning.
CO4: Understand Quantitative techniques for cost management
CO5: Analyze the pricing and apply for various projects.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**L**	**L**	**-**	**L**	**M**	**L**	**-**	**M**	**M**	**-**	**L**	**M**
CO2	**L2**	**L**	**-**	**M**	**-**	**H**	**L**	**H**	**-**	**L**	**L**	**L**	**L**
CO3	**L5**	**-**	**M**	**L**	**L**	**M**	**-**	**M**	**M**	**-**	**M**	**L**	**L**
CO4	**L3**	**L**	**M**	**L**	**M**	**-**	**H**	**-**	**L**	**M**	**L**	**M**	**L**
CO5	**L2**	**L**	**-**	**L**	**-**	**L**	**M**	**M**	**L**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Composite Materials (MTCSCS302E)

Course Objective

1. To know about introduction to composite materials.
2. To know about reinforcements.
3. To know about manufacturing process of composite materials.

Course Content:

Unit-I: **Introduction:** Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall compositeperformance.

Unit-II: **Reinforcements:** Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particlereinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.Isostrain and Isostress conditions.

Unit-III: **Manufacturing of Metal Matrix Composites:** Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic MatrixComposites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carboncomposites: Knitting, Braiding, Weaving. Properties and applications.

Unit-IV: **Manufacturing of Polymer Matrix Composites:** Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compressionmoulding – Reaction injection moulding. Properties and applications.

Unit-V: **Strength:** Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insightstrength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

- Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

- Hand Book of Composite Materials-ed-Lubin.
- Composite Materials – K.K.Chawla.
- Composite Materials Science and Applications – Deborah D.L. Chung.
- Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course Outcomes

At the end of the course, students will be able to:

CO1: Understand Definition – Classification and characteristics of Composite materials.

CO2: Know about Reinforcements.

CO3: Know about manufacturing of Metal Matrix Composites.

CO4: Know about manufacturing of Polymer Matrix Composites:

CO5: Know about strength and laminates.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**L**	**L**	**-**	**H**	**H**	**-**	**H**	**L**	**-**	**L**	**M**	**-**
CO2	**L2**	**L**	**-**	**M**	**H**	**-**	**L**	**H**	**-**	**M**	**M**	**L**	**L**
CO3	**L2**	**M**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**L**
CO4	**L2**	**-**	**M**	**-**	**M**	**M**	**-**	**H**	**M**	**-**	**M**	**L**	**-**
CO5	**L2**	**L**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Waste to Energy (MTCSCS302F)

Course Objective

1. To know about Energy waste introduction.
2. To know about Biomass process.
3. To know about various types of biomass plants and gasifiers.

Course Content:

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement forthermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kineticconsideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design,construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and theirclassification - Biomass conversion processes - Thermo chemical conversion - Direct combustion -biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

- Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes

At the end of the course, students will be able to:

O1: Know about various forms of Energy wastage.

CO2: Know about Biomass introduction.

CO3: Know about Biomass gasifiers.

CO4: Know about Biogas properties.

CO5: Know about Biomass combustion.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**H**	**-**	**H**	**L**	**-**	**L**	**H**	**H**	**H**	**-**	**M**	**L**
CO2	**L2**	**L**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**L**
CO3	**L2**	**H**	**L**	**-**	**L**	**-**	**-**	**H**	**H**	**H**	**-**	**L**	**L**
CO4	**L2**	**L**	**M**	**L**	**-**	**L**	**L**	**-**	**L**	**L**	**L**	**M**	**-**
CO5	**L2**	**H**	**-**	**H**	**M**	**L**	**-**	**H**	**-**	**H**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTCSCS303 Dissertation I

Mid Sem Evaluation weightage - 30%
End Sem Evaluation weightage - 70%

Dissertation-I:
will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution. Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.

Course Outcomes
By the end of this course every student is expected to be able to
CO1: handle research problems and use modern research tools/methods.
CO2: analyze and review the existing literature on a research problem.
CO3: design and conduct experiments.
CO4: write dissertation and technical reports.
CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	**M**	**M**
CO2	L4	M	M	H	L	M	M	-	-	-	L	**M**	**L**
CO3	L6	H	L	M	M	H	L	-	-	-	M	**H**	**L**
CO4	L3	H	-	M	H	H	H	-	-	-	L	**M**	**M**
CO5	L3	H	-	M	H	M	H	-	-	-	L	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3
CD2	Tutorials/Assignments	CO1, CO3
CD3	Seminars / Presentations	CO2, CO4, CO5
CD4	Project Discussions	CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Semester - IV

Code	Subject	Type	L	T	P	IA	EA	Total	Credits
MTCSCS 401	Dissertation II	Core	0	0	16	300	400	700	16
Total			**0**	**0**	**16**	**300**	**400**	**700**	**16**

MTCSCS401 Dissertation II

Syllabus

Dissertation – II: will be extension of the to work on the topic identified in Dissertation – I. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be presubmission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

Course Outcomes

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	**M**	**M**
CO2	L4	M	M	H	L	M	M	-	-	-	L	**M**	**L**
CO3	L6	H	L	M	M	H	L	-	-	-	M	**H**	**L**
CO4	L3	H	-	M	H	H	H	-	-	-	L	**M**	**M**
CO5	L3	H	-	M	H	M	H	-	-	-	L	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3
CD2	Tutorials/Assignments	CO1, CO3
CD3	Seminars / Presentations	CO2, CO4, CO5
CD4	Project Discussions	CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

Audit Courses (Common for all)
MTCSCS 106
MTCSCS 205
AUDIT 1 and 2 : ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVE

- To understand that how to improve your writing skills and level of readability
- To learn about what to write in each section
- To understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Course Content:

Unit-I: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Unit-II: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Unit-III: key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when Writing a Review of the Literature.

Unit-IV: skills are needed when writing the Methods, skills needed when writing the Results, Skills are needed when writing the Discussion; skills are needed when writing the Conclusions.

Unit-V: useful phrases, how to ensure paper is as good as it could possibly be the first- time Submission.

Suggested Studies:

- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
- Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
- Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
- Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

At the end of the course, students will be able to:

CO1: Students should know how to Plan and Prepare research paper.

CO2: Knowledge of Paraphrasing, Plagiarism and Literature review.

CO3: Knowledge and understanding of write every aspect and part of thesis like Abstract, Literature review, Title, etc,.

CO4: Discussion and skills developed in students when writing the Conclusions.

CO5: Ensuring students to write the paper first- time and also giving them knowledge about the quality of paper and procedure of Submission.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	H	M	H	M	-	L	M	L	L	M	L	L
CO2	L1	M	-	L	L	M	-	H	H	M	M	L	L
CO3	L1,L2	L	H	L	M	H	L	H	M	H	L	L	L
CO4	L2	M	M	-	L	H	M	-	M	M	-	L	L
CO5	L1	M	L	L	L	M	L	M	L	-	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO1, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO1, CO4, CO5

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objective

- To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Course Content:

Unit-I: **Introduction :** Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit-II: **Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks Of Disease And Epidemics, War and Conflicts.

Unit-III: **Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Unit-IV: **Disaster Preparedness and Management:** Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

Unit-V: **Risk Assessment:** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies For Survival.

Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Suggested Studies:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Course Outcomes:

At the end of the course, students will be able to:

CO1: Knowledge of disaster and its types.

CO2: Knowledge of Repercussions of Disasters And Hazards.
CO3: Study of Seismic Zones and Disaster Prone Areas In India.
CO4: Study of Disaster Preparedness and Management.
CO5: Understanding Disaster Risk Situation, Risk Assessment and Disaster Mitigation in India.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO1	PSO2
CO1	L1	H	M	H	L	-	L	M	L	L	M	L	L
CO2	L1	M	H	L	L	M	M	-	-	M	L	L	L
CO3	L2	-	M	L	M	L	M	-	M	H	M	L	L
CO4	L2	M	H	-	L	M	L	-	M	M	M	L	L
CO5	L2	M	M	L	H	M	L	L	H	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2 : SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objective

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To do Learning of Sanskrit to improve brain functioning
- To have thorough Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- To enhance the memory power
- To explore the huge knowledge from ancient literature

Course Content:

Unit-I: Alphabets in Sanskrit.

Unit-II: Past/Present/Future Tense.

Unit-III: Simple Sentences Order.

Unit-IV: Introduction of roots.

Unit-V: Technical information about Sanskrit Literature, Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Studies:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication.
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Outcomes:

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

CO1: Knowledge of Alphabets in Sanskrit.

CO2: Knowledge of Past/Present/Future Tense.

CO3: Study of Simple Sentences Order.

CO4: Introduction of roots and its knowledge.

CO5: Understanding Technical information and concepts about Sanskrit Literature and related Engineering concepts.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	H	L	-	L	M	L	L	L	L	L
CO2	L1	M	-	L	L	M	-	H	M	M	L	L	L
CO3	L2	L	H	L	M	H	M	L	M	H	M	L	L
CO4	L1	M	H	-	L	M	L	-	-	M	L	L	L
CO5	L2	-	M	L	L	M	M	L	H	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2 : VALUE EDUCATION

Course Objective

- To understand value of education and self-development
- To imbibe good values in students
- To let the should know about the importance of character

Course Content:

Unit-I: Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.

- Moral and non- moral valuation. Standards and principles.
- Value judgments

Unit-II: Importance of cultivation of values.

- Sense of duty. Devotion, Self-reliance. Confidence, Concentration.
- Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism. Love for nature ,Discipline

Unit-III: Personality and Behavior Development - Soul and Scientific attitude.

- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labor.
- Universal brotherhood and religious tolerance.

Unit-IV: Positive Thinking. Integrity and discipline. Positive Thinking. Integrity and discipline.

- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

Unit-V: Character and Competence –Holy books vs. Blind faith.

- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence ,Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively.

Suggested Studies:

- Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course Outcomes:

At the end of the course, students will be able to:

CO1: Knowledge of Values and self-development.

CO2: Understanding the Importance of cultivation of values.

CO3: Study of Personality and Behavior Development.

CO4: Understanding and inculcating Positive Thinking.

CO5: Study of Character and Competence.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	H	H	L	-	L	M	L	L	L	L	L
CO2	L1	M	M	L	L	M	L	M	-	M	L	L	L
CO3	L2	L	H	L	M	M	M	M	L	H	-	L	L
CO4	L2	M	H	-	L	M	-	-	L	M	L	L	L
CO5	L2	-	M	L	L	M	L	L	L	L	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO1, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2 : CONSTITUTION OF INDIA

Course Objective

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the IndianConstitution.

Course Content:

Unit-I: **History of Making of the Indian Constitution:**

History Drafting Committee, (Composition & Working).

Philosophy of the Indian Constitution: Preamble Salient Features.

Unit-II: **Contours of Constitutional Rights & Duties:**

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit-III: **Organs of Governance:**

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications

- Powers and Functions

Unit-IV: Local Administration:

- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

Unit-V: Election Commission:

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested Studies:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Course Outcomes:

At the end of the course, students will be able to:

CO1: Knowledge of History and Philosophy of the Indian Constitution.

CO2: Understanding the Contours of Constitutional Rights & Duties.

CO3: Study of Organs of Governance.

CO4: Understanding the Local Administration.

CO5: Study of Election Commission.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	H	H	L	-	L	M	L	L	M	L	L
CO2	L2	M	M	L	M	M	-	M	M	M	H	-	-
CO3	L2	L	M	L	M	L	M	H	M	H	M	-	-
CO4	L2	-	H	-	L	M	H	-	M	M	-	L	-
CO5	L2	L	M	L	L	M	L	L	-	L	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2 : PEDAGOGY STUDIES

COURSE OBJECTIVE

- To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- To identify critical evidence gaps to guide the development.

Course Content:

Unit-I: Introduction and Methodology:

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

Unit-II: Thematic overview:

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.

- Curriculum, Teacher education

Unit-III: Evidence on the effectiveness of pedagogical practices

- Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies

Unit-IV: Professional development: alignment with classroom practices and follow up support

- Peer support
- Support from the head teacher and the community.

- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

Unit-V: Research gaps and future directions

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact

Suggested Studies:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
- Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
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Course Outcomes:

At the end of the course, students will be able to:

CO1: Knowledge of Theories of learning and Conceptual framework.

CO2: Understanding the Pedagogical practices.

CO3: Interpretating the Theory of change when pedagogical practices are done.

CO4: Understanding the Professional development and Barriers to learning.

CO5: Study of Research gaps and future directions.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	H	M	H	L	-	L	M	L	L	L	L	L
CO2	L2	M	M	L	L	M	M	-	M	M	L	L	L
CO3	L2	H	H	L	M	M	M	M	M	H	M	L	L
CO4	L2	L	H	-	L	M	-	M	-	M	M	L	L
CO5	L2	L	M	L	L	M	L	L	L	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO4, CO5
CD4	Project Discussions	CO1, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

COURSE OBJECTIVE

- To achieve overall health of body and mind
- To overcome stress

Course Content:

Unit-I: Definitions of Eight parts of yog (Ashtanga).

Unit-II: Yam and Niyam: Do`s and Don't's in life.

Unit-III: Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwar pranidhan.

Unit-IV: Asan and Pranayam

I) Various yog poses and their benefits for mind & body

Unit-V: Regularization of breathing techniques and its effects-Types of pranayam.

Suggested Studies:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur.
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

Course Outcomes:

At the end of the course, students will be able to:

CO1: Knowledge of Eight parts of yog (Ashtanga).

CO2: Understanding the Do`s and Don't's in life.

CO3: Knowledge and application of Ahinsa, satya, astheya, bramhacharya, aparigraha, Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

CO4: Pracicing Asan and Pranayam..

CO5: Regularization of breathing techniques and its effects.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	M	M	H	L	-	L	M	L	L	L	L	L
CO2	L2	M	M	L	L	M	M	H	-	M	-	L	L
CO3	L1,L3	L	H	L	M	L	M	M	M	H	M	L	L
CO4	L3	M	H	-	L	M	M	-	M	M	M	-	-
CO5	L1,L2	L	M	L	L	M	L	H	L	L	L	-	-

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

COURSE OBJECTIVE

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Content:

Unit-I: Neetisatakam - Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29, 31, 32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52, 53, 59 (dont's)
- Verses- 71,73,75,78 (do's)

Unit-II: Approach to day to day work and duties.

- Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47, 48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit-III: Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16, 17, 18

Unit-IV: Personality of Role model. Shrimad BhagwadGeeta:

- Chapter2-Verses 17,
- Chapter 3-Verses 36, 37, 42,
- Chapter 4-Verses 18, 38, 39
- Chapter18 – Verses 37, 38, 63

Suggested Studies:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

At the end of the course, students will be able to:

CO1: Knowledge of Neetisatakam - Holistic development of personality.

CO2: Approach to day to day work and duties.

CO3: Understanding the Theory of Statements of basic knowledge.
CO4: Understanding the Personality of Role model. Shrimad Bhagwad Geeta.
CO5: Study of Personality Development through Life Enlightenment Skills.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	M	L	-	L	M	L	L	M	-	-
CO2	L1,L2	M	H	L	L	M	M	-	H	M	L	-	-
CO3	L2	L	H	L	M	M	L	M	L	H	L	-	-
CO4	L2	M	L	-	L	L	M	M	M	M	-	-	-
CO5	L2	M	M	L	L	M	L	L	L	L	M	-	-

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO4, CO5
CD4	Project Discussions	CO1, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

11. TEACHING-LEARNING PROCESS/ METHODOLOGY (TLM):

The teaching-learning process should be aimed at systematic exposition of basic concepts so as to acquire knowledge of technical program in a canonical manner. In this context, applications of technical program and linkage with the theory constitute a vital aspect of the teaching-learning process. The course offers many modes of learning and assessment methods. Students have great freedom of choice of course which they can study. The various components of teaching learning process are summarized in the following heads.

1. **Class room Lectures:** The most common method of imparting knowledge is through lectures.There are diverse modes of delivering lectures such as through blackboard, power point presentation and other technology aided means. A judicious mix of these means is a key aspect of teaching-learning process.
2. **Tutorials:** To reinforce learning, to monitor progress, and to provide a regular pattern ofstudy, tutorials are essential requirements. During these tutorials, difficulties faced by the students in understanding the lectures, are dealt with. Tutorials are also aimed at solving problems associated with the concepts discussed during the lectures.
3. **Practical:** To provide scientific visualization and obtaining results of Technical program inpractical sessions. These sessions provide vital insights into scientific concepts and drawlearner's attention towards limitations of scientific computations. During practical, scientific models arising in real life problems can also be simulated.
4. **Choice based learning/Open elective:** LOCF in this undergraduate program providesgreat flexibility both in terms of variety of courses and range of references in each course.
5. **Field based learning:** Students may enhance their knowledge through field based learningwhile understanding the practical importance.
6. **Textbooks learning:** A large number of books are included in the list of references of eachcourse for enrichment and enhancement of knowledge.
7. **E-learning:** Learner may also access electronic resources and educational websites for betterunderstanding and updating the concepts.
8. **Self-study materials:** Self-study material provided by the teachers is an integral part oflearning. It helps in bridging the gaps in the classroom teaching. It also provides scope for teachers to give additional information beyond classroom learning.
9. **Assignment/Problem solving:** Assignments at regular intervals involving applications oftheory are necessary to assimilate basic concepts of courses. Hence, it is incumbent on the part of a learner to complete open-ended projects assigned by the teacher.
10. **Internships:** The teaching-learning process needs to be further supported by other activitiesdevoted to subject-specific and interdisciplinary skills, summer and winter internships. During these internships it is expected that a learner will interact with experts and write a report on a topic provided to the learner.
11. **Institute visits:** Institute visit by a learner is also a part of learning process. During suchvisits a learner has access to knowledge by attending academic activities such as seminars, colloquia, library consultation and discussion with faculty members. These activities provide guidance and direction for further study.
12. **Industrial visits:** Industrial visits offer an opportunity to observe applications of scientific concepts. These visits also give an opportunity to realize the power of mathematical ideas and their translation in problem solving.
13. **Training programs:** Training programs organized by various agencies/institutes provide an opportunity to learn various dimensions of courses.

12. ASSESSMENT AND OUTCOME MESUAREMENT METHODS (AOMM):

A range of assessment methods which are appropriate to test the understanding of various concepts of courses will be used. Various learning outcomes will be assessed using time-bound examinations, problem solving, assignments and viva-voce examination. For various courses in this programme, the following assessment methods shall be adopted:

i. i Scheduled/unscheduled tests
ii. Problem solving sessions aligned with classroom lectures
iii. Practical assignments
iv. Regular chamber consultation with faculty members
v. Mid semester examination and semester end comprehensive examination

Examination and Evaluation:

I. The medium of instructions and examination shall be English.
II. Candidates shall be examined according to the scheme of examination and syllabus as approved by the BOS and Academic Council from time to time.
III. To pass each semester examination, a candidate must obtain at least 40% marks in each written paper, practical work semester examination.
IV. Each theory paper for the respective semester examination shall be set and evaluation of the answer books shall be done as per the University rules.
V. The assessment of External Evaluation i.e. End Term Semester Examination will be made out of 70 (Seventy) marks in theory Papers and Internal Evaluation of 30 (Thirty) marks.

Criterion for awarding Grading System:

Criterion for Awarding SGPA and CGPA: The criterion for awarding the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) for the entire professional programme shall be as follows:

a) The criterion for passing in a subject is that a student should secure minimum pass marks in the total of Internal Evaluation and End Term Examination as laid down in Appendix-I. A Student will earn the credits assigned for a subject if he/she passes in that subject.
b) A student obtaining less than pass marks as specified in Appendix-I, in each subject (sum of internal and End-Term examinations) he will be declared fail in that subject and will have to re-appear in a End-Term examination of the course in subsequent odd / even semester end term examination, subject to maximum permissible period of n+2 years / n+4 semestersto complete the course.
c) The University has adopted Absolute Grading System for converting marks into grades. The formula of 10- point grading system for conversion of marks obtained into Letter Grades and converting Letter Grades to Grade Point is given below:

Table 1: Marks, Letter Grades and Grade Points

Marks	Letter Grade	Grade Points
91-100	O (Outstanding)	10
81-90	A+(Excellent)	9
71-80	A(Very Good)	8
61-70	B+(Good)	7
51-60	B(Above Average)	6
46-50	C(Average)	5
40-45	P (Pass)*	4
0-39	F(Fail)	0
-	AB (Absent)	0

*For BBA, MBA, B.Com, M.Com, Diploma in Engg., B.Tech, BCA, MCA, M.Tech, B.Sc, B.Sc(Ag.)-Hons., B.A LL.B, BBA.LL.B – 40% in individual paper (See Apendix-I)

For B.Arch, M.Plan, LL.M – 45% in individual paper (See Apendix-I)

d) ***While converting the marks into Letter Grade, the rounding off marks must be considered.***

e)A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.

f) For non credit courses "Satisfactory" or Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

Computation of SGPA and CGPA

The university has adopted UGC recommended procedure for computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the papers/ courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = Σ (Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course. The university shall issue Semester Grade Card to the student.

a) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = Σ (Ci x Si) / Σ Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

b) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration of Computation of SGPA and CGPA and Format for Transcripts

a) Computation of SGPA and CGPA

Illustration for SGPA

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course/Paper 1	3	A	8	3x8=24
Course/Paper 2	4	B+	7	4x7=28
Course/Paper 3	3	B	6	3x6=18
Course/Paper 4	3	O	10	3x10=30
Course/Paper 5	3	C	5	3x5=15
Course/Paper 6	4	B	6	4x6=24
	20			**139**

Thus, SGPA= 139/20= 6.95

b) Illustration for CGPA

Semester-1	Semester-2	Semester-3	Semester-4	Semester-5	Semester-6
Credit: 20 SGPA:6.9	Credit: 22 SGPA:7.8	Credit: 25 SGPA:5.6	Credit: 26 SGPA:6.0	Credit: 26 SGPA:6.3	Credit: 25 SGPA:8.0

Thus, CGPA= 20x6.9+22x7.8+25x5.6+26x6.0+26x6.3+25x8.0

---------- = **6.73**

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13. TEACHERS TRAINING (TT):

Learning Outcomes Based Curriculum Framework (LOCF) Quality initiative of UGC based on Outcome Based Education (OBE) is being implemented by the University Grants Commission to enhance the Quality of Higher Education and that of Higher Education Learners and Teachers. Therefore, university arrange following activities for teachers training:

1. Workshops for LOCF implementation.
2. Seminar for LOCF implementation.
3. FDP on LOCF.
4. Outcome based higher education and understanding the learning objectives, learning outcomes, new approaches in the area of outcome measurement, preparing future ready teachers and students.
5. Developing a battery of quality speakers/educators to become resource persons to play role for Training of Trainers (TOT).

14. KEY WORDS:

LOCF, CBCS, Course Learning Outcomes, Employability, Post Graduate Attributes Communication Skills, Critical Thinking, and Descriptors.

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