GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR
(Established by State Legislature Act 17 of 1995)
'A+' Grade, NAAC Accredited State Govt. University

Acad./AC-III/BOS&R-6/2025/ 9522
Dated: 15/5/25

To

The Controller of Examinations
GJUS&T, Hisar.

Sub: Approval of the scheme of examinations and syllabi of M. Tech. (CSE) programme (3rd and 4th semester) for the students admitted in the academic session 2024-25 being run in University Teaching Department.

Sir,

I am directed to inform you that the Vice-Chancellor, on the recommendations of Dean, Faculty of Engineering & Technology on dated 12.05.2025, is pleased to approve the scheme of examinations and syllabi of M. Tech. (CSE) programme (3rd and 4th semester) for the students admitted in the academic session 2024-25 being run in University Teaching Department, under Section 11(5) of the University Act, 1995 in anticipation of approval of the Academic Council.

A copy of the scheme of examinations & syllabi of above said course is enclosed herewith.

You are therefore, requested to take further necessary action accordingly.

Yours faithfully

DA: As above

Assistant Registrar (Academic)
for Registrar

Endst. No. Acad./AC-III/BOS&R-6/2025/ 9523-26 Dated: 15/5/25

A copy of the above is forwarded to the following for information and necessary action:-

1. Dean, Faculty of Engineering & Technology, GJUST, Hisar.
2. Chairperson, Department of Computer Science & Engineering, GJUST, Hisar. He is requested to get upload the scheme of examinations & syllabi of above said course being run in University Teaching Department on the website of the University.
3. OSD to Vice-Chancellor (for kind information of the Vice-Chancellor), GJUST, Hisar.
4. Secretary to Registrar (for kind information of the Registrar), GJUST, Hisar.

Assistant Registrar (Academic)
for Registrar

21/5/25
A-E
Dr Sunil Verma
Mr. Ashwani (to upload on the website)

Master of Technology

in
Computer Science & Engineering

2-YEAR PROGRAMME

CHOICE-BASED CREDIT SYSTEM (CBCS)
w.e.f. JULY 2024

(Theory 70:30, Practical 50:50)

Department of Computer Science and Engineering
Guru Jambheshwar University of Science & Technology Hisar, Haryana

Vision and Mission of the Department

VISION

The vision of the Department is to become a centre of excellence for education in Computer Science, Engineering and Applications. We visualize ourselves as an agency to nurture young minds into leaders of tomorrow in the field of higher education, research and development, and corporate world. We aim to produce creators and innovators who will work towards the overall well-being of the society.

MISSION

- To impart state-of-the-art knowledge in Computer Science and Engineering, Information Technology and Computer Applications.
- To ensure our students graduate with a sound theoretical basis and wide-ranging practical experience.
- To foster linkages between the Department and public and private sectors, traversing research establishments as well as Information Technology industry.
- To promote ethical research of high quality.
- To adopt the best pedagogical methods in order to maximize knowledge transfer.
- To inculcate a culture of free and open discussions in the Department.
- To engage students in learning, understanding and applying novel ideas.
- To infuse scientific temper, professionalism, enthusiasm and team spirit.
- To inspire a zest into students for lifelong learning.
- To promote democratic values, an environment of equal opportunity for everyone irrespective of gender, religion and cast.
- To attract and retain the talented and dedicated teaching and supporting staff, and students.

Programme Educational Objectives (PEOs)

The educational objectives of the M. Tech. (CSE) Programme are:

PEO1. To set high academic goals for the graduating students and to train them in applying and extending the knowledge to the benefit of the society at large.

PEO2. To produce post-graduates with a sound theoretical and practical knowledge in the discipline of Computing Science and Engineering.

PEO3. To create knowledgeable and enthusiastic teaching professionals to engage in higher education institutions.

PEO4. To craft technically competent, proficient, and responsible professionals for IT and its related industries.

PEO5. To establish a research tradition that supports our post-graduates in pursuing research careers in premier universities and research institutes/organizations in India and abroad.

Programme Outcomes (POs)

In order to achieve the PEOs, we expect our students to attain the following programme outcomes by the time of their graduation. The main programme outcomes of the M.Tech (CSE) program are given here:

PO1. An understanding of the theoretical foundations and the limits of computing.

PO2. An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems.

PO3. An ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of industry and society.

PO4. Understanding and ability to use advanced computing techniques and tools.

PO5. An ability to undertake original research at the cutting edge of computer science & its related areas.

PO6. An ability to function effectively individually or as a part of a team to accomplish a stated goal.

PO7. An understanding of professional and ethical responsibility.

PO8. An understanding of professional and ethical responsibility.

PO9. An ability to communicate effectively with a wide range of audience.

PO10. An ability to learn independently and engage in life-long learning.

Department of Computer Science & Engineering
M. Tech. (Computer Science and Engineering)
(TWO YEAR PROGRAMME) SCHEME OF EXAMINATION
Choice Based Credit System w. e. f. July 2024-25

SEMESTER-I

Sr. No.	Course Code	Nomenclature of the Course	L	T	P	Credits	Internal	External
1	CSL711	Advanced Computer Networks	3	--	--	3	30	70
2	CSL712	Advanced Data Structure and Algorithms	3	--	--	3	30	70
3	CSL713	Advanced Database Management Systems	3	--	--	3	30	70
4	CSL714	Theory of Computation	3	--	--	3	30	70
5	CSL715	Advanced Software Engineering	3	--	--	3	30	70
6	CSP712	Advanced Data Structure and Algorithms Lab.	--	--	4	2	50	50
7	CSP713	Advanced Database Management Systems Lab.	--	--	4	2	50	50
8	Audit course-I *(Any one from attached list of audit-I Course)		2	--	0	0	--	--
Total			17	--	8	19	250	450

List of Audit-Course-1*:

1. **AC01** ENGLISH FOR RESEARCH PAPER WRITING
2. **AC02** DISASTER MANAGEMENT
3. **AC04** VALUE EDUCATION
4. **AC07** STRESS MANAGEMENT BY YOGA

SEMESTER-II

Sr. No.	Course Code	Nomenclature of the Course	L	T	P	Credits	Internal	External
1	CSL721	Soft Computing Concepts and Techniques	3	--	--	3	30	70
2	CSL722	Research Methodology	3	--	--	3	30	70
3	CSL723	High Speed Networks and Mobile Technologies	3	--	--	3	30	70
4	CSL724	Cloud Computing	3	--	--	3	30	70
5	Departmental Elective - I * (any one from the attached list of Departmental Elective courses)		3	--	--	3	30	70
6	CSP721	Soft Computing Lab.	--	--	4	2	50	50
7	CSP722	Research Tools for Computer Science & Engineering Lab.	--	--	4	2	50	50
8	Audit course-II **(Any one from attached list of audit-II Course)		2	--	0	0	--	--
Total			17	--	8	19	250	450

List of Departmental Elective-I *:

1. **CSL725** Software Project Management
2. **CSL726** Mathematical Concepts for Computer Science
3. **CSL727** Information and Cyber Security
4. **CSL728** Distributed Operating System

List of Audit-Course-II **:

1. **AC03** SANSKRIT FOR TECHNICAL KNOWLEDGE
2. **AC05** CONSTITUTION OF INDIA
3. **AC06** PEDAGOGY STUDIES
4. **AC08** PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

SEMESTER-III

Sr. No.	Course Code	Nomenclature of the Course	L	T	P	Credits	Internal	External
1	CSL731	Software Testing and Quality Assurance	3	--	--	3	30	70
2	Departmental Elective II * (any one from the attached list of Departmental Elective courses)		3	--	--	3	30	70
3	Open Elective #(any one from the attached list of Open Elective offered by other departments)		3	--	--	3	30	70
4	CSD731	Dissertation I**	--	--	4	10	--	100
Total			12	--	12	19	220	480

List of Departmental Electives II *

1. CSL732 Big Data Analytics
2. CSL733 Machine Learning
3. CSL734 Digital Image Processing
4. CSL735 Introduction to Natural Language Processing

*Departmental elective paper would be offered only if a minimum of 15 students opt for it.

CSD731 (Dissertation I) **

To be evaluated by a committee constituted by the Chairperson, CSE.

** M. Tech. dissertation workload of two hours per week should be assigned to the faculty members supervising M.Tech. Dissertation(s). The workload on this account cannot exceed 2 hours per week.

List of Open Electives (#)

1. 3OE01 Industrial Safety
2. 3OE02 Composite Materials
3. 3OE03 Computer Aided Design and Manufacturing
4. 3OE04 Advanced Communication System
5. 3OE05 Renewable Energy Systems
6. 3OE06 Soft Computing Techniques
7. 3OE07 Advanced Printing Technology
8. 3OE08 Food Safety and Quality Assurance
9. 3OE09 Application of Waste to Energy Production

The minimum number of students in an open elective offered by any Engineering Department will be 15 subjects to a maximum of 40 students per section.

SEMESTER-IV

Sr. No.	Course Code	Nome44nclature of the Course	L	T	P	Credits	Internal	External
1	CSD741	Dissertation II**	--	--	32	16	--	100
	Total					16	--	100

** M. Tech. dissertation workload of two hours per week should be assigned to the faculty members supervising M.Tech. Dissertation(s). The workload on this account cannot exceed 2 hours per week.

CSD741 (Dissertation II**):
To be evaluated jointly by internal supervisor and external examiner appointed by COE.

The research problem formulated after review of literature done in 3rd semester should be continued in the 4th semester. A student is required to publish a research paper related to his/her dissertation work in a Scopus Conference/Journal. The M.Tech. Dissertation cannot be submitted without acceptance/publication of a research paper.

Total credits of all semesters 19+19+19+16=73.

Advanced Computer Networks

General Course Information:

Course Code: CSL711 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Undergraduate Computer Networks course.

About the Course and its Objectives & Outcomes: This course will enable the student to refresh the fundamentals of Computer Networks and describes its architecture in Unit I. Unit II describes the networking devices and its operations. Through Unit II a student can learn the technologies and protocols needed to design and implement a converged switched network. Unit III, describes the operation of routers, and explains the principles of routing and routing protocols. This course in Unit IV discusses the transport layer and application layer.

The objectives of this course are to:

1. build a solid foundation in computer networks concepts and design.
2. understand computer network architectures, protocols, and interfaces.
3. develop the ability to design the networking solutions to real world problems.

By the end of the course, a student is expected to:

1. have depth knowledge of computer networks.
2. recognize the different internetworking devices and their functions.
3. explain the role of protocols in networking.
4. analyze the services and features of the various layers of data networks.
5. design, calculate, and apply subnet masks and addresses to fulfill networking requirements.
6. analyze the features and operations of various application layer protocols such as Http, DNS, and SMTP.

Syllabus

Unit I

Introduction
Network architecture- Layers, services, protocols, layer entities, service access points, Networking principles, Reference Models, Topology.

Physical Layer
The Theoretical Basis of Data Communications—Transmission impairments and channel capacity. Transmission Media, The Public Switched Telephone Network, Structure of Telephone network, The Local Loop, Modems, Cable Modems, ADSL, Multiplexing and Switching.

Unit II

Data Link Layer
Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols, Example Data Link Protocol: HDLC- High Level Data Link Control, PPP-point to point protocol.

Medium Access Control Sub-Layer
Introduction, The Channel Allocation Problem, The Binary Exponential Back-off Algorithm, Multiple Access protocols-ALOHA, Carrier Sense Multiple Access Protocols, Carrier Sense Multiple Access Protocols/Collision

detection protocol, Collision Free Protocols.
Ethernet: Ethernet Cabling, Manchester Encoding, The Ethernet MAC Sub-layer Protocol, Performance. Data Link Layer Switching: Local Internetworking, Hubs, Repeaters, Bridges: Spanning Tree Bridges, Transparent Bridges, Remote Bridges, Switches- Virtual LAN's, Gateways, Routers.

Unit III
The Network Layer
Network Layer Protocol: IPV4:- IP Protocol, IP Addressing (Classful Addressing, Private IP Addresses, Classless Addressing: Sub-netting and Super-netting, NAT: Network Address Translation), IPV6:- Basics, Address Expressions, Address Types, Auto- configuration, Dual Stacking and Tunnelling.
Routing: Introduction, Administrative Distance, Types of Routing: Default Routing, Static Routing, IGP & EGP. Mobile IP, Internet Control Protocols, Congestion Control Algorithm, Introduction to Voice over IP.

Unit IV
The Transport Layer
Elements of Transport Protocols, Introduction to Internet Transport Protocols: UDP, TCP - Introduction, TCP Service Model, TCP Protocol, TCP Segment Header, TCP Connection Establishment, TCP Connection Release, TCP congestion control, TCP timer management.
The Application Layer
Introduction to DNS, FTP, TELNET, HTTP, SMTP, Electronic Mail, WWW and Multimedia.

Text and Reference Books:

1. Andrew S Tanenbaum, Computer Networks, 5th Edition, Pearson, 2010.
2. Forouzan, Data Communication and networking, 5th Edition, TMH, 2012.
3. William Stalling, Data & Comp. Communication, 6th edition, LPE Pearson Education, 2013.
4. Todd Lammle, CCNA Study Guide, 6th Edition, 2013.
5. RFCs and Internet Drafts, available from Internet Engineering Task Force.

Advanced Data Structure and Algorithms

General Course Information:

Course Code: CSL712 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Undergraduate Data Structures course.

About the Course and its Objectives & Outcomes: This course covers advanced concepts in data structure. Data structures play a central role in modern computer science. Interaction with data structures much more often than with algorithms. In addition, data structures are essential building blocks in obtaining efficient algorithms. This course will cover major results and current directions of research in data structures. The course will introduce the advances of data structure, dictionaries and hashing, trees, text processing.

Objectives of the course are to:

1. provide depth knowledge about appropriate data structures.
2. develop advanced paradigms and data structure used to solve algorithmic problems.

By the end of the course, a student is expected to:

1. understand the appropriate data structures & ADT/Libraries.
2. develop and analyze algorithms for B-search trees, Threaded B-Trees & AVL Trees..
3. identify suitable data structures and develop algorithms for text compression Problems.

Syllabus

UNIT I

Algorithms, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big Oh, Omega and Theta notations, Complexity Analysis Examples. Data structures-Linear and non linear data structures, ADT concept, Linear List ADT, Array representation, Linked representation, Vector representation, singly linked lists -insertion, deletion, search operations, doubly linked lists-insertion, deletion operations, circular lists. Representation of single, two dimensional arrays, Sparse matrices and their representation.

UNIT II

Stack and Queue ADTs, array and linked list representations, infix to postfix conversion using stack ,implementation of recursion, Circular queue-insertion and deletion, Dequeue ADT, array and linked list representations, Priority queue ADT, implementation using Heaps, Insertion into a Max Heap, Deletion from a Max Heap.

UNIT III

Searching-Linear and binary search methods, Hashing-Hash functions, Collision Resolution methods-Open Addressing. Chaining, Sorting Bubble sort, Insertion sort, Quick sort, Merge sort, Heap sort, Radix sort, comparison of sorting methods.

UNIT IV

Trees- Ordinary and Binary trees terminology, Properties of Binary trees, Binary tree ADT, representations, recursive and non-recursive traversals, threaded binary trees. Balanced search trees, AVL trees-Definition and examples, B-Trees, Text compression-Huffman coding and decoding.

Graphs- Graphs terminology, Graph ADT, representations, graph traversals/search methods- DFS and BFS, Applications of Graphs- Minimum cost spanning tree using Kruskal's algorithm, Dijkstra's algorithm for Single Source Shortest Path Problem, Greedy Algorithms, Knapsack problem.

Text Books/ Reference Books:

1. Data Structure with C by Seymour Lipschutz 2.
2. Data Structure with C by Aaron M.Tanenbaum, Yedidyah Langsam
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004
4. M T Goodrich Roberto Tamassia, Algorithm Design, John Willey, 2002

Advanced Database Management Systems

General Course Information:

Course Code: CSL713 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: One should have the basic knowledge of Database System concepts and basic queries of SQL.

About the Course and its Objectives & Outcomes: This course covers advanced concepts in database management systems. Advanced database course aims at developing computer applications with different kinds of data models. A range of features and benefits of Advanced Database Management Systems discusses about various databases, database architecture and emerging trends in database systems. The course will introduce the transaction management, recovery system and Oracle & SQL concepts.

Objectives of this course are to:

1. provide in depth knowledge and designing the database using data models.
2. develop the ability to normalize the data.
3. implement the applications involving complex transaction processing.

By the end of the course a student is expected to:

1. be able to understand the advanced concept of database management systems.
2. have the knowledge of design a good database and normalize data.
3. understand the concept of transaction management, recovery and oracle.

Syllabus

Unit I

Introduction to Database System: Introduction, Purpose of database, View of Data, Database architecture, ,Database System Applications, Normalization: 1NF, 2NF, 3NF, BCNF, 4NF and 5NF, SQL Queries, Database Users and Administrators.

Unit II

Transaction Management: Transactions and Its Properties, Serializability: Conflict Serializability, View Serializability, Testing for Serializability, Concurrency Control Techniques: Lock-Based Protocols, Timestamp Based Protocols, Validation Based Protocol, Deadlock Detection and Recovery.

Unit III

Recovery System: Failure Classification, Storage Structure: Types, Stable Storage Implementation, Data Access, Log Based Recovery, Advanced Recovery Techniques: Logical Undo Logging, Transaction Rollback, Checkpoints, Remote Backup Systems.

Unit IV

Advance Oracle Concepts: : Introduction of SQL, Advanced SQL Features, PL/SQL: Basic, Architecture, Identifiers, Procedures, Functions, Package, Triggers. SQL vs PL/SQL. Introduction to SQL*PLUS: Basics, Command line argument, SQL*Plus's Relation to SQL, PL/SQL.

Software and Tools to be learnt: SQL, Oracle

T**ext and Reference Books:**

1. Henry F. Korth, Database System Concepts, Fifth Edition, McGraw-Hill, 2006.
2. Navathe, Fundamentals of Database Systems, Fourth Edition, Pearson Education, 2008.
3. P.S. Deshpande, SQL & PL/SQL for Oracle, Black Book, Dreamtech Press, 2006.
4. Juneau J., Oracle PL/SQL Recipes: A Problem Solving Approach, APress, 2010.

Theory of Computation

General Course Information:

Course Code: CSL714 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Basic knowledge of Mathematical Induction, Structural Induction, Predicate logic and Set Theory.

About the Course and its Objectives & Outcomes:

The language has been very important for the interaction and development of mankind. Study of grammar plays important role in the design of languages for human being or programming language for computer. The theory of computation is about the study of theoretical computer science and it has to be a formal, i.e. mathematical investigation of general questions raised about algorithmic studies. This course is going to include Automata, Regular Expression, Context Free Grammar, Push down Automata, Turing Machine and Undesirability.

Objectives of this course are to:

1. be able to construct FSA and the equivalent regular expressions.
2. be able to construct PDA and equivalent CFG.

By the end of the course a student is expected to be able to:

1. understand the relationship between Automata and Regular Expressions, and Context Free Grammar and Push down Automata. Abstract model of computation in the form of Turing Machine and applications of Turing Machine for the study of decidability.
2. understand the application of the theory of finite automata and context free grammars in the design of programming languages and compilers in the interest of more practical inclination.

Syllabus

Unit I

Introduction: Motivation for studying theory of computation, a quick overview of the subject. Notion of formal language. Language membership problem, why this is taken as the central problem of the subject. Finite automata and regular expressions: DFA, NFA (with and without null transitions), their equivalence. Definition of regular expressions. Proof that FAs. recognize, and regular expressions denote the same class of languages, viz., regular languages.

Unit II

Properties of regular languages: Pumping lemma and its use to prove non-regularity of a language, closure properties of class of regular languages, decision properties: converting among representations, testing emptiness, etc. Minimization of DFAs, Myhill-Nerode theorem.
Context-free grammars and languages: Derivation, parse trees. Language generated by a CFG. Eliminating useless symbols, unit productions. Chomsky normal form.

Unit III

Pushdown automata: Definition, instantaneous description as a snapshot of PDA computation, notion of

acceptance for PDAs: acceptance by nal states, and by empty stack; the equivalence of the two notions. Proof that CFGs generate the same class of languages that PDAs accept.
Properties of context-free languages: Pumping lemma for context-free languages and its use to prove a language to be not context-free. Closure properties of the class of context- free languages. CYK algorithm for CFL membership.

Unit IV

Turing machines: Historical context, informal proofs of undecidability. Definition of TM, instantaneous description as a snapshot of TM computation, notion of acceptance. Generalizations: multi-track, multi-tape, nondeterministic, etc. Restrictions: semi-infinite tape, counter machines. Church-Turing hypothesis.
Undecidability: Definitions of regular expressions and recursive languages. Turing machine codes, the diagonalization language and proof of that it is not regular expression. Universal Turing machine. Universal language, its semi-decidability. Reducibility and its use in proving undecidability. Rices theorem. Undecidability of Posts correspondence problem.

Text and Reference Books:

1. J Hopcroft, JD Ullman, R Motwani, Introduction to Automata Theory, Languages and Computation, 3rd Ed., Pearson, 2008.
2. M Sipser, Introduction to the Theory of Computation, 2nd Ed., Thomson, 2005.
3. Peter Linz, Introduction to Formal Languages & Automata, Narosa, 2001.

Advanced Software Engineering

General Course Information:

Course Code: CSL715 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Basic Knowledge of software engineering principles, software development life cycles and software models.

About the Course and its Objectives & Outcomes:

This course covers advanced theoretical concepts in software engineering. The course will introduce the advance concepts of software engineering, object-oriented software engineering, component-based software engineering, aspect-oriented software engineering and finally end with re-engineering and reverse engineering.

Objective of this course are to:

1. expose the student to technical issues related to the advancement of software engineering.
2. apply the software engineering techniques to homework assignments and mini-projects throughout the course. Both individual-and group-oriented exercises will be assigned.

By the end of the course a student is expected to:

1. develop and /or improve their technical writing and software development skills after the completion of the course.
2. be proficient in methodologies related to object-oriented software engineering, component-based software engineering, and aspect-oriented software engineering.
3. apply the concepts of reverse engineering and re-engineering to increase reliability and minimize maintenance efforts.

Syllabus

UNIT I

Introduction to software engineering, Software Development Life Cycle, requirement analysis and design, software design process, coding, software testing, implementation and maintenance, and software metrics.

Software Process Models: generic process model, process assessment and improvement, prescriptive process models, specialized process models, unified process, personal and team process models, process technology, product and process.

UNIT II

Object-Oriented Software Engineering: object-oriented concepts, object-orientated paradigm, object modelling languages, object-oriented analysis, object-oriented design concepts, object-oriented programming, test strategies for Object Oriented Software, and testing object-oriented applications.
Component-Based Software Engineering: CBSE and software reuse, CBSE processes, component composition, component-based software development life cycle, component level design, and component-based software testing.

UNIT III

Product Metrics: framework for product metrics, metrics for the requirement model, metrics for the design model, design metrics for Webapps, metrics for source code metrics for testing and metrics for maintenance.

Software engineering with aspects, aspects, aspect vs. object, aspect vs. component, join points and pointcuts, separation of concerns, crosscutting concerns, scattering, and tangling, aspect-oriented programming, aspect-oriented software testing.

UNIT IV

Maintenance and Reengineering: Software maintenance, software supportability, reengineering, business process reengineering, software reengineering, reverse engineering, restructuring, forward engineering, and economics of reengineering.
Engineering Trends in Software Engineering: Technology Evolution, Observing Software Engineering Trends, Identifying “Soft Trends”, Technology Directions and Tools-Related Trends.

T**ext and Reference Books:**

1. K K Aggarwal and Yogesh Singh, Software Engineering, 3rd Edition, New age International Publishers, 2008.
2. Yogesh Singh, Software Testing, Cambridge university press, 2012.
3. Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publishing House, New Delhi 1997.
4. Ian Sommerville, Software Engineering, Pearson Education, 2009.
5. Pressman Roger S., Software Engineering: Practitioner's Approach, McGraw-Hill Inc., 2004.
6. N. S. Gill, Software Engineering: Software Reliability, Testing and Quality Assurance, Khanna Book Publishing Co (P) Ltd., New Delhi, 2002.
7. Yogesh Singh and Ruchika Malhotra, Object Oriented Software Engineering, PHI Learning Pvt. Ltd., 2012.
8. J. Rumbaugh, M. Blaha, W. Premerlani, Object-Oriented Modeling and Design, PHI, 1991.
9. George T. Heineman, William T. Councill, Component-Based Software Engineering: Putting the Pieces Together, Addision Wesley, 2001.
10. Robert E. Filman, Tzilla Elrad, Siobhán Clarke, Mehmet Aksit, Aspect-Oriented Software Development Addison-Wesley Professional, 2004.

Advanced Data Structure and Algorithms Lab

General Course Information:

Course Code: CSP712 *Course Credits: 2 Type: Compulsory Contact Hours: 4 hours/week Mode: Experimental Lab *In lab work one credit is equivalent to two hours	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Understanding of data structures and different algorithms.

About the Course and its Objectives & Outcomes:

This lab. course describes various data structures applications. Students will apply different operations of data structures by optimizing the performance, to develop applications using Greedy, Divide and Conquer, dynamic programming. Students will implement applications for backtracking algorithms using relevant data structures.

Objectives of this lab are to be:

1. implement various data structures algorithms.
2. analyse space and time complexity of algorithms.
3. compare solutions on the basis of the appropriateness of data structure used and the efficiency of the operations implemented.

By the end of the course students will be able to:

1. understand and apply data structure operations.
2. understand and apply non-linear data structure operations.
3. develop dynamic programming algorithms for various real-time applications.
4. illustrate and apply backtracking algorithms, further able to understand non-deterministic algorithms.

List of Experiments/ Assignments

1. Write programs that use both recursive and non-recursive functions for implementing the following searching methods: a) Linear search b) Binary search
2. Write programs to implement the following using an array. a) Stack ADT b) Queue ADT
3. Write a program that uses both a stack and a queue to test whether the given string is a palindrome or not.
4. Write programs to implement the following using a singly linked list. a) Stack ADT b) Queue ADT
5. Write a program to perform the following operations:
   a) Construct a binary search tree of elements.
   b) Search for a key element in the above binary search tree.
   c) Delete an element from the above binary search tree.
6. Write programs to implement all the functions of a dictionary (ADT).
7. Write programs that use recursive and non-recursive functions to traverse the given binary tree in a)Preorder b) Inorder c) Postorder
8. Write programs for the implementation of bfs and dfs for a given graph.
9. Write programs for implementing the following sorting methods: a) Bubble sort b) Insertion sort c) Quick sort d) Merge sort e) Heap sort f) Radix sort g) Binary tree sort
10. Write a program to perform the following operations: a) Insertion into a B-tree b) Searching in a B-tree.

Advanced Database Management System Lab.

General Course Information:

Course Code: CSP713 *Course Credits: 2 Type: Compulsory Contact Hours: 4 hours/week Mode: Experimental Lab. *In lab work one credit is equivalent to two hours	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory files, and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Exposure to a programming language, MS Access.

About the lab Course and its Objectives & Outcomes: This lab. course on DBMS involves a rigorous training on Oracle programming. It provides a strong formal foundation in database concepts, technology and practice to the students to groom them into well-informed database application developers. The objective of the lab course is to develop proficiency in the execution of commands of the database design and query using Oracle.

The objectives of this lab. Course is to:

1. implement database problems using Oracle DML/DDL commands.
2. enforce integrity constraints on a database using a state-of-the-art RDBMS.
3. analyze the design of a relational database.

By the end of the course a student is expected to:

1. design a relational database for a given schema.
2. create lab assignment record that includes problem definitions, solutions, results and conclusions.
3. demonstrate ethical practices, self-learning and team spirit.

Students are required to do eight to ten practical. The lab practical are evenly spread over the syllabus. Every student is required to prepare a file of lab Experiments done.

Soft Computing Concepts and Techniques

General Course Information:

Course Code: CSL721 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites:

Basic knowledge of Probability Theory, Set Theory, programming skills and Data Structure and Computer Algorithms

About the Course and its Objectives & Outcomes:

This course aims to learn soft computing techniques to make intelligent machines that possess human like abilities to reason, learn and handle the uncertainty and vagueness often inherent in real world problems. This course on soft computing is going to cover Genetic Algorithms, Artificial Neural Networks and Fuzzy Logic. The course is primarily an applied one with solid emphasis on computational formulations and their applications.

The objectives of this course are to:

1. provide in-depth knowledge and understanding of the soft computing techniques.
2. develop the ability to design soft computing solutions to real world problems.
3. implement the soft computing solutions using appropriate tools.

By the end of the course a student is expected to:

1. be able to apply Genetic Algorithms, Artificial Neural Networks, Fuzzy Logic or a combination of these as computational tools to solve a variety of problems related to optimization and machine learning.
2. acquire knowledge of the tools like MATLAB, R, GALIB and KEEL, NeuroXL etc. available to implement the GAs, ANN and FL systems.
3. Applications of Soft computing to solve problems in varieties of application domains.

Syllabus

Unit I

Concept of computing systems, soft computing versus hard computing, Characteristics of Soft computing, need of soft computing, Major Areas of Soft Computing, hybrid soft computing, and Applications of soft computing techniques.

Unit II

Fuzzy Sets: crisp set, fuzzy set, fuzzy membership functions, operation on fuzzy sets, fuzzy relations, and fuzzy extension principle. Fuzzy Logic: Crisp Logic, fuzzy logic basics, fuzzy rules, and fuzzy reasoning. Rough Sets: Information Systems and Decision Systems, indiscernibility, set approximations, properties of rough sets, rough membership, and applications.

Unit III

Neural networks: Basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Characteristics of neural networks, Learning methods, Rosenblatt's Perceptron, Fixed increment perceptron learning algorithm for a classification problem, Examples of learning of AND/OR gate by perceptron, XOR problem.
Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation learning, Delta or gradient descent learning rule and effect of learning rate, Back propagation learning algorithm.

Unit IV

Natural Evolutions: Chromosomes, natural selection, crossover, and mutation. Genetic Algorithms (GAs): chromosomes, fitness function, population, GA operators, GA parameters, and convergence. Multi-Objective Genetic Algorithm: MOO problem formulation, pareto-optimal front, pareto-optimal ranking, multi-objectives fitness and multi-objective GA process.
Hybrid Systems: Neuro-fuzzy systems, Neuro-Genetic Systems and Fuzzy-Genetic System

Programming Using MATLAB: Using Neural Network toolbox–Using Fuzzy Logic Toolbox-Using Genetic Algorithm & directed search toolbox.

Text and Reference Books:

1. David.E. Goldberg, Genetic Algorithms in Search, Optimization and machine learning, Addison Wesley, 1999.
2. Zbigniew Michalewicz, Genetic algorithms +Data Structures = Evolution Programs, Springers-Verlag, 1999.
3. M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall, 1998.
4. S. Rajasekaran & G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, PHI, 2003.
5. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007.
6. J-S. R. Jang, C.-T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 1997.
7. Simon O. Haykin, Neural Networks, A Comprehensive Foundation, PHI, 1994.
8. Samir Roy and Udit Chakraborty, Introduction to Soft Computing Neuro-fuzzy and Genetic Algorithms, 2013, Pearson.

Research Methodology

General Course Information:

Course Code: CSL722 Course Credits: 3 Type: Elective Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites:

Basic knowledge of set theory and calculus

About the Course and its Objectives & Outcomes:

With this course, students will learn the core concepts of probability theory and will be able to understand statistical inference principles. This course trains students to experiment with data, apply probability theory principles and various statistical tests. The course emphasizes on the scientific research concepts, statistical analysis, probability and distributions, random variables, sampling distributions and testing hypothesis.

The main objective of this course is to:

1. make the students familiar with basic concept of research and its methodologies.
2. identify research problems and address them

By the end of the course a student is expected to be able to:

1. identify and define a research problem and its parameter.
2. organize and conduct research in an organized manner.
3. use basic counting techniques to compute probability.

Syllabus

Unit I

Introduction: Nature and objectives of research, types and methods of research; empirical and experimental research, study and formulation of a research problem.

Statistical analysis: Measures of central tendency and dispersion,-mean, median, mode, range, mean and standard deviations. computing correlation in variables, linear and non-linear regression.

Unit II

Probability: classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence.

Probability distributions: binomial, poisson, geometric, negative binomial uniform exponential, normal and log normal distribution.

Unit III

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles, Markov inequality, correlation and regression, independence of random variables.

Unit IV

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems.

Hypothesis Testing: Basic ideas of testing hypothesis, null and alternative hypotheses, the critical and acceptance regions, two types of error, tests for one sample and two sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications.

Software and Tools to be learnt: Statistical packages like SPSS and R.

Text and Reference Books:

1. Hwei Hsu, Schaum's Outline of Probability, Random Variables, and Random Processes , 2nd Ed, McGraw-Hill, 2010.
2. Johnson, R.A. Probability and Statistics, PHI, New Delhi, 1994.
3. Kishore S. Trivedi, Probability & Statistics with Reliability, Queuing and Computer Sc. Applications, PHI, 2001.
4. S. Lipshutz, Schaums Outline series: Theory and Problems of Probability, McGraw-Hill Singapore, 1982.
5. V.K. Rohatgi, A.K. Md.E.Saleh, An Introduction to Probability and Statistics, Johm Willey, 2011.
6. S.M. Ross, A First Course in Probability, 8th Edition, Printice Hall, 2009.

High Speed Networks and Mobile Technologies

General Course Information:

Course Code: CSL723 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites:
Basic knowledge of computer networks, layers of OSI reference model, protocols at different layers of OSI reference model.

About the Course and its Objectives & Outcomes:

Today computers without effective and fast communication systems are practically of no use. We have seen sufficient growth in terms of computing power but a lot of work is required to be done to improve communication speed of computers.

The objective of the course is to:

1. make the students learn about different high speed communication technologies like 10 G Ethernet, WiFi, WiMAX, Fiber Channel, LTE, HSPA, GSM, CDMA, ATM, ISDN and Frame Relay.

By the end of the course a student is expected to:

1. have knowledge of different high speed communication technologies like 10 G Ethernet, WiFi, WiMAX, Fiber Channel, LTE, HSPA, GSM, CDMA, ATM, ISDN and Frame Relay.
2. be able to start research for improvement of performance of these technologies.

Syllabus

Unit I
Gigabit Ethernet: Overview of fast Ethernet, Gigabit Ethernet – overview, specifications, layered protocol architecture, network design using Gigabit Ethernet, applications, 10GB Ethernet – overview, layered protocol architecture, applications.
Wireless Networks: Existing and emerging standards, Wireless LAN(802.11), Bluetooth(802.15) their layered protocol architecture and frame format.
Fiber Channel: Fibre channel physical characteristics – topologies & ports, layered protocol architecture, class of service, technology comparison.

Unit II
Frame Relay: Protocol architecture, frame format.
ISDN: Channels, interfaces, addressing, protocol architecture, services.
ATM: Virtual circuits, cell switching, reference model.

Unit III
Voice Communication Technologies: Overview, Multiple Access Techniques and architecture of Global System for Mobile Communication, Code Division Multiple Access
Data Communication Technologies: Overview and Architecture of EDGE, HSPA, WiMAX (802.16) and Long Term Evolution

Unit IV
Mobile network Layer Protocols: Mobile IP- goals, assumption, requirement, entities, terminology, IP packet

delivery, Agent advertisement and discovery, registration, tunnelling, encapsulation, optimization , reverse tunnelling.

Mobile Transport Layer Protocols: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP fast retransmission/ recovery, transmission/time out freezing, selective retransmission, Transaction oriented TCP.

Software tools to be learnt: NS2, NS3, GLOMOSIM, Qualnet

Text and Reference Books:

1. Andrew S. Tanenbaum, Computer Networks, 5th Edition, Pearsons, 2010.
2. Jochen Schiller, Mobile Communication, 2nd Edition, Pearsons, 2003.
3. Lee, Mobile Cellular Telecommunications, 2nd Edition, McGraw- Hill, 2010.

Cloud Computing

General Course Information:

Course Code: CSL724 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Basic knowledge of parallel and distributing computing.

About the Course and its Objectives & Outcomes:

Cloud Computing has recently emerged as one of the buzzwords in the field of ICT. This course covers theoretical concepts in Cloud Computing such as Cloud Computing Platform and Technologies, Cloud Computing Architecture, Monitoring and Management, and finally Governance and Case Studies. The objective of this course is to educate students about the benefits of cloud computing and the best way to harness the full potential of the cloud. For home assignments and mini-projection problem solutions, the students would apply Cloud Computing Techniques throughout the course. Individual as-well-as group-oriented exercises will be assigned to the students.

The objectives of this course are to:

1. provide in-depth knowledge and understanding of the cloud computing.
2. analyze the role technology plays in the design of a storage solution in cloud architecture
3. compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.

By the end of course a student is expected to:

1. understand the fundamental concepts of Cloud Computing environment.
2. learn emerging concepts of virtualization, resource managements and Cloud Services.
3. explain major security and privacy problems in Cloud Computing and how they are addressed with security mechanisms.
4. analyze and monitor cloud applications for real life problems solutions.
5. design and implement a novel cloud computing application.

Syllabus

Unit I

Overview of Computing Paradigms: Recent trends in Computing: Parallel Computing, Distributed Computing, Utility Computing, Parallel vs. Distributing Computing, Elements of Parallel Processing and Distributing Processing, Technologies of Distributed Computing. Evolution of Cloud Computing, Business Driver for Adopting Cloud Computing, Introduction to Cloud Computing, Cloud Service Providers, Features of a Cloud, Cloud Computing vs. Cluster Computing vs. Grid Computing, Migrating into a Cloud.

Unit II

Cloud Computing Architecture: Introduction, Cloud Reference Model, Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud. Infrastructure as a Service (IaaS): Introduction to Virtualization, Different Approaches to Virtualization, Resource Virtualization (Server, Storage, Network), Virtual Machine (Resource), Examples: Amazon EC2, Eucalyptus. Platform as a Service (PaaS): Service

Oriented Architecture (SOA), Cloud Platform and Management: Computation and Storage, Examples: Google App Engine, Microsoft Azure. Software as a Service (SaaS): Access of Web Services.

Unit III

Monitoring and Management: An Architecture for Federated Cloud Computing: Basic Principles of Cloud Computing, A Model for Federated Cloud Computing, Security Considerations, SLA Management in Cloud Computing: Traditional Approaches to SLA Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud, Automated Based Policy Management, Cloud Applications: Scientific Applications, Business Consumer Applications – CRM.

Unit IV

Governance and Case Studies: Organizational Readiness and Change Management in the Cloud Age: Basic Concepts of Organizational Readiness, Drivers for Changes, Common Change Management Models, Change Management Maturity Model, Organizational Readiness Self-Assessment, Data Security in the Cloud: Idea of Data Security, The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risks, Cloud Computing and Identity, Digital Identity and Data Security.

T**ext and Reference Books:**

1. Rajkumar Buyya, James Broberg and Andrez Gosscinski, Cloud Computing: Principles and Paradigm, John Wiley and Sons, Inc. 2011 (ISBN 978-470-88799-8).
2. Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, Mastering Cloud Computing, McGraw Hill Publication (India) Private Limited, 2013 (ISBN 978-1-25-902995-0).
3. John W. Rittinghouse, James F. Ransome, Cloud Computing Implementation, Management and Security, Taylor & Francis group, 2010.
4. Anthony T.velte, Toby J.velte Robert Elsenpeter, Cloud Computing a Practical Approach, Tata Mc Graw Hill, 2010.
5. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.
6. Kris Jamsa, Cloud Computing, Jones & Bartlett Publishers, 2014.

Software Project Management

General Course Information:

Course Code: CSL725 Course Credits: 3 Type: Elective Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisite: Basic Knowledge of software engineering principles, software development life cycles, software models, planning issues, and estimation process.

About the Course and its Objectives & Outcomes:

This course covers advanced theoretical concepts in software project management. The course will introduce the basics of software project management, project life cycle models, risk management techniques, software configuration and finally end with project estimation and maintenance.

The objectives of this course are to:

1. discuss the various aspects of project management.
2. understand the tasks in software project management.
3. describe the requirements of project plan.

By the end of course a student is expected to:

1. understand and practice the process models, project life cycle models and the metrics road map along with typical metrics strategy used in software project management.
2. analyze risk management analysis techniques that identify the factors that put a project on risk and to quantify the likely effect of risk on project timescales.
3. process activities related to configuration management, Software Quality Assurance, project initiation and completion criteria for the project intimation phase.
4. demonstrate use of tools and techniques for project planning and tracking, estimation along with the activities involved in testing phase and maintenance in software project management.

Syllabus

Unit I

Project Life Cycle Models: Project Life Cycle Model, A Framework for studying different life cycle models, The waterfall model, The prototyping model, The rapid Application Development (RAD) model, The spiral model and its variants. Process Models: Characteristics of a process, what constitutes an effective process, why are the processes important, process models, Common misconceptions about processes. Project evaluation and selection of an appropriate project approach.

Unit II

Software Configuration Management: The processes and activities of software configuration management, configuration status accounting, Configuration Audit, Software configuration management in geographically distributed teams, Metrics in software configuration management,

Risk Management: What is risk management and why it is important? Risk Management Cycle, Risk Identification: Common Tools and Techniques Risk quantification, Risk Monitoring, Risk mitigation, Risks and

mitigation in the context of Global Project Teams. Some Practical Techniques in Risk Management, Metrics in risk management.

Unit III

Project Initiation: Activities during Project initiation, Outputs, quality records and completion criteria for the project intimation phase. Interfaces to the process database.

Project Planning and Tracking: Components of project planning 48, and tracking, the ―What‖ part of a project plan, The ―What Cost‖ part of a Project plan, The ―When‖ part of project planning, The ―How‖ part of project planning, The ―By whom‖ part of project management plan, putting it all together: The software project management plan Activities specific to project tracking.

Unit IV

Software Project Estimation: software project size, estimation and decomposition approaches, empirical estimation models, algorithmic models for estimation, automated estimation tools.

Project Management in testing phase: What is testing, what are the activities that make up Testing? Test scheduling and type of test, people issues in testing, Management structures for testing in global teams, metrics for Testing phase.

Project management in the maintenance phase: Activities during the maintenance phase, management issues during the maintenance Phase, Configuration management during the maintenance phase, Skill sets for people in the maintenance phase, Estimating size, effort and people resources for the maintenance phase, metrics for the maintenance phase.

Text and Reference Books:

1. Bob Hughes and Mike Cotterell, ―Software Project Management‖, Second Edition, Tata McGraw-Hill, 2001.
2. S. A. Kelkar, ―Software Project Management: A Concise Study‖ Third Edition, PHI Learning Pvt. Ltd., January 2013.
3. Gopalaswamy Ramesh ―Managing Global Software project‖ TMH Publishing Company, New Delhi, 2001.
4. Tom Demarco, Controlling Software Project Management, , Measurement, Prentice Hall , New jersey, 1982.
5. Tom Glib, Finzi Susannah, Principals of Software Engineering management, Addison Wesley, England, 2000.

Mathematical Concepts for Computer Science

General Course Information:

Course Code: CSL726 Course Credits: 3 Type: Elective Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Basic knowledge of set theory, logic gates, probability theory, matrix and graph fundamentals.

About the Course and its Objectives & Outcomes:
This course will enable to acquaint the students with mathematical/logical fundamentals including numerical techniques. This course will also enable to understand probability, sampling and graph theory that serve as an essential tool for applications of computer and information sciences.

The objectives of this course are to:

1. enable students to think mathematically about data and how to apply discrete theory principles on random variables in real world scenarios.
2. emphasizes on the algebraic structures, propositional calculus, graph theory, concept of random variables and stochastic processes.

By the end of the course a student is expected to:

1. formulate logical expressions, fuzzy logic to solve a variety of problems related to real scenarios.
2. create and comprehend mathematical arguments.

Syllabus

Unit I
Groups: Subgroup, Normal group, Cyclic group, Rings, Characteristics of a ring, Fields, Vector spaces: Definition, Basis of a Vector space, Subspaces, Sum of subspaces, Dimensionality, Linear span, Linear dependence and independence, Norm of a vector, Orthogonality, Orthonormal set.

Unit II
Logic propositions and logical operations, Truth tables and proposition generated by a set equivalence and implication, Tautologies, Contradictions, Fuzzy sets, Operations on fuzzy sets, Fuzzy Relations, Properties and operations on fuzzy relations.

Unit III
Graphs: components of a graph, subgraphs, spanning graph, isomorphic and homomorphic graphs, Planar graphs, Euler's and Hamiltonian graphs (along with based theorems), Graph colouring, Chromatic numbers , Trees: forests, spanning trees, rooted trees and binary trees(along with based theorems), Algorithms on graphs – BFS, DFS Dijkstra's algorithm for shortest path, Floyd's algorithm for all pairs of shortest paths.

Unit IV
Random variables, Functions of random variables, Sequences of random variables, Stochastic processes, Markov process, Transition probability, Transition probability matrix, First and higher order markov process, n-step transition probabilities, Markov chain, Queuing theory: Queueing system and problem, Transient and Steady states, Probability distributions in queueing systems.

Text and Reference Books:
1. Ernest Davis, Linear Algebra and Probability for Computer Science Applications (1st Ed): CRC Press, 2012.

2. Hwei Hsu, Schaum's Outline of Probability, Random Variables, and Random Processes (2nd Ed), McGraw-Hill, 2010.
3. Bernard Kolman and Robert Busby, Discrete Mathematical Structures for Computer Science (1st Ed), PHI (1984).
4. Kishore S. Trivedi, Probability & Statistics with reliability, queuing and computer Sc. Applications, PHI, 2001.
5. S. Lipshutz, Schaums Outline series: Theory and problems of Probability, McGraw-Hill Singapore, 1982.
6. Hamdy A. Taha, Operations Research, 9th edition, Pearsons Printice Hall, 2010.
7. Hiller and Dieherman, Introduction to Operations Research, Stanford University, 2010.
8. C.Liu , Elements of Discrete Mathematics, Tata McGraw-Hill, 2000.

Information and Cyber Security

General Course Information:

Course Code: CSL727 Course Credits: 3 Type: Compulsory Contact Hours:3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Elementary Number Theory, Arithmetic functions, Algebraic Structures, Computer Networks.

About the Course and its Objectives & Outcomes: This course provides an introduction to technical aspects of information and cyber security. It describes threats and types of attacks against computers and networks to enable students to understand and analyze security requirements. The objective of this course is to give insight into the underlying mathematics in different cryptographic algorithms and to impart knowledge on wireless network security. In the current scenario, we also require to have knowledge of copyright issues of software and cyber laws and IT protections for different countries.

The objectives of this course are to:

1. explain standard algorithms used to provide confidentiality, integrity and authenticity.
2. distinguish key distribution and management schemes.
3. deploy encryption techniques to secure data in transit across data networks
4. implement security applications in the field of Information technology

By the end of the course students will be able to:

1. describe the basic mathematical principles and functions that form the foundation for cryptography.
2. evaluate the types of threats and vulnerabilities in context to the risks associated and their countermeasures.
3. analyse and compare symmetric-key encryption and public-key encryption schemes based on different security models
4. identify security threats in Advanced Wireless networks.

Syllabus

Unit I

Principles of Security, Types of Attacks, Denial of Service (DOS) Attack, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Block Cipher Design Principles and Modes of operation, Symmetric and Asymmetric Key Cryptography Steganography.

Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC4, Blowfish, Advanced Encryption Standard (AES).

Unit II

RSA Algorithm, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Digital Signatures, Knapsack Algorithm, Attacks on Digital Signatures, Message Authentication, Hash and MAC Algorithms, SHA-512, HMAC, Public Key Infrastructure, Kerberos

Web Security: SQL Injection Attack, Web Security Requirements; Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Hyper Text Transfer Protocol (SHTTP), Secure Electronic Transaction (SET).

Unit III

Email Security: Pretty Good Privacy (PGP) and S/MIME; Wireless Application Protocol (WAP) Security, WEP, Security in GSM, Security in 3G, Bluetooth Security, IEEE 802.11 Security, Wi-Fi Security

Malware: Viruses, Worms, Trojan horses, Bombs, Spyware, Adware, Ransomware, backdoor, Viruses, Worms; Firewalls, Firewall Architecture, Types of Firewalls, IP Security, Virtual Private Networks (VPN), Intruders, Intrusion Detection System (IDS), Intrusion Detection Techniques, IDS Tools.

Unit IV

Introduction to cybercrime and cyber law, cyber space and information technology, Cybercrime: Phishing, unauthorized access, White collar crimes, Cyber stalking, voyeurism, obscenity in internet, Software piracy; Web threats for Organizations, Social Computing and associated Challenges for Organizations, Ethical Hacking, Intellectual Property Rights and Issues.

The Indian IT Act 2000, Offences & Penalties under the IT Act 2000, The Indian IT (amendment) Act 2008.

T**ext and Reference Books:**

1. Kahate, A., Cryptography and Network Security, 4/E, McGraw Hill Education, 2019.
2. Stallings, W., Cryptography and network security, 4/E, Pearson Education India, 2006.
3. Schneier, B., Applied cryptography: protocols, algorithms, and source code in C, John Wiley & Sons, 2007.
4. Forouzan, B. A., & Mukhopadhyay, D., Cryptography and network security (Vol. 12), Mc Graw Hill Education (India) Private Limited, 2015.
5. Santanam, R., Sethumadhavan, M., & Virendra, M. (Eds.), Cyber Security, Cyber Crime and Cyber Forensics: Applications and Perspectives, IGI Global, 2010.
6. Godhole, N.& Belapure, S., Cyber Security, Wiley India, 2011.
7. Duggal, P., Cyberlaw – The Indian Perspective, Saakshar Law Publications, 2004.

Distributed Operating System

General Course Information:

Course Code: CSL728 Course Credits: 3 Type: Compulsory Contact Hours:3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Basic knowledge of operating system and Distributed Operating Systems.

About the Course and its Objectives & Outcomes: This course provides an introduction to technical aspects of Distributed Operating Systems. It describes algorithms and protocols to enable students to understand and analyze system requirements. The objective of this course is to impart knowledge on Communication, deadlocks, web services and security In the Distributed Operating Systems.

The objectives of this course are to:

1. develop skill set in developing a distributed system.
2. design and evaluate algorithms and protocols for various distributed systems.

By the end of the course students will be able to:

1. have a broad and up-to-date coverage of the principles and practice in the area of Distributed Systems.
2. understand the heterogeneous systems such as computers, mobile phones, other devices and Internet) and their functionalities.

Syllabus

Unit I

Basics: Definition of a distributed systems, Examples, Resource sharing and the Web, Challenges, System models, Architectural and fundamental models, Networking Interprocess communication, External data representation and marshaling, Client-server and Group communication**.** Distributed objects and remote invocation, Communication between distributed objects, Remote procedure call, Events and notifications - The operating system layer, Protection, Processes and Threads.

Unit II

Attributes of Distributed Operating System: Performance and Scalability, Connectivity and Security, Reliability and Fault Tolerance, Transparency, Network Operating Systems, Distributed Operating Systems.

Communication in Distributed Systems: Remote Procedure Call (RPC), Remote Method Invocation (RMI), CORBA (Common Object Request Broker Architecture), DCOM (Distributed Component Object Model, Process Migration in Distributed Systems.

Unit III

Synchronization in Distributed Systems: Mutual Exclusion in Distributed Systems, Mutual Exclusion without Shared Memory, Agrawala and Ricart's Distributed Mutual Exclusion Algorithm.

Deadlock in Distributed Systems: Distributed Deadlock, Deadlock Prevention, Deadlock Detection, A Distributed Resource Deadlock Algorithm.

Unit IV

Distrubuted Systems and Web Services: Distributed File System Concepts, Network File System (NFS). Multicompouter Systems, Clustering, Distributed Computing, Grid Computing.

Security in Operating System: Cryptography, Access Control, Security Attacks and Security Solutions, Key Agreement Protocols, Secure Communication Protocols, Steganography, Open Source Security

Text and Reference Books:

1. George Coulouris, Jean Dollimore, and Tim Kindberg, " Distributed Systems Concepts and Design", 5th ed., Pearson Education, 2011.
2. Andrew S. Tanenbaum, Maartenvan Steen, "Distributed Systems Principles and Paradigms", 2nd ed., Pearson Education, 2006.
3. Nancy A. Lynch, "Distributed Algorithms", Hardcourt Asia Pvt. Ltd., Morgan Kaufmann, 2000.
4. M. Milenkovic : Operating Systems, McGraw Hill.
5. Gary Nutt : Operating System, Modern Perspective, Addison Wesley.

Soft Computing Lab.

General Course Information:

Course Code: CSP721 *Course Credits: 2 Type: Compulsory Contact Hours: 4 hours/week Mode: Experimental Lab. *In lab work one credit is equivalent to two hours	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Programming in C/C++/Java/python.

About the lab. Course and its Objectives & Outcomes: This lab course aims to apply soft computing techniques to make intelligent machines in real world problems. This Lab course on soft computing is going to cover Genetic Algorithms, Artificial Neural Networks and Fuzzy Logic. The course is primarily an applied one with solid emphasis on computational formulations and their applications.

The objectives of this lab. course are to:

1. give students a hands on training to implement soft computing techniques.
2. apply genetic algorithms to the unseen problems.
3. learn the tools to apply other soft computing techniques like neural net and fuzzy logic.

By the end of the course a student is expected to be able to:

1. practically apply Genetic Algorithms using C/C++/Java programming language to optimize some benchmark functions.
2. use the tools like MATLAB to implement the GAs, ANN and FL systems.

Students are required to do eight to ten practical. The lab practical are evenly spread over the syllabus. Every student is required to prepare a file of lab Experiments done. Students are required to solve small research problems in the lab.

Research Tools for Computer science & Engineering Lab

General Course Information:

Course Code: CSP722 *Course Credits: 2 Type: Compulsory Contact Hours: 4 hours/week Mode: Experimental Lab. *In lab work one credit is equivalent to two hours	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Programming experience and basic statistics.

About the lab. Course and its Objectives & Outcomes: With this lab. course, students will apply and implement the core concepts of probability theory and will be able to perform statistical inference principles. This course trains students to experiment with data, apply probability theory principles and various statistical tests. The lab. course emphasizes on the scientific research concepts, statistical analysis, probability and distributions, random variables, sampling distributions and testing hypothesis.

The objectives of this lab. Courses are to:

1. develop advanced skills in applying research methods.
2. train students in using appropriate research tools to address research problems.

By the end of the course a student is expected to:

1. be able to practically select and appropriate research tools to solve a real world research problem.
2. design experiments to test a research hypothesis.
3. be able to use the tools like MATLAB and R, Python .
4. understand data and interpret results.

Students are required to do eight to ten practical. The lab practical are evenly spread over the syllabus. Every student is required to prepare a file of lab Experiments done. Students are required to solve small research problems in the lab.

Software Testing and Quality Assurance

General Course Information:

Course Code: CSL731 Course Credits: 3 Type: Compulsory Contact Hours:3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Basic knowledge of Software Testing and Quality Assurance.

About the Course and its Objectives & Outcomes: This course provides an introduction to technical aspects of Software Testing and Quality Assurance. It describes algorithms and protocols to enable students to understand and analyze system requirements. The objective of this course is to impart knowledge on software testing, security and quality of software in the Software Testing and Quality Assurance.

The objectives of this course are to:

1. Develop methods and procedures for software development that can scale up for large systems and that can be used to consistently produce high-quality software at low cost and with a small cycle time

2. Learn systematic approach to the development, operation, maintenance, and retirement of software

3. Learn how to use available resources to develop software, reduce cost of software and how to maintain quality of software

4. Methods and tools of testing and maintainace of software's.

By the end of the course students will be able to:

1. Explain and Apply Knowledge of Key Concepts of Software Testing, Quality and Testing Tools.

2. Draw the DD Graph and Identify the Various Test Cases of Software Testing Problems and Determine the Complexity of Software.

3. Design Test Cases and Develop Test Suite, for Carrying Out the Various Levels of Testing Manually and Automatically.

4. Manage Software Defects, and Risks Within a Software Project.

5. Work Effectively in Profile of Software Tester, Quality Assurance and Control officer, Project Manager and Leaders.

Syllabus

Unit I

Software Testing Process, Objectives, Phases of Software Testing, Testing Techniques, Software Testing Axioms, Role of Software Tester, , Bugs, Types of Bugs, Stubs and Drivers, Verification and Validation, Different Types of Verification & Validations Mechanisms, Software Testing Techniques, Concepts of Software Reviews, Code Inspection and Code Walkthrough, Testing of Component Based Software System.

Unit II

Software Testing Methods, Testing Fundamentals, Test Case Design, White Box Testing and its Types, Black Box Testing and its Types, Software Testing Strategies, Strategic Approach to Software

Testing, Unit Testing, Integration Testing, Validation Testing, System Testing, Test Planning, Budgeting and Scheduling.

Unit III

Software Testing Metrics, Concept and Developing Testing Metrics, Different Types of Software Testing Metrics, Complexity Metrics, Defect Management, Definition of Defects, Defect Management Process, Defect Reporting, Metrics Related to Defects, Using Defects for Process Improvement.

Unit IV

Software Quality, Factors Affecting Software Quality, Quality Models, Software Quality Assurance, SQA Activities, SQA Components, Software Quality Metrics, Software Quality Management, SQA Plan. Software Quality Improvement, SQI Tools: Pareto Diagrams, Cause-Effect Diagrams, Scatter Diagrams, Run Charts, Histogram. ISO 9001 Quality Standard.

Text and Reference Books:

1. Roger S. Pressman, Software Engineering a Practitioners Approach, McGraw Hill Education: 7 Edition, 1 April 2009.
2. K.K. Aggarwal& Yogesh Singh, "Software Engineering", 2nd Ed., New Age International Publishers, New Delhi, 2005.
3. Kshirsagar Naik, PriyadarshiTripathy, Software Testing and Quality Assurance Theory and Practice. Wiley-Spektrum; I Edition, August 18, 2008.
4. Donna C. S. Summers, Quality Management, Pearson; 2 Edition, April 26, 2008
5. Yogesh Singh, Software Testing. Cambridge University Press, 2012
6. William Perry, "Effective Methods for Software Testing", John Wiley & Sons, New York, 1995
7. Louise Tamres, "Software Testing", Pearson Education Asia, 2002
8. CemKaner, Jack Falk, Nguyen Quoc, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 1993.

Big Data Analytics

General Course Information:

Course Code: CSL732 Course Credits: 3 Type: Elective Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Knowledge of basic mathematical concepts related to data analysis, big data, and working knowledge of data analytics tools.

About the Course and its Objectives & Outcomes: In today's environment, properly leveraged data can give organizations of all types a competitive advantage. Companies now handle vast amounts of data on a daily basis and there is unparalleled demand for professionals in this field. Big data analytics helps us to make sense of large volumes of data and convert them into valuable business insights. The need for big data analytics comes from the fact that we are generating data at an extremely rapid pace, and every enterprise needs to make sense of this data. This course would provide the students with sufficient knowledge of the utilization of big data analytics tools that are available for analysis of data etc.

The objectives of this course are to:

1. Study the basic technologies that form the foundations of Big Data.
2. Understand the specialized aspects of big data including big data application, and big data analytics.
3. Study different types of case studies on the current research and applications of Big Data Analytics tools in the industry.

By the end of the course a student is expected to:

1. Understand the building blocks of Big Data.
2. Represent the analytical aspects of Big Data.
3. Know the recent research trends related to Hadoop File System and MapReduce etc.
4. Demonstrate the use of Big Data Analytics tools to analyze big data.
5. Practice self-learning by using e-courses and web materials.

Syllabus

Unit 1

Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Typical Analytical Architecture – Requirement for new analytical architecture – Challenges in Big Data Analytics – Need of big data frameworks, Big Data Workflow, Big Data Analytics in Industry Verticals, Big Data Analytics Lifecycle, Challenges of Conventional Systems, Recent Trends in Big Data Analytics. Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error, Regression Modeling, Multivariate Analysis, and Bayesian Modeling.

Unit II

Mining Data Streams: Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real-time Analytics, Platform (RTAP) Applications, Case Studies, Real-Time Sentiment Analysis, Stock Market Prediction.

Unit III

Exploratory Data Analysis: Introduction to Exploratory Data Analysis, Preprocessing-Traditional Methods And, Maximum Likelihood Estimation, Preprocessing Bayesian Estimation, Data Summarization & Visualization, Outlier Analysis, Feature Subset Selection, and Dimensionality Reduction.

Unit IV

Big Data Frameworks: Hadoop Framework: Hadoop – Requirement of Hadoop Framework - Design principle of Hadoop –Comparison with Other systems - Hadoop Components – Hadoop 1 vs Hadoop 2 – Hadoop Daemon's – HDFS Commands – Map Reduce Programming: I/O formats, Map side join, Reduce Side Join, Secondary sorting, Pipelining MapReduce jobs. Spark Framework: Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features. Overview of other Big Data Analytics tools: MongoDB, Cassandra, SAS ,etc.

Text and Reference Books:

1. Intelligent Data Analysis Michael Berthold, David J. Hand, Springer 2007.
2. Mining of Massive Datasets, A. Rajaraman, J.D. Ullman, Cambridge University Press, 2012.
3. Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics Bill Franks John Wiley & Sons 2012.
4. Making Sense of Data: A Practical Guide to Exploratory Data Analysis and Data Mining, Wiley–Blackwell, 2006.
5. Big Data Glossary, Pete Warden, O'Reilly,2011.
6. Data Analytics with Hadoop, An Introduction for Data Scientist, Benjamin Bengfort & Jenny Kim, O'Reilly, 2016.

Machine Learning

General Course Information:

Course Code: CSL733 Course Credits: 3 Type: Elective Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods**: Two minor examinations each of 20 marks, class performance measured through percentage of lectures attended (4 marks), assignment and quizzes (6 marks), and end semester examination of 70 marks. For the end semester examination nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions each of two marks. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt four questions by selecting one from each unit. All the questions carry equal marks.

Pre-requisites: Students are expected to have knowledge of Linear algebra, probability and Statistics **The objectives of this course are to:**

1. study how to build computer systems that learn from experience.
2. study the representation of patterns and classes and the proximity measures.
3. study how to reduce the data and its use for pattern classification.
4. learn classification and clustering of patterns.

By the end of the course a student is expected to:

1. describe how to build systems that learn and adapt using real-world applications.
2. apply feature extraction and feature selection techniques.
3. develop pattern recognition techniques for practical problems such as document recognition.
4. compare and Contrast supervised learning and unsupervised learning.

Sylla

bus Unit-I

Introduction: Well posed learning problems, designing a learning system, Issues in machine learning, the concept learning task, Concept learning as search, Finding a maximally specific hypothesis, Version spaces and candidate elimination algorithm, Remarks on version spaces and candidate-eliminations, Inductive bias.

Unit-II

Supervised Learning: Linear regression, Multiple linear regression, Logistic regression, basic decision tree learning (ID3) algorithm, Hypothesis space search in decision tree learning algorithm, Inductive bias in decision tree learning, Issues in decision tree learning, k-nearest neighbor learning.

Unsupervised Learning: About clustering, type of data in clustering analysis, k-means and k-medoids, DBSCAN density-based clustering method, Performance analysis of clustering algorithms.

UNIT-III

Artificial Neural networks: Neural Network representations, Problems for neural network learning, Perceptron. The perceptron training rule, Gradient descent and delta rule, Multilayer Networks and back propagation algorithm.

Bayesian Learning: Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Naïve Bayes Classifier.

Unit-IV

Advanced Learning: Evaluating Machine Learning algorithms, Model Selection, evaluation and Tuning, Statistical Learning Theory, Ensemble Learning(Boosting, Bagging, Random Forests), Sparse Modeling, Modeling Sequence/Time-Series Data, Deep Learning.

T**ext and Reference Books:**

1. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.
2. R. O. Duda, P.E. Hart and D. G.Stork, Pattern Classification, Wiley, 2000.
3. Devi V.S., Murty, M.N., Pattern Recognition: An Introduction, Universities Press, Hyderabad, 2011.
4. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
5. R. Xu and D. C. Wunsch, II, Clustering, IEEE Press, 2009.

Digital Image Processing

General Course Information:

Course Code: CSL734 Course Credits: 3 Type: Compulsory Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Knowledge of basic linear algebra, probability theory; Exposure to programming techniques, Fourier Transforms, and working knowledge of Matlab.

About the Course and its Objectives & Outcomes:

Visual information has its own role in our life. Most of the time, we find that much of this information is represented by digital images. Digital image processing is omnipresent, with applications including television, tomography, photography, printing, robot perception, and remote sensing. Through this course we expect to cover the topics like image acquisition and display, colour representations, image sampling and quantization, point operations, linear image filtering and correlation, image transforms, enhancement, image restoration, image compression, segmentation and image representation. This course would provide the students sufficient knowledge of mathematical concepts that would help them in self-study of advanced topics such as computer vision systems, biomedical image analysis etc.

The objectives of this course are to:

1. develop a theoretical foundation of digital image processing concepts.
2. provide mathematical foundations for digital manipulation of images, image acquisition, preprocessing, enhancement, segmentation, and compression.
3. implement algorithms that perform basic image processing operations (e.g., histogram processing, noise removal and image enhancement and restoration);
4. implement algorithms for image analysis (e.g., image compression, image segmentation and image representation);
5. assess the performance of image processing algorithms and systems.

By the end of the course a student is expected to:

1. Possess a clear understanding of two-dimensional signal acquisition, sampling, and quantization.
2. Acquire a good understanding of the mathematical foundations for digital manipulation of images such as image acquisition, preprocessing, segmentation, compression and representation.
3. Learn and understand the image enhancement in the spatial domain and frequency domain.
4. Design and implement Matlab algorithms for digital image processing operations such as histogram equalization, filtering, enhancement, restoration, and denoising.
5. Analyze a wide range of problems and provide solutions related to the design of image processing systems and apply these techniques to real world problems.
6. Practice self-learning by using e-courses and web materials.

Sylla

bus Unit I

Introduction and fundamental to digital image processing: What is digital image processing, Origin of digital image processing, Examples that use digital image processing, Fundamental steps in digital image

processing, Components of digital image processing system, Image sensing and acquisition, Image sampling, Quantization and representation, Basic relationship between pixels.
Image enhancement in spatial domain: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and sharpening spatial filters.

Unit II
Image enhancement in frequency domain: Introduction to Fourier transform, sampling, discrete Fourier transform, extension to functions of two variables, Basics of filtering in frequency domain, Smoothing and sharpening frequency domain filters.
Image Restoration: Image degradation/restoration Process, Noise models, Restoration in presence of noise, Inverse filtering, Minimum mean square filtering, Geometric mean filter, Geometric transformations.

Unit III
Color Image Processing: Color fundamentals, Color models, Basics of full color image processing, Color transformations, Smoothing and sharpening.
Image Compression: Fundamentals, Spatial and temporal redundancy, Measuring image information, Image compression methods, Loss less compression, Lossy compression, Digital image watermarking.

Unit IV
Image Segmentation: Fundamentals, Point, line and edge detection, Edge linking and boundary detection, Thresholding, Region based segmentation.
Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors- simple, topological descriptors, Pattern and Pattern classes-Recognition based on matching techniques and neural networks.
Software and Tools to be learnt: MATLAB tool box on image processing,
SCILAB

T**ext and Reference Books:**

1. Rafael C. Gonzalez and Richard E. Woods,―Digital Image Processing‖, Pearson Education,Ed, 2001.
2. Anil K. Jain, ―Fundamentals of Digital Image Processing‖, Pearson Education, PHI, 2001.
3. Tinku Acharya and Ajoy K. Ray,―Image Processing-Principles and Applications‖, John Wiley & Sons, Inc., 2005.
4. Chanda and D. Dutta Majumdar, ―Digital Image Processing and Analysis‖, PHI, 2003.
5. Milan Sonka, Vaclav Hlavac, Roger Boyle, ―Image Processing, Analysis, and Machine Vision‖, Brookes/Cole, PWS Publishing Company, Thomson Learning, 2nd edition,1999.

Introduction to Natural Language Processing

General Course Information:

Course Code: CSL735 Course Credits: 3 Type: Elective Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Theory of Automata, Probability Theory.

The objectives of this course are to:

1. Understand approaches to syntax, semantics, dialogue and summarization in NLP,
2. Understand current methods for statistical approaches to machine translation.
3. Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars and clustering

By the end of the course a student is expected to:

1. Understand the mathematical and linguistic foundations in the area of NLP.
2. Design, implement and test algorithms for NLP problems.
3. Assess or evaluate NLP based systems.
4. Choose appropriate solutions for Natural Processing Language.

Syllabus

Unit 1

Introduction and Overview: What and why of Natural language Processing, Ambiguity and Uncertainty in language, The Turing test.

Regular Expressions: Chomski Hierarchy, Regular Languages and their limitations, Finite-state automata. Practical regular expressions for finding and counting language phenomena. A little morphology.

String Edit Distance and Alignment: Key algorithmic tool, dynamic programming, optimal alignment of sequences, Strings edit operations, edit distance, and spelling correction.

Unit II

Context Free Grammars: Constituency, CFG definition, use and limitations. Chomsky Normal Form. Top-down parsing, bottom-up parsing, and problems, Combining evidence.

Non-probabilistic Parsing: Efficient CFG parsing with CYK, dynamic programming algorithm, Earley parser, Designing a little grammar and parsing.

Information Theory: What is information? Measuring it in bits, The noisy channel model, The "Shannon game"-motivated by language, Entropy, cross-entropy, information gain and applications.

Unit III

Language modelling and Naive Bayes: Probabilistic language modelling and its applications. Markov models. N-grams. Estimating probability of a word and smoothing, Generative models of language and applications.

Part of Speech Tagging and Hidden Markov Models: parts-of-speech, examples, usage, The Penn Treebank and Brown Corpus, Probabilistic (weighted) finite state automata; Hidden Markov models (HMMs): definition and use.

Viterbi Algorithm for Finding Most Likely HMM Path: Dynamic programming with Hidden Markov Models, and its use for part-of-speech tagging, Chinese word segmentation, prosody, information extraction etc.

Unit IV

Probabilistic Context Free Grammars: Weighted context free grammars, Weighted CYK, Pruning and beam search, parsing with PCFGs: A Treebank. The probabilistic version of CYK, Eye-tracking, Modern parsers.

Maximum Entropy Classifiers: The maximum entropy principle, the need in NLP to integrate many pieces of weak evidence. Maximum entropy classifiers and applications, document classification, sentence segmentation, other language tasks.

Text and Reference Books:

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech recognition, Second Ed., 2009.
2. Chris Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press. Cambridge, MA, 1999.
3. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, First Edition, OReilly Media, 2009.
4. Lawrence Rabiner And Biing-Hwang Juang, “Fundamentals Of Speech Recognition”, Pearson Education, 2003.

Department of Mechanical Engineering
Industrial Safety (3OE01)

General Course Information

Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcome:

Sr. No.	At the end of semester, student will be able to	RBT Level
CO1.	**Identify** main causes of accidents in industries and their remedies.	LOTS: Level 1: Remember
CO2.	**Explain** the objective and importance of industrial safety, maintenance, fault tracing and decision tree concept.	LOTS: Level 2: Understand
CO3.	**Apply** basic principles of engineering for Industrial safety.	LOTS: Level 3: Apply
CO4.	**Examine** wear, corrosion, and faults in various machine components.	HOTS: Level 4: Analyze
CO5.	**Develop** maintenance schedule for industrial machine components**.**	HOTS: Level 5: Create

Course Content

UNIT-1

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, Safety colour codes. Fire prevention and firefighting, equipment and methods.

UNIT-2

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-3

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. Ring oil lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-4

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, Steps/procedure for periodic and preventive maintenance of: i. Pumps, ii. Air compressors, iii. Diesel generating (DG) sets.

Text and Reference Books:

1. R. Keith Mobley, "*Maintenance Engineering Handbook*", McGraw Hill Education, 8th Edition, 2014
2. L.C. Morrow and L.R. Higgins, "*Maintenance Engineering Handbook*", McGraw Hill Higher Education; 3rd edition, 1977.
3. H. P. Garg "*Industrial Maintenance*", S. Chand and Company, 3rd edition, 1987
4. F. Graham, "*Pump-hydraulic Compressors*", Theo Audels & co 1949.

Course Articulation Matrix

Industrial Safety (3OE01)			
	PO1	**PO2**	**PO3**
CO1. Identify main causes of accidents in industries and their remedies	1	-	-
CO2. Understand the objective and importance of industrial safety, maintenance, fault tracing and decision tree concept.	1	-	1
CO3. Apply basic principles of engineering for Industrial safety.	-	-	1
CO4. Examine wear, corrosion, and faults in various machine components	2	-	2
CO5. Develop maintenance schedule for industrial machine components**.**	3	-	2

Department of Mechanical Engineering

Composite Materials (3OE02)

General Course Information

Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes:

Sr. No.	At the end of semester, student will be able to	RBT Level
CO1.	**Define** the characteristics, applications and manufacturing processes of composite materials.	LOTS: Level 1: Remember
CO2.	**Describe** the properties and basic principles of composite manufacturing techniques.	LOTS: Level 2: Understand
CO3.	**Analyze** properties and performance of various processed composites.	LOTS: Level 3: Analyze
CO4.	**Select** composites and composite manufacturing techniques according to requirement.	HOTS: Level 4: Evaluate
CO5.	**Create** basic composite material to address the need of industrial and research requirement.	HOTS: Level 5: Design

Course Content

UNIT-1

Introduction: Classification and characteristics of composite materials, advantages and application of composites, functional requirements of reinforcement and matrix, Different types of matrix materials their properties, Effect of reinforcement (size, shape, distribution) on overall composite performance.

UNIT-2

Reinforcements: Preparation-layup, properties and applications of Glass fiber, Carbon fiber, Kevlar fiber and Boron fiber.
Properties and applications of whiskers, Mechanical behaviour of composites: Rule of mixtures, Inverse rule of mixtures, Iso-strain and Iso-stress conditions.

UNIT-3

Manufacturing of Metal Matrix Composites: Types, Processing methods– Liquid-State Processes, Solid State Processes, In-Situ Processes, Interface, Properties and applications.
Manufacturing of Ceramic Matrix Composites: Types, fabrication methods, Interface, Properties and applications.

UNIT-4

Manufacturing of Carbon – Carbon composites: Fabrication methods, Oxidation Protection, advantages, limitations and applications.
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs - hand layup method - Autoclave method - Filament winding method - Compression moulding - Reaction injection moulding, Properties and applications.

Text and Reference Books:

1. K.K.Chawla, "*Composite Materials*", 3rd Edition, Springer, 2012
2. Deborah D.L. Chung, "*Composite Materials Science and Applications*", 2nd Edition, Springer, 2010.
3. WD Callister, Jr., Adapted by R. Balasubramaniam, "*Materials Science and Engineering*", John Wiley & Sons, NY, Indian edition, 2007.
4. R.W.Cahn, "*Material Science and Technology*" – Vol 13 – Composites, West Germany, 1994.

Course Articulation Matrix:

Composite Materials (3OE02)			
	PO1	**PO2**	**PO3**
CO1. Define the characteristics, applications and manufacturing processes of composite materials.	1	_	1
CO2. Describe the properties and basic principles of composite manufacturing techniques.	2	_	2
CO3. Analyze properties and performance of various processed composites.	2	_	3
CO4. Select composites and composite manufacturing techniques according to requirement.	2	_	3
CO5. Create basic composite material to address the need of industrial and research requirement.	3	_	3

Department of Mechanical Engineering

Computer Aided Design and Manufacturing (3OE03)

General Course Information

Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcome:

Sr. No.	At the end of semester, student will be able to	RBT Level
CO1.	**Define** the scope and applications of CAD/CAM	LOTS: Level 1: Remember
CO2.	**Discuss** the basic overview of geometric transformations, curves, surface and solids	LOTS: Level 2: Understand
CO3.	**Analyze** CAM, Computer Control Machines (CNC), and additive manufacturing.	LOTS: Level 3: Analyze
CO4.	**Validate** CAM, Computer Control Machines (CNC), Programming and additive manufacturing.	HOTS: Level 4: Evaluate
CO5.	**Generate** basic part programmes	HOTS: Level 5: Design

Course Content

UNIT-1

Introduction: Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process, CAD/CAM applications,

Transformations: 2D and 3D transformations. 2-D translation, rotation, reflection, scaling, homogeneous representation, concatenated transformation, mapping of geometric models, 3-D scaling, shearing, rotation, reflection and translation.

UNIT-2

Curves and surfaces: Curve representation, analytic curves – lines, arcs, circle, synthetic curves – cubic, Bezier, b-spline, surface representation, analytic surfaces – plane surface, ruled surface, surface of revolution, tabulated cylinder, synthetic surface – cubic, Bezier, b-spline.

Solids: Solid primitive models, types of representation – boundary, constructive solid geometry, sweep, cell decomposition.

UNIT-3

Computer Aided Manufacturing: CNC machine tools, principle of operation of CNC, Steps in manufacturing , construction features including structure and drives, Direct numerical control (DNC) and its application, advantages and limitations of CNC systems.

Manual part programming. Components of part program, steps in CNC programming, geometric calculations, coordinate systems, axes, program reference zero, G-codes, preparatory functions, miscellaneous functions, absolute & incremental systems.

UNIT-4

Additive manufacturing. Role of additive manufacturing, benefits, applications, additive manufacturing processes – stereolithography (STL), fused deposition modeling (FDM), selective laser sintering (SLS), multi-jet printing (MJP)

Text and Reference Books:

1. Zeid, I., "*CAD/CAM: Theory and Practice*", McGraw Hill, 2nd edition, 2009.
2. Rao P.N. "*CAD/CAM Principles and Applications*" Eighth edition, 2013.
3. Rogers, D. F. and Adams, J. A., "*Mathematical Elements for Computer Graphics*", McGraw Hill 2nd edition, 1989.
4. Radhakrishnan, P. and Kothandaraman, C. P., "*Computer Graphics & Design*", Dhanpat Rai Publication", 2nd edition, 2005.
5. Krishnamoorathy, C. S. and Rajeev, J. S., "*Computer Aided Design (Software and Analysis Tools*)", Narosa Publication House, 2nd edition, 2005.
6. Mattson Mike, "*CNC Programming: Principles & Applications*", Cengage learning, 1st edition 2013.
7. Fitzpatrick, "*Machining and CNC Technology*", McGraw-Hill Higher Education, 3rd edition 2013.

Course Articulation Matrix

Computer Aided Design and Manufacturing (3OE03)			
	PO1	**PO2**	**PO3**
CO1. Define the scope and applications of CAD/CAM.	-	-	1
CO2. Describe the basic overview of geometric transformations, curves, surface and solids.	1	-	1
CO3. Analyze CAM, Computer Control Machines (CNC), and additive manufacturing.	2	-	3
CO4. Validate CAM, Computer Control Machines (CNC), Programming and additive manufacturing.	2	-	3
CO5. Generate basic part programmes.	3	-	3

Department of Electronics & Communication Engineering
Advanced Communication Systems (3OE04)

General Course Information

Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes:

Sr. No.	At end of the semester, students will be able to	RBT Level
CO1	**Describe** terminologies & various form of communication systems and there technical specifications.	LOTS: Level 1: Remember
CO2	**Explain** the concepts of cellular system, optical communication & wireless internet systems.	LOTS: Level 2: Understand
CO3	**Apply** the concepts of radio planning & channel access for wireless mobile communication systems.	LOTS: Level 3: Apply
CO4	**Analyze** the performance of various wireless communication systems.	HOTS: Level 4: Analyze
CO5	**Design** basic wireless communication system to address the needs of subscriber's requirements with thorough knowledge of latest wireless communication technologies.	HOTS: Level 6: Create

Course Content

UNIT-1

Basic block diagram of a Communication system, Analog communication vs. Digital communication, Introduction to ASK, FSK, PSK. Generations of wireless mobile communication (from 1G to 5G).

UNIT-2

Block diagram of optical communication system, Basic principles of light propagation, Total internal reflection, Types of optical fibers, WDM optical networks, Block diagram of Radio over fiber network.

UNIT-3

Concept of multiplexing and multiple access, Time division multiplexing, Frequency division multiplexing, Introduction to Multiple Access: FDMA, TDMA, Spread Spectrum multiple Access: CDMA, Block Diagram of OFDMA.

UNIT-4

Basic architecture of GSM network, architecture of LTE system, architecture of 5G network.
Wireless sensor network: Basic architecture and applications. Block diagram and architecture of Wi-Fi network.

Text and Reference Books:

1. T.S. Rappaport, "*Wireless Communication: Principles and Practice*", Second Edition, Pearson, 2014.
2. John M. Senior**, "***Optical Fiber Communications: Principles and Practice*", Third Edition, Pearson, 2014.
3. BP Lathi, "*Modern Digital & Analog Communication System*", 4th edition, Oxford Press, 2011.
4. EH Callaway, "*Wireless Sensor Networks*", 1st edition, Auerbach Publications, 2003.
5. M Dryjanski. "*From LTE to LTE-Advanced Pro and 5G*", 1st edition, Artech House, 2017.

Course Articulation Matrix:

Advanced Communication Systems (3OE04)			
	PO 1	**PO 2**	**PO 3**
CO1. Describe terminologies & various form of communication systems and their technical specifications.	2	--	3
CO2. Explain the concepts of cellular system, optical communication & wireless internet systems.	2	--	3
CO3. Apply the concepts of radio planning & channel access for wireless mobile communication systems.	3	-	3
CO4. Analyze the performance of various wireless communication systems.	3	--	3
CO 5. Design basic wireless communication system to address the needs of subscriber's requirements with thorough knowledge of latest wireless communication technologies.	3	-	3

Department of Electronics & Communication Engineering

Renewable Energy Systems (3OE05)

General Course Information

Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes:

Sr. No.	At end of the semester, students will be able to	RBT Level
CO1.	**Describe** terminologies & various form of renewable energy resources.	LOTS: Level1: Remember
CO2.	**Explain** the concepts of renewable energy harvesting technologies.	LOTS: Level 2 Understand
CO3.	**Apply** the concept of energy production through different renewable energy resource systems.	LOTS: Level 3: Apply
CO4.	**Analyze** the performance of various renewable energy harvesting technologies.	HOTS: Level 4: Analyze
CO5.	**Design** different energy harvesting systems to address the needs of society with thorough knowledge of renewable energy harvesting technologies.	HOTS: Level 6: Create

Course Content

UNIT 1

Classification of energy sources, Electric Energy from Conventional Sources, Energy Efficiency and Conservation, renewable energy sources, Advantages and disadvantages of renewable energy sources.

UNIT 2

Photovoltaic Systems: Materials for solar cells, Photovoltaic Effect, Efficiency of Solar Cells, Solar Photovoltaic System (SPS), Grid Interactive Solar PV Power System, Solar Photovoltaics in India, Application of PV Systems , Advantages and disadvantages of solar energy technology.

UNIT 3

Wind energy technology, principle and operation of wind turbine, different types of wind turbines, Wind Energy Extraction, Extraction of Wind Turbine Power, Wind Power Generation Curve, Wind Characteristics, Grid Interfacing of a Wind Farm, Methods of Grid Connection, Advantages and disadvantages of wind energy system.

UNIT 4

Ocean Energy Resources: Introduction to Tidal Energy, Tidal Characteristics, Tidal Range, Tidal Energy Estimation, Development of a Tidal Power Scheme, Important Components of a Tidal Power Plant, Grid Interfacing of Tidal Power, Advantage and Disadvantage of Tidal Power, Tidal Power Development in India, Basics of Hybrid energy harvesting technologies.

Text and Reference Books:

1. D P Kothari, "*Renewable Energy Sources and Emerging Technologies*", 2nd edition, PHI, 2011.
2. Indu Shekhar Jha, "*Renewable Energy Technology*" 1st edition, New Age International Publishers, 2018.
3. Jean-Claude Sabonnadière, "*Renewable Energies*", 1st edition, Wiley Education, 2009.
4. John Twidell and Tony Weir, "*Renewable Energy Resources*", 3rd edition, Taylor and Francis, 2015.
5. Mehmet Kanoğlu, "*Fundamentals and Applications of Renewable Energy*", 1st Edition, TMH publication, 2020.

Course Articulation Matrix:

RENEWABLE ENERGY SYSTEMS (3OE07)			
	PO 1	**PO 2**	**PO 3**
CO1. Describe terminologies & various form of renewable energy resources.	2	--	3
CO2. Explain the concepts of renewable energy harvesting technologies.	2	--	3
CO3. Apply the concept of energy production through different renewable energy resource systems.	3	-	3
CO4. Analyze the performance of various renewable energy harvesting technologies.	3	--	3
CO5. Design different energy harvesting systems to address the needs of society with thorough knowledge of renewable energy harvesting technologies.	3	-	3

Department of Computer Science and Engineering

Soft Computing Techniques (3OE06)

General Course Information

Course Credit: 3 Type: Open Elective Contact Hours: 3/week Mode: Lectures Examination Duration: 3 Hours	**Course Assessment Methods** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes:

Sr. No.	After doing this course, students will be able to:	RBT Level
CO1.	**define** the terminology and concepts related to soft computing techniques.	LOTS: Level 1: Remember
CO2.	**discuss** soft computing techniques including genetic algorithms, fuzzy systems and neural networks.	LOTS: Level 2: Understand
CO3.	**solve** problems related to Genetic algorithms, Fuzzy logic and Neural Networks.	LOTS: Level 3: Apply
CO4.	**analyse** the design of Genetic Algorithms, Neural Networks and Fuzzy Systems.	HOTS: Level 4: Analyse
CO5.	**justify** the design of a soft computing algorithm for a given problem.	HOTS: Level 5: Evaluate
CO6.	**design** Genetic Algorithms and Neural Networks to solve optimization and pattern recognition problems.	HOTS: Level 6: Create

Course Content

UNIT-I

Introduction to Soft Computing and related definitions: Defining hard computing and soft computing, Examples situations for application of soft computing techniques.

Working of a simple Genetic Algorithm: Representation/Encoding Scheme, initializing a GA population, evaluation function, genetic operators, Block diagram of working of GA, Convergence of GA, Exploration and exploitation in GA. Function optimization using GA.

UNIT-II

Designing Genetic Algorithms: Different types encoding schemes, role of fitness function, different types of genetic operators, Designing GAs for numerical optimization, knapsack problem and TSP etc. Multi-objective Genetic Algorithms, Distributed Genetic Algorithms

UNIT-III

Fuzzy Sets: Basic terminology and definitions, Operations on Fuzzy sets, Properties of Fuzzy Sets

MF formulations and parameterization: Triangular, Trapezium and Gaussian Fuzzy MFs, Derivatives of parameterized MFs, Fuzzy numbers, Extension principle and fuzzy relations, Operations on Fuzzy relations, Linguistic variables. Fuzzification and defuzzification.

UNIT-IV

Neural networks: Review of the basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Perceptron, perceptron learning algorithm for a classification problem, Examples of learning of AND/OR gate by perceptron, XOR problem. Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation learning.

Text and Reference Books:

1. David.E. Goldberg, *Genetic Algorithms in Search, Optimization and machine learning*, Addison Wesley, 1999.
2. ZbigniewMichalewicz, *Genetic algorithms + Data Structures = Evolution Programs*, Springers-Verlag, 1999.
3. M. Mitchell, *An Introduction to Genetic Algorithms*, Prentice-Hall, 1998.
4. S. Rajasekaran& G. A. VijayalakshmiPai, *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications*, PHI, 2003.
5. S. N. Sivanandam& S. N. Deepa, *Principles of Soft Computing*, Wiley - India, 2007.
6. J-S. R. Jang, C.-T. Sun, E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 1997.
7. Simon O. Haykin, *Neural Networks, A Comprehensive Foundation*, PHI, 1994.

Articulation Matrix: Soft Computing Techniques (3OE06)

COs	PO1	PO2	PO3
CO1. **Define** the terminology and concepts related to soft computing techniques.	1	-	-
CO2. **Discuss** soft computing techniques including genetic algorithms, fuzzy systems and neural networks.	1	-	1
CO3. **Solve** problems related to Genetic algorithms, Fuzzy logic and Neural Networks.	2	-	2
CO4. **Analyse** the design of Genetic Algorithms, Neural Networks and Fuzzy Systems.	3	-	3
CO5. **Justify** the design of a soft computing algorithm for a given problem.	3	-	3
CO6. **Design** Genetic Algorithms and Neural Networks to solve optimization and pattern recognition problems.	3	-	3

Department of Printing Technology
Advanced Printing Technology (3OE07)

General Course Information

Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes:

Sr. No.	At end of the semester, students will be able to	RBT Level
CO1.	**Describe** various type of printing processes used in industry.	LOTS: Level 1: Remember
CO2.	**Explain** the utilization/ advantages/disadvantages of various printing processes.	LOTS: Level 2: Understand
CO3.	**Classify** principles of printing technology engineering and sciences.	LOTS: Level 3: Apply
CO4.	**Identify** most inclusive areas where various printing processes can be used in different industries.	HOTS: Level 4 Analyze
CO5.	**Justify** the knowhow of various printing processes for numerous printing job.	HOTS: Level 5: Evaluate

Course Content

UNIT-I

Brief introduction to History of Printing, Evolution of Printing in India, Recent trends in Printing. Basic operations in printing: Pre-Press, Press and Post-press operations. Introduction to Printing process; Traditional printing processes, letterpress, lithography, flexography, gravure, screen printing, Digital printing process

UNIT-II

Understanding Colour: Introduction of Colour, function of Colour, Physical Dimension of Colour, Dimension of colour, Colour Theory- Additive theory, Subtractive theory, **Letterpress Process of printing**: Introduction, Characteristics of letterpress printing, tools & equipment used in the letterpress department, classification of letterpress printing machines, Pre-make ready & make ready steps, letter press substrates, inks & image carrier.

UNIT-III

Lithographic Printing process: Introduction, characteristics of lithographic printing, classification of offset printing, different units of offset machine, pre-make ready & make-ready steps, machine production, Flexography printing process: Introduction, characteristics of flexography, components of Flexo press, flexography plates, flexography presses.

UNIT-IV

Gravure Printing process: Introduction, characteristics of Gravure, Principles of Gravure printing, basic components of gravure press, brief introduction to image carrier preparation for Gravure printing, **Screen Printing process**: Introduction, application of screen printing, image carriers for screen printing. **Digital Printing**: Introduction, various, digital printing technologies & Brief introduction to digital inks & substrates

Common printing faults in various printing processes, their causes and remedies, Identification of different Print Products- Job suitability of various printing processes, advantages and disadvantages of various printing processes.

Text & Reference Books:

1. Adams, Faux, Rieber, "*Printing Technology*" Delmar Publications, 5th edition, 2002.
2. H. Kippan, "*Handbook of Print Media*", Springer, 1st Edition, 2000.
3. C.S. Misra, "*Letter Press Printing, Part I & II*", 1st Edition, 1992.
4. Hugh Speirs, "*Introduction to Prepress*", Pira International,2nd Edition, 2003.
5. Frank Cost, "*Pocket guide to digital Printing*", Delmar Publishers, 1997.

Course Articulation Matrix:

ADVANCED PRINTING TECHNOLOGY (3OE07)			
	PO 1	**PO 2**	**PO 3**
CO1. Describe various type of printing processes used in industry.	1	--	--
CO2. Explain the utilization / advantage / disadvantages of various printing processes.	1	--	2
CO3. Classify principles of printing technology engineering and sciences.	2	--	2
CO4. Identify most inclusive areas where various printing processes can be used in different industries.	3	--	3
CO5. Justify the knowhow of various printing processes for numerous printing job.	3	--	3

Department of Food Technology

Food Safety and Quality Assurance (3OE08)

General Course Information

Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 Hours	**Course Assessment Method:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions by selecting one from each of the four units. All questions carry equal marks.

Course Outcomes:

Sr. No.	At end of the semester, students will be able to	RBT Level
CO1.	**Recognize** different areas of food safety & quality assurance.	LOTS: Level 1: Remember
CO2.	**Demonstrate** knowledge of the quality assessments of different food products.	LOTS: Level 2: Understand
CO3.	**Prepare** food quality management systems.	LOTS: Level 3: Apply
CO4.	**Distinguish** various International and Indian food laws.	HOTS: Level 4: Analyze
CO5.	**Test** different food products as per standards and laws.	HOTS: Level 6: Create

Course Content

UNIT-I

Sampling, specification, labeling, safety and quality assessment of fruits and vegetable, cereals, dairy products, meat, fish, poultry and processed food products, Sensory evaluation: Introduction, panel screening, selection methods, interaction and thresholds.

UNIT-II

Developments, objective and functions of food safety and quality assurance, quality enhancement models, statistical quality control for food industry, food quality management systems, implementation of quality control programmes, quality control tools, quality control charts for food plant sanitation, food safety management systems, causes of failure of food safety programs.

UNIT-III

Indian food laws and regulations, food safety acts, regulations for waste disposals, codex Alimentations, ISO series, world trade organization, food and agricultural organization, world health organization, food safety and legislation in USA and Europe, technical barriers in trade, enforcers of food laws approval process for food additives, additives food labeling, intellectual property right, HACCP and its application.

UNIT-IV

Food adulteration: types of adulterants, common adulterants for foods like milk and milk products, honey, wheat flours, edible oils, cereals, condiments (whole and ground) pulses, coffee, tea, confectionery, baking powder, non-alcoholic beverages, vinegar, besan and curry powder.

Text and Reference Books:

1. Lawless, H. T. and Heymann, H. (2013). "*Sensory Evaluation of Food: Principles and Practices*", Springer, New Delhi.
2. Shapton, D. A. and Shapton, N. F. (1993). "*Principles and Practice for the Safe Processing of Foods*", Heinemann, Oxford.
3. Schmidt, R. H. and Rodrick, G. E. (2003). "*Food Safety Handbook*", John Wiley, New Jersey.
4. Rees, N. and Watson, D. (2000). "*International Standards for Food SafetyI"*, Aspen, America.
5. Anjaneyulu, Y. and Marayya, R. (2009). "*Quality Assurance and Quality Management in Pharmaceutical Industry*", Pharma, Hyderabad.
6. Ho, S. K. M. (1999). "*Operations and Quality Management*", ITP, London.

Course Articulation Matrix:

Food Safety and Quality Assurance (3OE08)			
COs	**PO1**	**PO2**	**PO3**
CO1. Recognize different areas of food safety & quality assurance.	-	-	-
CO2. Demonstrate knowledge of the quality assessments of different food products.	1	-	1
CO3. Prepare food quality management systems.	2	-	1
CO4. Distinguish various International and Indian food laws.	2	-	2
CO5. Test different food products as per standards and laws.	3	-	3

Department of Environment Science & Engineering

Application of Waste to Energy Production (3OE09)

General Course Information

Course Credits: 3 Type: Open Elective Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 Hours	**Course Assessment Method:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes:

Sr. No.	At the end of the semester, students will be able to	RBT Level
CO1	**Define** various categories of Waste.	LOTS: Level 1: Remember
CO2	**Describe** the various techniques for conversion of waste to energy.	LOTS: Level 2: Understand
CO3	**Demonstrate** techniques for conversion of waste to energy.	LOTS: Level 3: Apply
CO4	**Analyse** techniques for conversion of waste to energy.	HOTS: Level 4: Analyze
CO5	**Compare** advantages and drawbacks of all energy conversion process.	HOTS: Level 5: Evaluate

Course Content

UNIT -I

Introduction of waste

Characterization of wastes, agricultural residues and wastes including animal wastes; industrial wastes; municipal solid wastes. Waste processing types and composition of various types of wastes; Characterization of Municipal Solid Waste, Industrial waste and Biomedical Waste, waste collection and transportation; waste processing-size reduction, separation; waste management hierarchy, waste minimization and recycling of Municipal solid waste.

UNIT-II

Thermo chemical conversion: incineration, pyrolysis, gasification of waste using gasifiers, environmental and health impacts of incineration; strategies for reducing environmental impacts. Energy production from wastes through incineration, energy production through gasification of wastes. Energy production through pyrolysis and gasification of wastes, syngas utilization.

UNIT-III

Bio-chemical Conversion: Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, anaerobic digestion biogas production, and present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships and villages. Energy production from wastes through fermentation and trans esterification. Cultivation of algal biomass

from wastewater and energy production from algae. Energy production from organic wastes through anaerobic digestion and fermentation, introduction to microbial fuel cells. Process analysis and reactor configurations for Methane production, Energy assessment, Bio-methanation from sludge digestion.

UNIT-IV

Energy production from waste plastics, gas clean-up Waste, Heat Recovery: Concept of conversion efficiency, energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices

Environmental and health impacts-case studies: Environmental and health impacts of waste to energy conversion, case studies of commercial waste to energy plants, waste to energy- potentials and constraints in India, eco-technological alternatives for waste to energy conversions.

Text and Reference Books:

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

Course Articulation Matrix:

Application of Waste to Energy Production (3OE09)			
	PO1	**PO2**	**PO3**
CO1. Define various categories of Waste	-	-	1
CO2. Discuss the various techniques for conversion of waste to energy.	1	-	2
CO3. Demonstrate techniques for conversion of waste to energy.	2	-	3
CO4. Analyse techniques for conversion of waste to energy.	3	-	3
CO5. Compare advantages and drawbacks of all energy conversion process.	3	-	3

Dissertation I

General Course Information:

Course Code: CSD-731 Course Credits: 10 Type: Compulsory Contact Hours: 2 hours/week with supervisor Mode: One- to- one discussions with the supervisor	**Course Assessment Methods (internal assessment: 100)** Every student is allotted a supervisor at the beginning of the third semester and is required to present his/her dissertation synopsis using power point presentation towards the end of third semester. The presentation is evaluated by a committee of senior teachers constituted by the Chairperson of the Department.

The objectives of Dissertation and Seminar-I are to train students to:

1. Do literature survey to identify a research problem of appropriate level and size.
2. Understand the process of research.
3. Plan and write dissertation synopsis.
4. Communicate and discuss research ideas.

Outcomes for Dissertation and Seminar-I: By the end of this phase every students is expected to display the evidence of having learnt:

1. Planning research including steps like in identifying research problem and selecting appropriate research methods and tools.
2. Organising ideas into the form of a research synopsis/proposal.
3. Organising and write references.
4. Communicating effectively verbally and in writing.
5. Discussing novel ideas critically and openly, and improving the research proposal in the light of the feedback given by others.
6. MS Office and other tools for writing and presenting the research proposals.

Dissertation II

General Course Information:

Course Code: CSD-741 *Course Credits: 16 Type: Compulsory Contact Hours: 2 hours/week with supervisor Mode: One- to- one discussions with the supervisor	**Course Assessment Methods (Joint evaluation: 100)** Fourth semester is dedicated to carry out the research proposal submitted at the end of third semester. It is to be jointly evaluated by internal and external examiners. The supervisor of a student acts as an internal examiner and the external examiner is appointed by COE from panel of experts approved by the BOS of the Department.

The objectives of Dissertation and Seminar-II are to train students to:

1. make students learn to conduct independent, original, and significant research.
2. try out novel and innovative research ideas
3. select suitable research methods and tools.
4. enhance the functionality of research tools.
5. conducted suitable experiments and discuss the results in the light of similar works done by other.
6. understand the scope and relevance of their work.
7. write a dissertation.
8. publish research papers.
9. know the ethics of research

Outcomes for Dissertation and Seminar-II: By the end of this phase every students is expected to be able to

1. handle research problems independently.
2. analyse and review the existing literature on a research question.
3. read research material/papers critically and make original comments on it.
4. design and conduct experiments.
5. interpret data and result, and critically evaluate empirical evidence.
6. use research methods efficiently.
7. use modern research tools.
8. write dissertation and technical reports.
9. publish research papers.
10. understand the social relevance of research.
11. communicate research ideas verbally and in writing.
12. to discuss ideas in a group and accept critical comments.