K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING AND TECHNOLOGY

Master of Technology

M. Tech (CSE)

Programme Code: 50

2021-23

Approved in the 26th Meeting of Academic Council Held on 11 August 2021

Academic Council
Member Secretary
K.R. Mangalam University

Registrar
K.R. Mangalam University
Sohna Road, Gurugram, (Haryana)

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PREFACE

In consultation with Deans, Faculty Members, Industry Experts, and University Alumni, the Academic Council constituted school-wise committees to draft the model curriculum of postgraduate engineering programmes. Realizing the need for post-graduation in engineering, the curriculum committee of School of Engineering & Technology (SOET) prepared Model Curriculum for Post Graduate Degree course in Computer Science & Engineering. The total number of credits in M.Tech. Computer Science & Engineering (Full Time) is 73.

M.Tech. (CSE) programme is spread over two years in four semesters and includes mini-project, audit courses, open electives, and dissertation. Emphasis is made to have all the significant areas that affect product lifecycle. The dissertation is for one year and distributed over two semesters. The students and faculty members can design the research project in consultation with industry experts.

The programme is designed to retain the undergraduate students going for higher studies but also to attract international students making K.R. Mangalam University a global place of higher learning and research in engineering and technology.

1. Introduction

The K.R. Mangalam Group has made a name for itself in the field of education. Over a period of time, the various educational entities of the group have converged into a fully functional corporate academy. Resources at KRM have been continuously upgraded to optimize opportunities for the students. Our students are groomed in a truly inter-disciplinary environment wherein they develop integrative skills through interaction with students from engineering, management, journalism and media study streams.

The K.R. Mangalam story goes back to the chain of schools that offered an alternative option of world-class education, pitching itself against the established elite schools, which had enjoyed a position of monopoly till then. Having blazed a new trail in school education, the focus of the group was aimed at higher education. With the mushrooming of institutions of Higher Education in the National Capital Region, the university considered it very important that students take informed decisions and pursue career objectives in an institution, where the concept of education has evolved as a natural process.

K.R. Mangalam University was founded in the year 2013 by Mangalam Edu Gate, a company incorporated under Section 25 of the Companies Act, 1956.

K. R. Mangalam University is unique because of its

i. Enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
ii. Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives

i. To impart undergraduate, post-graduate and Doctoral education in identified areas of higher education.
ii. To undertake research programmes with industrial interface.
iii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programmes with foreign, Indian Universities/Institutions and MNCs.
iv. To act as a nodal center for transfer of technology to the industry.
v. To provide job oriented professional education to the pecia student community with particular focus on Haryana.

2. About School

The School of Engineering and Technology offers three undergraduate Programmes: four years B. Tech, three years BCA, B. Sc. in four specialization courses (Electronics Science/Computer

Science/Data Sciences/Cyber Security) and postgraduate Programme: M.Tech. in various disciplines. These Engineering programs have the distinct objective of equipping the students with knowledge, skills, and attitude in engineering and technology to make them capable of successfully meeting the present requirements and future challenges in the engineering profession. SOET brings together outstanding academics, industry professionals, experienced researchers to deliver a unique hands-on and multi-disciplinary learning experience.

The curriculum of programs has been designed to cater to the industry's ever-changing needs and demands. The syllabus and curriculum are regularly updated. The school has the best infrastructure, including domain-specific labs. SOET aims to provide exposure to the principles and practices of Design / Developments and Projects in engineering. SOET is offering Ph.D. programs also.

School Vision

Aspires to become an internationally recognized School through excellence in interdisciplinary education, research and innovation, preparing socially responsible life-long learners contributing to nation building.

School Mission

- Foster employability and entrepreneurship through interdisciplinary curriculum and progressive pedagogy with cutting-edge technology.
- Instill notion of lifelong learning through stimulating research, Outcomes-based education and innovative thinking.
- Integrate global needs and expectations through collaborative programs with premier universities, research centers, industries and professional bodies
- Enhance leadership qualities among the youth having understanding of ethical values and environmental realities
- Developing active leadership skills, ethical values, and environmental responsibility.
- Foster employability and entrepreneurship through futuristic curriculum and progressive pedagogy with cutting-edge technology.
- Instill notion of lifelong learning through stimulating research, Outcomes-based education, and innovative thinking.
- Integrate global needs and expectations through collaborative programs with premier universities, research centers, industries, and professional bodies

- Enhance leadership qualities among the youth understanding ethical values and environmental reality.

3. Programmes offered by the School

School offers undergraduate B.Tech Programme, B.Sc. (Hons) Programmes, postgraduate M.Tech Programmes and Doctoral Programmes. All these programmes are designed to impart scientific knowledge to the students and will provide theoretical as well as practical training in their respective fields.

3.1 Department of Computer Science & Engineering

The Department of Computer Science & Engineering administers bachelors, masters and doctoral degree programs in Computer Science & Engineering. The department is committed to provide quality, cutting-edge educational experiences that give students a holistic view of the engineering education and prepare them to take up their career in wide range of industries or establishing startup companies. Core strength of the department lays in its experienced and extremely competent faculty, advanced computing facilities, good placements, ever growing alumni network, emphasis on developing students' skill set while focusing on leadership and ethics in parallel.

Programme Outcome

PO 1 Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO 2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering employability.

PO 7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects through entrepreneurship skills and in multidisciplinary environments.

PO 12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change through skill development.

3.1.1 M.Tech. Computer Science & Engineering

This programme is aimed to exhibit analytical decision making and problem-solving skills by applying research principals for handling real life problems with realistic constraints related to Learning Outcome Based Curriculum Framework (LOCF) and Choice Based Credit System (CBCS)

Eligibility Criteria: - The student has passed B. Tech in computer science & engineering/ MCA from recognized central or state university with an overall minimum aggregate of 50% or more.

Course Outline:- Advance Algorithms / Machine Learning / Data Science/Soft Computing/ Digital Forensics/ Artificial Intelligence.

Career Options:- Opportunities are there in the field of IT Consulting, Solution Development, Design Engineering, Network Administrator, IT Manager, Hardware and Software Domains, PSUs, Defense & Civil Services, Research.

Programme Specific Outcome: M. Tech Computer Science & Engineering

PSO1. Application of Concepts: Ability to apply key principles and practices of computing to design and implement practical systems by actively getting engaged into learning, understanding, and applying new ideas and technologies as the field evolves.

PSO2. Research Orientated: Able to carry out research and intellectual endeavours of the highest standards that advances the theoretical knowledge and are of immediate and long-range practical significance.

PSO3. Global Perspective: Exposed to global view so that they can appreciate diversity in the world and in intellectual pursuits which will be attained by inculcating in them an understanding of the human, social and business context in which they will utilize their engineering skills.

PSO4. Reasoning and Communication Skills: Develop strong reasoning skills and communication skills so that they are able to express ideas clearly and persuasively.

4. Program Duration:

The maximum completion period of the full time M.Tech. (CSE) Programme offered by the University shall be two years. The maximum completion period of the part time M.Tech. (Software Engineering/Cyber Security) Programme offered by the University shall be three years.

5. Class Timings

The classes will be held from Monday to Friday from 09:10 am to 04:00 pm..

6. Syllabi

The syllabi of M.Tech. (CSE) program for all semester is given in the following pages. These are arranged as semester-wise.

For each course, the first line contains; Course Code and Credits (C) of the course.
This is followed by the course objectives, course outcome and the syllabus (Unit I to IV), Text book and reference books.

M.Tech (CSE)-Full Time course at glance

	Semester I	Semester II	Semester III	Semester IV	Total
Course	7	7	4	1	18
Credit	20	20	19	16	75

6.1 Scheme of studies- M. Tech (CSE) related to Learning Outcome Based Curriculum Framework (LOCF) and Choice Based Credit System (CBCS)

SEMESTER I

Year	SNo		Course Code	Course Title	L	T	P	C
FIRST	1	CC	ETCS 601A	Mathematical foundations of Computer Science	3	1	-	4
	2	CC	ETCA802A	Data Structures and Algorithms	3	1	0	4
	3	SE	ETMC 674A	Research Methodology and IPR	2	-	-	2
	4	**DE**	**Departmental Electives (without lab) - I**					
	i	**DE**	ETCS 605A	Machine Learning	4	0	-	4
	ii	**DE**	ETCS 607A	Wireless Sensor Networks	4	0	-	4
	iii	**DE**	ETCS 609A	Introduction to Intelligent Systems	4	0	-	4
	5	**DE**	**Departmental Electives (with lab) - II**					
	i	**DE**	ETCS 611A	Data Science	4	0	-	4
		DE	ETCS 653A	Data Science Lab	0	-	2	1
	ii	**DE**	ETCS 613A	Distributed Systems	4	0	-	4
		DE	ETCS 655A	Distributed Systems Lab	0	-	2	1
	iii	**DE**	ETCS 615A	Advanced Wireless and Mobile Networks	4	0	-	4

		DE	ETCS 657A	Advanced Wireless and Mobile Networks Lab	0	-	2	1
	6	**CC**	ETCA852A	Data Structures and Algorithms Lab	0	0	2	1
	7			Audit Course - I *	2	-	-	-
					20	**0**	**4**	**20**

SEMESTER II

SNo		**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CC	ETCS 602A	Advance Algorithms	3	1	-	4
2	CC	ETCS 604A	Soft Computing	3	1	-	4
3	**DE**	**Departmental Electives (with lab) - III**					
i	**DE**	ETCS 606A	Data Preparation and Analysis	3	1	-	4
	DE	ETCS 652A	Data Preparation and Analysis Lab	0	-	2	1
ii	DE	ETCS 608A	Secure Software Design & Enterprise Computing	3	1	-	4
	DE	ETCS 654A	Secure Software Design & Enterprise Computing Lab	0	-	2	1
iii	DE	ETCS 610A	Computer Vision	3	1	-	4
	DE	ETCS 656A	Computer Vision Lab	0	-	2	1
4	**DE**	**Departmental Electives (without lab) - IV**					
i	DE	ETCS 612A	Human and Computer Interaction	3	1	-	4
ii	DE	ETCS 614A	GPU Computing	3	1	-	4
iii	DE	ETCS 616A	Digital Forensics	3	1	-	4
5	CC	ETCS 658A	Soft Computing Lab	0	-	2	1

6	CC	ETCS 660A	Mini Project with Seminar	2	-	-	2
7			Audit Course - II *	2	-	-	-
				16	**4**	**4**	**20**

SEMESTER III

SNo		**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	**DE**	**Departmental Electives (without lab) - V**					
i	DE	ETCS 617A	Mobile Applications and Services	3	1	-	4
ii	DE	ETCS 619A	Compiler for HPC	3	1	-	4
iii	DE	ETCS 621A	Optimization Techniques	3	1	-	4
2	**OE**	**Open Electives**					
i	OE	ETMC 675A	Business Analytics	3	-	-	3
ii	OE	ETME 817A	Industrial Safety	3	-	-	3
iii	OE	ETMC 676A	Operations Research	3	-	-	3
iv	OE	ETMC 677A	Cost Management of Engineering Projects	3	-	-	3
v	OE	ETME 819A	Composite Materials	3	-	-	3
vi	OE	ETME821 A	Waste to Energy	3	-	-	3
3	CC	ETCS 659A	Dissertation-I /Industrial Project	0	-	0	10
			MOOC	1	-	-	2
				7	**1**	**0**	**19**

SEMESTER IV

SNo	Course Code	Course Title	L	T	P	C
1	ETCS 662A	Dissertation-II	-	-	-	16
TOTAL			**0**	**0**	**0**	**16**
Total Hours: Lect [L]+Prac [P]+Tut [T]			**55**			
Total Credits [C]			**75**			

AUDIT COURSES

SEMESTER I

SNo	Course Code	Course Title	L	T	P	C
1	ETEL 402A	English for Research Paper Writing	2	-	-	-
2	ETCE 601A	Disaster Management	2	-	-	-
3	SEED 545A	Value Education	2	-	-	-

SEMESTER II

SNo	Course Code	Course Title	L	T	P	C
1	ETLS 601A	Constitution of India	2	-	-	-
2	SEED 546A	Pedagogy Studies	2	-	-	-
3	ETMC 678A	Stress Management by Yoga	2	-	-	-
4	ETMC 679A	Personality Development through Life Enlightenment Skills.	2	-	-	-

OE	OPEN ELECTIVE
CC	CORE COURSE
SE	SKILL ENHANCEMENT
DE	DEPARTMENTAL ELECTIVE

ETCS 601A	Mathematical Foundations of Computer Science	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Probability and Set Theory				
Co-requisites	--				

Course Objectives

1. To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data Mining, Network protocols, Analysis of Web Traffic, Computer Security, Software Engineering, Computer Architecture, Operating Systems, Distributed Systems, Bioinformatics, and Machine Learning.
2. To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
3. To study various sampling and classification problems.

Course Outcomes

On completion of this course, the students will be able to

CO1. To understand the basic notions of discrete and continuous probability.
CO2. To understand the methods of statistical inference, and the role that sampling Distribution play in those methods.
CO3. To be able to perform correct and meaningful statistical analyses of simple to Moderate Complexity.
CO4. To be able to apply basic principles of graph theory to solve real-time problems.

Catalog Description

This course imparts the basic concepts of probability theory and statistics to gain insight into real, everyday statistical problems and solutions. The main objective is to develop an intuitive understanding of statistical procedures and strategies most often used by practicing engineers and scientist.

Course Content

Unit I: **14 lecture hours**

Probability mass, density, and cumulative distribution functions, parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate

and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains, Random samples, sampling distributions of estimators.

Unit II: **8 lecture hours**

Methods of Moments and Maximum Likelihood. Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** the problem of over-fitting model assessment.

Unit III: **8 lecture hours**

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

Unit IV: **10 lecture hours**

Computer science and engineering applications, Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning. Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

Text Books

1. John Vince, "Foundation Mathematics for Computer Science", Springer.
2. K. Trivedi, "Probability and Statistics with Reliability, Queuing, and Computer Science Applications", Wiley
3. Alan Tucker. "Applied Combinatorics", Wiley

Reference Books/Materials

1. Sheldon M. Ross, "Probability and Statistics for Engineers and Scientist", Elsevier Academic Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To understand the basic notions of discrete and continuous probability.	**PO1**
CO2	To understand the methods of statistical inference, and the role that sampling distribution play in those methods.	**PO2**
CO3	To be able to perform correct and meaningful statistical analyses of simple to moderate complexities.	**PO4**
CO4	To be able to apply basic principles of graph theory to solve real-time problems.	**PO3**

		Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective
Course	Course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO	PO			

Code	Title	1	2	3	4	5	6	7	8	9	0	11	12	PSO1	PSO2	PSO3
ETCS601A	Mathematical Foundations For Computer Science	3	3	3	3									3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCA802A	**Data Structures and Algorithms**	**L**	**T**	**P**	**C**
Version 1.0		**3**	**1**	**0**	**4**
Pre-requisites/Exposure	**Basics of programming**				
Co-requisites	**--**				

Course Objectives

1. To understand the abstract data types stack, queue, dequeue, and list.
2. To be able to implement the ADTs stack, queue, and deque.
3. To understand the performance of the implementations of basic linear data structures.
4. To be able to recognize problem properties where stacks, queues, and deques are appropriate data structures.
5. To expose the student to the algorithm analysis techniques, to the theory of reductions, and to the classification of problems into complexity classes like NP.

Course Outcomes

On completion of this course, the students will be able to

CO1. Formulate and apply object oriented programming as a modern tool to solve engineering problems.
CO2. Demonstrate an understanding of basic data structures and algorithms.
CO3. Demonstrate the ability to analyze, design, apply and use data structures and algorithms to solve engineering problems and evaluate their solutions.
CO4. Demonstrate an understanding of analysis of algorithms.

Catalog Description

The aim of the course is to introduce basic data structures and algorithms. This course covers the design, analysis, and implementation of data structures and algorithms to solve engineering problems using an object-oriented programming language. Topics include elementary data structures, (including arrays, stacks, queues, and lists), advanced data structures (including trees and graphs), the algorithms used to manipulate these structures, and their application to solving practical engineering problems.

Course Content

Unit I: **10 lecture hours**

Python: types, expressions, strings, lists, tuples; Python memory model: names, mutable and immutable values; List operations: slices etc - Binary search; Inductive function definitions: numerical and structural induction; Elementary inductive sorting: selection and insertion sort; In-place sorting.

Basic algorithmic analysis input size, asymptotic complexity, O() notation ; Arrays vs lists; ; Merge sort ; Quick sort ; Stable sorting.

Unit II: **8 lecture hours**

Dictionaries; More on Python functions: optional arguments, default values; Passing functions as arguments; Higher order functions on lists: map, lter, list comprehension.
Exception handling; Basic input/output; Handling Files; String processing.

Unit III: **10 lecture hours**

Backtracking: N Queens, recording all solutions; Scope in Python: local, global, nonlocal names; Nested functions; Data structures: stack, queue; Heaps.
Abstract data types; Classes and objects in Python; "Linked" lists: find, insert, delete; Binary search trees: find, insert, delete; Height-balanced binary search trees.

Unit IV: **12 lecture hours**

Efficient evaluation of recursive definitions: memorization | Dynamic programming: examples | Other programming languages: C and manual memory management | Other programming paradigms: functional programming.

Text Books

1. Narasimha Karumanchi, Data Structures and Algorithms, Carrer Monk Publications
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford Stein, "Introduction to Algorithms", 2nd Ed., PHI

Reference Books/Materials

1. Ellis Horowitz and SartazSahani, "Computer Algorithms", Galgotia Publications.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Formulate and apply object-oriented programming as a modern tool to solve engineering problems.	**PO1**

CO2	Demonstrate an understanding of basic data structures and algorithms.	**PO3**
CO3	Demonstrate the ability to analyze, design, apply and use data structures and algorithms to solve engineering problems and evaluate their solutions.	**PO2**
CO4	Demonstrate an understanding of analysis of algorithms.	**PO3**

		Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Cours	Course	PO1	PO2	PO3	PO4	PO5	PO6	PO	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO	

e Code	Title							7						1	2	3	PSO 4
ETCA 802A	Data Structures and Algorithms	3	3	3										3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETMC674A	Research Methodology And Ipr	L	T	P	C
Version 1.0		2	0	0	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To be able to formulate research problem from real life problems.
2. To learn ecosystem to conduct a research.
3. To inculcate research ethics in a researcher throughout conduction of research.
4. To develop sense of thinking out of the box to frame a novel research idea by analysing the available literature.
5. To make learner sensitive toward Intellectual Property Right (IPR) to enhance their growth of expansion in various band like socio-economic growth, Research and development growth.

Course Outcomes

On completion of this course, the students will be able to

CO1.Understand research problem formulation.
CO2.Analysis research related information
CO3.Follow research ethics
CO4. Understand that today's world is controlled by Computer, Information, Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about
Intellectual Property Right to be promoted among students in general & engineering in particular.
CO6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Catalog Description

This course imparts the basic concepts of research methodology and Intellectual Property Right. It enables them to understand flow of research starting from novel idea till ethically completion of the work. The course of Research Methodology and IPR help organizing the steps to be

carried out during research to solve the problem efficiently. The course introduces the basic concepts about meaning and feature of good research problem, literature survey and writing an article. It also discusses about IPR and Patents.

Course Content

Unit I: **10 lecture hours**

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

Unit II:

8 lecture hours

Literature Survey: Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit III:

8 lecture hours

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

Unit IV: **8 lecture hours**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books

Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

Reference Books/Materials

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO 1	Understand research problem formulation.	**PO2**
CO 2	Analyses research related information	**PO2**
CO 3	Follow research ethics	**PO8**
CO 4	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	**PO10**
CO 5	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.	**PO3**
CO 6	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits	**PO6**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETMC 674A	RESEARCH METHODOLOGY AND IPR		3	3			2		2		2					3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS605A	**Machine Learning**	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2. Design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3. Explore supervised and unsupervised learning paradigms of machine learning.
4. Explore Deep learning technique and various feature extraction strategies.

Course Outcomes

On completion of this course, the students will be able to

CO1. Develop an appreciation for what is involved in learning from data.

CO2. Understand a wide variety of learning algorithms.

CO3. Understand how to apply a variety of learning algorithms to data.

CO4. Understand how to perform evaluation of learning algorithms and model selection.

Catalog Description

Machine Learning is a key to develop intelligent systems and analyze data in science and engineering. Machine learning engines enable intelligent technologies such as Siri, Kinect or Google self-driving car, to name a few. At the same time machine learning methods help unlocking the information in our DNA and make sense of the flood of information gathered on the web, forming the basis of a new Science of Data. This course introduces the fundamental methods at the core of modern machine learning. It covers theoretical foundations as well as essential algorithms for supervised and unsupervised learning. Classes on theoretical and algorithmic aspects are complemented by practical lab sessions.

Course Content

UNIT I **8 lecture hours**

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

UNIT II **12 lecture hours**

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

UNIT III **12 lecture hours**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, and Random Forests). Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

UNIT IV **8 lecture hours**

Scalable Machine Learning (Online and Distributed Learning): A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.
Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

Text Books

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

Reference Books/Materials

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media

2. AurélienGéron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow:

Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media

3. Jain V.K., “Data Sciences”, Khanna Publishing House, Delhi.

4. Jain V.K., “Big Data and Hadoop”, Khanna Publishing House, Delhi.

5. Jeeva Jose, “Machine Learning”, Khanna Publishing House, Delhi.

6. Chopra Rajiv, “Machine Learning”, Khanna Publishing House, Delhi.

7. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press

http://www.deeplearningbook.org

8. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan

Kaufmann Publisher

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Develop an appreciation for what is involved in learning from data.	**PO1**
CO2	Understand a wide variety of learning algorithms.	**PO4**
CO3	Understand how to apply a variety of learning algorithms to data.	**PO5**
CO4	Understand how to perform evaluation of learning algorithms and model selection	**PO2**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
ETCS605A	Machine Learning	2	2		3	3								3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS607A	**Wireless Sensor Networks**	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Advanced of Computer communication				
Co-requisites	--				

Course Objectives

Upon completion of the course the students will be able to:-
1. Architect sensor networks for various application setups.
2. Devise appropriate data dissemination protocols and model links cost.
3. Understand the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
4. Evaluate the performance of sensor networks and identify bottlenecks.

Course Outcomes

On completion of this course, the students will be able to
CO 1 Describe and explain radio standards and communication protocols for wireless sensor networks.
CO 2 Explain the function of the node architecture and use of sensors for various applications.
CO3 Be familiar with architectures, functions and performance of wireless sensor networks System and platforms.

Catalog Description

This course will also provide a systematic explanation of mobile computing as a discrete discipline and will provide an in-depth coverage of mobile systems and devices, mobile operating systems used for application development, mobile databases, client-server computing agents, application servers, security protocols, and mobile Internet, and ad-hoc and sensor networks.

Course Content

Unit I: **12 lecture hours**

Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors.
Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture.

Unit II:

8 lecture hours

Hardware Platforms: Motes, Hardware parameters.
Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.
Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled

Unit III:

12 lecture hours

Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis.
MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain).
Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution.

Unit IV:

8 lecture hours

Routing protocols: Introduction, MANET protocols
Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast **Opportunistic Routing Analysis**: Analysis of opportunistic routing (Markov Chain), advanced topics in wireless sensor networks.
Recent development in WSN standards, software applications.

Text Books

1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley 2010
2. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks -Technology, Protocols, and Applications", Wiley Interscience 2007

Reference Books/Materials

1. Wireless Communications and Networking, Vijay Garg, Elsevier

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO 1	Describe and explain radio standards and communication protocols for wireless sensor networks.	**PO1, PO2**
CO 2	Explain the function of the node architecture and use of sensors for various applications.	**PO3, PO4**
CO 3	Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.	**PO10, PSO1, PSO2**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS607A	Wireless Sensor Networks	2	2	2	2						3			3	3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS609A	**Introduction To Intelligent Systems**	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Basics of Computer Programming				
Co-requisites	--				

Course Objectives

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

Course Outcomes

On completion of this course, the students will be able to
CO1. Will gain deep understanding of the basic artificial intelligence techniques
CO2. Apply knowledge to design solutions to different problems and will gain the ability to design and develop an intelligent system for a selected application.
CO3. Apply artificial intelligence techniques to solve different problems.
CO4. Apply different learning and evolutionary algorithms to enhance the AI applications.

Catalog Description

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

Course Content

Unit I:

12 lecture hours

Biological foundations to intelligent systems I: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit II:

8 lecture hours

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

Unit III:

12 lecture hours

Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

Unit IV: **8 lecture hours**

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.
Recent trends in Fuzzy logic, Knowledge Representation

Text Books

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

Reference Books/Materials

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Will gain deep understanding of the basic artificial intelligence techniques.	**PO1, PO2**
CO2	Apply knowledge to design solutions to different problems and will gain the ability to design and develop an intelligent system for a selected application	**PO3, PO4**
CO3	Apply artificial intelligence techniques to solve different problem	**PO10, PSO1, PSO2**

		Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
ETCS609A	Introduction To Intelligent Systems	2	2	2	2						3			3	3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS611A	Data Science	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Discrete Mathematics and Statistics				
Co-requisites	--				

Course Objectives

1. Provide students with the knowledge and expertise to become a proficient data scientist.
2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
3. Produce Python code to statistically analyse a dataset.
4. Critically evaluate data visualisations based on their design and use for communicating Stories from data.

Course Outcomes

On completion of this course, the students will be able to

CO1. Abstract thinking: Ability to understand the abstract concepts that lead to various data science theories in Mathematics, Statistics and Computer science.

CO2. Modern software tool usage: Acquire the skills in handling data science programming tools towards problem solving and solution analysis for domain specific problems.

CO3. Ability to identify analyze and design solutions for data science problems using fundamental principles of mathematics, Statistics, computing sciences, and relevant domain disciplines.

CO4. Design application using data science and basic machine learning techniques.

Catalog Description

This course introduces the basic notions and definitions used in data analysis, machine learning. The course will enable the students to formulate the problem of knowledge extraction as combinations of data filtration, analysis and exploration methods and translate a real-world problem into mathematical terms. The students will be able to develop complex analytical reasoning and apply the algorithms on real world problems.

Course Content

Unit I: **10 lecture hours**

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

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Unit II: **10 lecture hours**

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

Unit III: **10 lecture hours**

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

Unit IV: **10 lecture hours**

Applications of Data Science, Technologies for visualization, Bokeh (Python).

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

Text Books

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from the Frontline. O'Reilly.

Reference Books/Materials

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Abstract thinking: Ability to understand the abstract concepts that lead to various data science theories in Mathematics, Statistics and Computer science	**PO1**
CO2	Modern software tool usage: Acquire the skills in handling data science programming tools towards problem solving and solution analysis for domain specific problems	**PO5**
CO3	Ability to identify analyze and design solutions for data science problems using fundamental principles of mathematics, Statistics, computing sciences, and relevant domain disciplines	**PO2**
CO4	Design application using data science and basic machine learning techniques	**PO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
ETCS611A	Data Science	2	3	3		3								3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS653A	Data Science Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Prior coding in Python/R				
Co-requisites	--				

Course Objectives

1. Understanding of the Python Programming Language.
2. Exposure on solving of data science problems.
3. Understand and implement the classification and Regression Model.
4. Understand and implement the clustering models.

Course Outcomes

On completion of this course, the students will be able to
CO1. Develop solutions to simple computational problems using python.
CO2. Solve problems of regression and correlation using python.
CO3. Design and solve problems of classification using python.
CO4. Design and solve problems of clustering using python.

Catalog Description

Data Science Lab is designed to not only facilitate students to practice basic programming in Python/R; but also learn advanced technologies of computer science such as Machine Learning, Artificial Intelligence and Data Mining. Each lab sessions is aimed to translate the theory lectures into practical implementation through programming paradigms and tools, platforms provided in the data science lab. Data Science Lab helps students to design solutions to data mining and machine learning problems arising in numerous application areas involving data analytics.

Course Content

LIST OF EXPERIMENTS

1. Introduction to Python/R tool for data analytics science.
2. Basic Statistics and Visualization in Python/R.
3. Implementation of K-means Clustering.

4. Implementation of Association Rules.
5. Implementation of Linear Regression.
6. Implementation of Logistic Regression.
7. Implementation of Naive Bayesian Classifier.
8. Implementation of Decision Trees.
9. Simulate Principal component analysis.
10. Simulate Singular Value Decomposition.

Text Books

- Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from the Frontline. O'Reilly.

Reference Books/Materials

1. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Develop solutions to simple computational problems using python.	PO3
CO2	Solve problems of regression and correlation using python	PO4

CO3	Design and solve problems of classification using python	**PO2**
CO4	Design and solve problems of clustering using python	**PO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
ETCS653A	Data Science Lab		3	2	3									3	3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS613A	Distributed Systems	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Basics of Data base				
Co-requisites	--				

Course Objectives

1. Uunderstand the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.
2. Design trends in distributed systems

Course Outcomes

On completion of this course, the students will be able to

CO1. To provide hardware and software issues in modern distributed systems.

CO2. To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

CO3. Understand the concepts and issues related to distributed systems.

CO4. Design and develop the programs for distributed environment.

CO5. Manage performance, reliability and other issues while designing in distributed

environment.

CO6. To expose students to both the abstraction and details of file systems.

CO7. To provide students with contemporary knowledge in parallel and distributed computing.

CO8. Introduce a variety of methodologies and approaches for reasoning about concurrent and

distributed programs

Catalog Description

This course provides an introduction to the fundamentals of distributed computer systems, assuming the availability of facilities for data transmission. The structure of distributed systems

using multiple levels of software is emphasized. Specific topics include: distributed algorithms, distributed file systems, distributed databases, security and protection of distributed services such as the world-wide web, and examples of research and commercial distributed systems

Course Content

Unit I: **12 lecture hours**

INTRODUCTION: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts.
DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues.

Unit II: **8 lecture hours**

DISTRIBUTED DATABASE DESIGN: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation.

SEMANTICS DATA CONTROL: View management; Data security; Semantic Integrity Control.

QUERY PROCESSING ISSUES: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data.

Unit III: **12 lecture hours**

DISTRIBUTED QUERY OPTIMIZATION: Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms.

TRANSACTION MANAGEMENT: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models.

CONCURRENCY CONTROL:
Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management.

Unit IV: **8 lecture hours**

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

PARALLEL DATABASE SYSTEMS: Parallel architectures; parallel query processing and optimization; load balancing.

ADVANCED TOPICS: Mobile Databases, Distributed Object Management, Multi-databases

Text Books

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

Reference Books/Materials

1. J. Han and M. Kamber, Data Mining - Concepts and Techniques, Morgan-Kaufman, 2001.
2. Distributed Database Management Systems: A Practical Approach, Author(s): Saeed K. RahimiFrank S. Haug
3. Principles of Distributed Database Systems, Fourth Edition, M. Tamer Özsu, Patrick Valduriez

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes

CO1	To provide hardware and software issues in modern distributed systems.	**PO2**
CO2	To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.	**PO3**
CO3	Understand the concepts and issues related to distributed systems.	**PO4**
CO4	Design and develop the programs for distributed environment.	**PO5**
CO5	Manage performance, reliability and other issues while designing in distributed environment.	**PO4**
CO6	To expose students to both the abstraction and details of file systems.	**PO4**
CO7	To provide students with contemporary knowledge in parallel and distributed computing.	**PO9**
CO8	Introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs	**PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Orientated	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3	PSO 4
ETCS 613A	Distributed Systems		2	3	3	3				3				3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS655A	Distributed Systems Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning				
Co-requisites	--				

Course Objectives

1. To expose students to both the abstraction and details of file systems.
2. 2. To introduce concepts related to distributed computing systems.
3. 3. To focus on performance and flexibility issues related to systems design decisions

Course Outcomes

On completion of this course, the students will be able to

CO1. To understand the Distributed Systems and will be able to describe the problems and challenges associated with these principles.

CO2. To Understand Distributed Computing techniques, Synchronous and Processes.

CO3. To be able to design a distributed system that fulfills requirements with regards to key distributed systems properties with understanding of Distributed File Systems and Distributed Shared Memory.

Catalog Description

This course introduces the main principles underlying distributed systems: processes, communication, naming, synchronization, consistency, fault tolerance, and security. Students will be familiar with some of the main paradigms in distributed systems: object-based systems, file systems, web-based and coordination-based systems. On the completion of the unit, students will understand the fundamentals of distributed computing and be able to design and develop distributed systems and applications.

Course Content

1	Implement concurrent echo client-server application.	**2 lab hours**

2	Implement concurrent day-time client-server application.	**2 lab hours**
3	Configure following options on server socket and tests them: SO_KEEPALIVE, SO_LINGER, SO_SNDBUF, SO_RCVBUF, and TCP_NODELAY.	**2 lab hours**
4	Incrementing a counter in shared memory.	**2 lab hours**
5	Create CORBA based server-client application.	**2 lab hours**
6	Design XML Schema and XML instance document.	**4 lab hours**
7	WSDL based: Implement Arithmetic Service that implements add, and subtract operations / Java based: Implement Trigonometric Service that implements sin, and cos operations.	**4 lab hours**
8	Configuring reliability and security options.	**2 lab hours**
9	Monitor SOAP request and response packets. Analyze parts of it and compare them with the operations (java functions) headers.	**2 lab hours**
10	Design and test BPEL module that composes Arithmetic Service and Trigonometric Service.	**2 lab hours**
11	Test open source ESB using web service.	**2 lab hours**
12	Implementing Publish/Subscribe Paradigm using Web Services, ESB and JMS.	**2 lab hours**
13	Implementing Stateful grid services using Globus WS-Core-4.0.3.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To understand the Distributed Systems and will be able to describe the problems and challenges associated with these principles.	**PO2**
CO2	To Understand Distributed Computing techniques, Synchronous and Processes.	**PO3**
CO3	To be able to design a distributed system that fulfills requirements with regards to key distributed systems properties with understanding of Distributed File Systems and Distributed Shared Memory.	**PO5, PSO1, PO9**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS655A	Distributed Systems Lab		2	3		3				3				3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS615A	Advanced Wireless And Mobile Networks	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Get familiar with the wireless/mobile market and the future needs and challenges.
2. Get familiar with key concepts of wireless networks, standards, technologies and their basic operations.
3. To learn how to design and analyse various medium access.
4. To learn how to evaluate MAC and network protocols using network simulation software tools.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand fundamentals of wireless communications.

CO2. Analyse security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks.

CO3. Demonstrate basic skills for cellular networks design.

CO4. Apply knowledge of TCP/IP extensions for mobile and wireless networking.

Catalog Description

This course will cover the fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks. Various aspects of wireless networking will be covered including: fundamentals of cellular communication, mobile radio propagation, multiple access techniques, and mobility support, channel allocation, Wireless PAN/LAN/MAN standards, mobile ad-hoc networks, wireless sensor networks, and routing in wireless and mobile networks. The goal of this course is to introduce the students to state-of-the-art wireless network protocols and architectures. We will introduce the students to wireless networking research and guide them to investigate novel ideas in the area via semester-long research projects. We will also look at industry trends and discuss some innovative ideas that have recently been developed. Some of the course material will be drawn from research papers, industry white papers and Internet RFCs. The course should provide the students with a good understanding of the wireless networking concepts and research directions.

Course Content

UNIT I **8 lecture hours**

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

WIRELESS LOCAL AREA NETWORKS: IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.

UNIT II **12 lecture hours**

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

UNIT III **12 lecture hours**

WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview

WIRELESS SENSOR NETWORKS: Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

UNIT IV **8 lecture hours**

WIRELESS PANs: Bluetooth AND ZigBee, Introduction to Wireless Sensors.

SECURITY: Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, Dos in wireless communication.

ADVANCED TOPICS: IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks.

Text Books

1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
3. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002.
4. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000.
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 2000.

Reference Books/Materials

1. William Stallings, "Wireless Communications & Networks", 2/E, Pearson Education India, Reprint 2007.
2. Jochen Schiller, "Mobile Communications", 2/E, Pearson Education India, reprint 2007.
3. Sandeep Singhal, "The Wireless Application Protocol" , Addison Wesley, India, reprint 2001
4. T S Rappaport, "Wireless Communications: Principles & Practice", 2/E, Pearson Education, 2002.
5. C E Perkins, "Ad Hoc Networking", Addison Wesley, 2000. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Understand fundamentals of wireless communications.	PO1
CO2	Analyse security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks.	PO4

CO3	Demonstrate basic skills for cellular networks design.	**PO5**
CO4	Apply knowledge of TCP/IP extensions for mobile and wireless networking.	**PO2**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
ETCS615A	Advanced Wireless And Mobile Networks	2	2		3	3								3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS 657A	Advanced Wireless And Mobile Networkslab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To know about Second Generation, Third Generation Cellular technologies.
2. To study the Evolution Generation (2.5G) technology platforms.
3. To study various 4G technologies like OFDM, MC-CDMA etc.
4. To understand General Packet Radio Receiver.

Course Outcomes

On completion of this course, the students will be able to

CO1. Explain and compare Second and Third Generation technologies, their architectures.
CO2. Describe improved version of 2G technology i.e., evolution Generation (2.5G).
CO3. Define 4G technologies, their applications in modern wireless communication systems.
CO4. Explain working of General Packet Radio Receiver.

Catalog Description

Machine Learning is concerned with computer programs that automatically improve their performance through experience. This course covers the theory and practical algorithms for machine learning from a variety of perspectives. We cover topics such as FIND-S, Candidate Elimination Algorithm, Decision tree (ID3 Algorithm), Backpropagation Algorithm, Naïve Bayesian classifier, Bayesian Network, k-Means Algorithm, k-Nearest Neighbor Algorithm, Locally Weighted Regression Algorithm.

List of Experiments (Indicative)

1	To understand the Basic circuit of Mobile phone(Transmitter, Receiver and Base band control Section).	**2 lab hours**
2	To study working of SIMcard in GSM handset SIM card	**2 lab hours**

	detection.	
3	To Study and observe Transmitted/Received RF signal.	**2 lab hours**
4	Study and observe Transmitted (I & Q) /Received (I & Q)signals constellations.	**2 lab hours**
5	Study and analyze the Buzzer in 4G LTE Smart Phone TechBook.	**2 lab hours**
6	To study and Analyze the Vibrator in 4G LTE smart phone Tech book.	**4 lab hours**
7	Study of switch faults in User Interface Section of 4G LTE Smart PhoneTechBook.	**4 lab hours**
8	Study and analyze the Power Management Unit in 4G LTE Smart Phone TechBook.	**4 lab hours**
9	To study AT commands using GSM trainer module10	**4 lab hours**
10	To study General Packet Radio Receiver.	**4 Lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Explain and compare Second and Third Generation technologies, their architectures.	**PO2**
CO2	Describe improved version of 2G technology i.e., evolution Generation (2.5G).	**PO3**

CO3	Define 4G technologies, their applications in modern wireless communication systems.	**PO5**
CO4	Explain working of General Packet Radio Receiver.	**PO8**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
ETCS657A	Advanced Wireless And Mobile Networks Lab		3	3		2			2					3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCA852A	Data Structures and Algorithms Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	Basics of programming				
Co-requisites	--				

Course Objectives

1. To understand and remember algorithms and its analysis procedure.
2. Introduce the concept of data structures through ADT including List, Stack, Queues .
3. To design and implement various data structure algorithms.
4. To introduce various techniques for representation of the data in the real world.
5. To develop application using data structure algorithms.
6. To compute the complexity of various algorithms.

Course Outcomes

On completion of this course, the students will be able to

CO1. Design and analyze the time and space efficiency of the data structure.
CO2. Identity the appropriate data structure forgiven problem.
CO3. Analyze algorithms and algorithm correctness.
CO4. Have practical knowledge on the applications of data structures.

Catalog Description

The course is designed to develop skills to design and analyze simple linear and non-linear data structures. It strengthen the ability of the students to identify and apply the suitable data structure for the given real world problem. It enables them to gain knowledge in practical applications of data structure.

Course Content

LIST OF EXPERIMENTS

Topic 1: Sorting – Searching

- Write a program to implement Bubble Sort.
- Write a program to implement Selection sort.
- Write a program to implement Quick Sort.
- Write a program to implement Insertion Sort.

- Write a program to implement Merge Sort.
- Write a program to implement Binary Search.

Topic 2: Arrays –Stacks-Recursion

- Write a program that finds the transposes a given square matrix.
- Write a recursive program that prints all the permutations of the first n characters of a string.
- Write a program to implement a stack of strings (illustrate the operations push (), pop(), size(), empty() and top()).
- Write a program to show the linked implementation of the Stack class.
- Write a program to covert infix to postfix.
- Write a program to implement Towers of Hanoi using Stack and Queues-Linked-Lists.
- Write a program to implement a linear list and perform the operation such as insert(), search() and delete().
- Write a program to implement a queue by adding the functions such as (i) Determine the size (ii) input queue (iii) output a queue (iv) split a queue into two queues

Topic 3: Binary Trees - Binary Tree Traversal

- Write a program to implement Binary Search Tree.
- Write a program to implement Binary Search Trees using Priority queue.
- Write a program to create a binary tree and find the height of a binary tree.
- Write a program to perform the binary tree traversals.
- Write a program to perform a deletion from a Binary Tree (using a delete () function).

Topic 4: Graphs

- Write a program to implement DFS traversal of a graph.
- Write a program to implement BFS traversal of a graph

Text Books

1. Narasimha Karumanchi, Data Structures and Algorithms, CarrerMonk Publications
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford Stein, "Introduction to Algorithms", 2nd Ed., PHI

Reference Books/Materials

1. Ellis Horowitz and Sartaz Sahani, "Computer Algorithms", Galgotia Publications.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Design and analyze the time and space efficiency of the data structure.	**PO3**
CO2	Identity the appropriate data structure for given problem.	**PO4**
CO3	Analyze algorithms and algorithm correctness.	**PO2**
CO4	Have practical knowledge on the applications of data structures	**PO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCA852A	Data Structures and Algorithms Lab	3	3	3	3									3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS602A	Advance algorithms	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Advanced Computer Programming				
Co-requisites	--				

Course Objectives

1. The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
2. Students should be able to understand the necessary divide and conquer algorithms.
3. To familiarize students with greedy and dynamic programming concepts
4. Student should be able to come up with analysis of efficiency and proofs of correctness.

Course Outcomes

On completion of this course, the students will be able to
CO 1 Understand the implementation of symbol table using hashing techniques.
CO 2 Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
CO 3 Understanding the concept and usage of graphs and trees
CO 4 Understanding the concept of backtracking, branch and bound technique.

Catalog Description

This course imparts the basic concepts of advance data structures and algorithms. It enables them to write algorithms for solving problems with the help of fundamental data structures. The course of data structures help organizing the data in variety of ways to solve the problem efficiently. The objective of this course is to study paradigms and approaches used to design and analyze algorithms and to appreciate the impact of algorithm design in practice.

Course Content

Unit I: **8 lecture hours**

Sorting: Review of various sorting algorithms, topological sorting.

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.

Unit II: 12 lecture hours

Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Unit III: 12 lecture hours

Shortest Path in Graphs: Floyd-War shall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit IV: 8 lecture hours

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest: Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm.

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Text Books

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.

2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.

3. "Algorithm Design" by Kleinberg and Tardos.

Reference Books/Materials

- Schaum's outline series, "Data Structure", McGraw Hills.
- Y. Langsamet. al., "Data Structures using C and C++", PHI.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the implementation of symbol table using hashing techniques.	**PO1**
CO2	Develop and analyze algorithms for red-black trees, B-trees and Splay trees.	**PO4**
CO3	Understanding the concept and usage of greedy and dynamic programming	**PO5**
CO4	Understanding the concept of backtracking, branch and bound technique.	**PO2**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS602A	Advance algorithms	1	3		2	3								3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS604A	Soft Computing	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Algorithms, Programming Skill in C/C++/ JAVA, MATLAB				
Co-requisites	Basic Mathematics				

Course Objectives

Help in understanding principle component of fuzzy logic, neural network and genetic algorithm as a part of Artificial Intelligence and integrating the techniques to solve problems efficiently.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
CO2. Implement soft computing based solutions for real-world problems.
CO3. Showcase knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, and genetic algorithms.
CO4. Application of ANN training algorithms for real life problem solving
C05. Understanding fundamental and operational feature of deep learning and genetic Algorithms.

Catalog Description

Through this subject, student will be able to understand the coarse grained aspects of Artificial Intelligence and its branches. Student will understand the applications of artificial network and its working in real life problems. The internals of framework and working will be discussed throughout the course duration.

Course Content

Unit I: **10 lecture hours**

Introduction To Soft Computing And Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.

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

Unit II: **10 lecture hours**

NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.

Unit III: **10 lecture hours**

GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

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

Unit IV: **8 lecture hours**

Recent Trands in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Text Books

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

Reference Books/Materials

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.	**PO1**
CO2	Implement soft computing based solutions for real-world problems.	**PO2, PO3**
CO3	Showcase knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, and genetic algorithms.	**PO2**
CO4	Application of ANN training algorithms for real life problem solving.	**PO4**
CO5	Understanding fundamental and operational feature of deep learning and genetic Algorithms.	**PO1, PO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS604A	Soft Computing	3	3	3	2									3	2		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS606A	Data Prepration and Analysis	L	T	P	C
Version 1.0		3	1	-	4
Pre-requisites/Exposure	Basics of Python/R				
Co-requisites	--				

Course Objectives

Upon the completion of this course the students:-

1. Will learn how to prepare data for analysis
2. Will perform exploratory data analysis.
3. Will develop meaningful data visualizations.
4. Will work on a variety of real world datasets.

Course Outcomes

On completion of this course, the students will be able to

CO1. Design an approach to leverage data using the steps in the machine learning process.

CO2. Apply machine learning techniques to explore and prepare data for modeling.

CO3. Identify the type of machine learning problem in order to apply the appropriate set of techniques.

CO4. Construct models that learn from data using widely available open source tools.

Catalog Description

This course surveys industrial and scientific applications of data analytics, with case studies. Students will learn to prepare data for analysis, perform exploratory data analysis and develop meaningful data visualizations. Thy will work with variety of real world datasets and learn how to prepare datasets for analysis by cleaning and reformatting. Students will also learn to apply a variety of different data exploratory techniques and visualization methods.

Course Content

Unit I **10 lecture hours**

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

Unit II **10 lecture hours**

Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation.

Unit III

10 lecture hours

Exploratory Data Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation.

Unit IV

10 lecture hours

Visualization: Designing visualizations, Time series, Geo-located data, Correlations and connections, Hierarchies and networks, interactivity.

Text Books

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.

Reference Books/Materials

1. Daniel T. Larose, "Data Mining and Predictive Analytics (Wiley Series on Methods and Applications in Data Mining) 2nd Edition", Wiley.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Design an approach to leverage data using the steps in the machine learning process.	PO3

CO2	Apply machine learning techniques to explore and prepare data for modeling.	**PO4**
CO3	Identify the type of machine learning problem in order to apply the appropriate set of techniques	**PO2**
CO4	Construct models that learn from data using widely available open source tools.	**PO5**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS606A	Data Preparation and Anal		3	3	2	3								3			

	ysis																

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS652A	**Data Preparation and Analysis Lab**	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	Basics of python programming				
Co-requisites	--				

Course Objectives

The course should enable the students to:

1. Learn pre-processing method for multi-dimensional data
2. Practice on data cleaning mechanisms
3. Learn various data exploratory analysis
4. Develop the visualizations for clusters or partitions.

Course Outcomes

On completion of this course, the students will be able to

CO1. Apply pre-processing methods on various datasets as per the problem specific requirement.
CO2. Apply exploratory data analysis on the datasets.
CO3. Apply various data integration and cleaning techniques.
CO4. Apply various data visualization techniques on the datasets.

Catalog Description

This course surveys industrial and scientific applications of data analytics, with case studies. Students will learn to prepare data for analysis, perform exploratory data analysis and develop meaningful data visualizations. Thy will work with variety of real world datasets and learn how to prepare datasets for analysis by cleaning and reformatting. Students will also learn to apply a variety of different data exploratory techniques and visualization methods.

Course Content

LIST OF EXPERIMENTS

S.No	Experiment	No of hours
1	Data pre processing methods on student and labor datasets Implement data cube for data warehouse on 3-dimensional data.	2
2	Implement various missing handling mechanisms, Implement various noisy handling mechanisms.	4
3	Develop k-means and MST based clustering techniques, Develop the methodology for assessment of clusters for given dataset.	4
4	Design algorithms for association rule mining algorithms.	2
5	Derive the hypothesis for association rules to discovery of strong association rules; Use confidence and support thresholds.	2
6	Construct Haar wavelet transformation for numerical data, Construct principal component analysis (PCA) for 5-dimensional data.	2
7	Implement binning visualizations for any real time dataset, Implement linear regression techniques.	2
8	Visualize the clusters for any synthetic dataset, Implement the program for converting the clusters into histograms.	2
9	Write a program to implement agglomerative clustering technique.	2
10	Write a program to implement divisive hierarchical clustering technique.	4
11	Develop scalable clustering algorithms.	2
12	Develop scalable a priori algorithm.	4

Text Books

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.

Reference Books/Materials

1. Daniel T. Larose, "Data Mining and Predictive Analytics (Wiley Series on Methods and Applications in Data Mining) 2nd Edition", Wiley.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Apply pre-processing methods on various datasets as per the problem specific requirement.	PO03
CO2	Apply exploratory data analysis on the datasets.	PO4
CO3	Apply various data integration and cleaning techniques	PO2
CO4	Apply various data visualization techniques on the datasets.	PO4

Reasoning and Communication Skills	PSO4	
Global Perspective	PSO3	
Research Orientated	PSO2	
Application of Concepts	PSO1	3
Life-long Learning	PO12	
Project management	PO11	
Communication	PO10	
Individual or team	PO9	
Ethics	PO8	
Environment and	PO7	
The engineer and	PO6	
Modern tool usage	PO5	
Conduct investigations	PO4	3
Design/development of	PO3	3
Problem analysis	PO2	3
Engineering	PO1	
	Course Title	Data Preparation and Analysis Lab
	Course Code	ETCS652A

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS 608A	Secure Software Design &Enterprise Computing	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Software Engineering				
Co-requisites	--				

Course Objectives

1. Fix software flaws and bugs in various software.
2. Identify various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
3. Identify techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.

Course Outcomes

On completion of this course, the students will be able to:

CO1. Differentiate between various software vulnerabilities
CO2. Identify software process vulnerabilities for an organization
CO3. Monitor resources consumption in a software
CO4. Interrelate security and software development process

Catalog Description

This course make helps understand how the security aspects of software development are embedded into the system to be developed. It includes secure architecture design, secure coding, secure deployment and secure software development methodologies.

Course Content

Unit I: **8 lecture hours**

Secure Software Design
Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

Unit II: **12 lecture hours**

Enterprise Application Development

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

Unit III: 8 lecture hours

Enterprise Systems Administration

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

Unit IV: 12 lecture hours

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them. Handle insecure exceptions and command/SQL injection, defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.
Case study of DNS server, DHCP configuration and SQL injection attack.

Text Books

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

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Differentiate between various software vulnerabilities	**PO2**
CO2	Identify software process vulnerabilities for an organization	**PO1, PO2**
CO3	Monitor resources consumption in a software	**PO4**
CO4	Interrelate security and software development process	**PO3, PO5**

Reasoning and Communication Skills	PSO4	1
Global Perspective	PSO3	1
Research Oriented	PSO2	3
Application of Concepts	PSO1	3
Life-long Learning	PO12	
Project management and finance	PO11	
Communication	PO10	
Individual or team work	PO9	
Ethics	PO8	
Environment and sustainability	PO7	
The engineer and society	PO6	
Modern tool usage	PO5	2
Conduct investigations of complex	PO4	3
Design/development of solutions	PO3	3
Problem analysis	PO2	3
Engineering Knowledge	PO1	2
	Course Title	Secure Software Design & EnterpriseComputing
	Course Code	ETCS 608A

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS 654A	Secure Software Design & Enterprise Computing Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Software Engineering				
Co-requisites	--				

Course Objectives

1. Fix software flaws and bugs in various software.
2. Identify various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
3. Identify techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.

Course Outcomes

On completion of this course, the students will be able to:

CO1. Differentiate between various software vulnerabilities
CO2. Identify software process vulnerabilities for an organization
CO3. Monitor resources consumption in a software
CO4. Interrelate security and software development process

Catalog Description

Based on theory subject **ETCS 654A**, the following experiments are to be performed. It enables students to understand the use the Secure Software Design & Enterprise Computing concept and use them practically to secure enterprise systems.

List of Experiments (Indicative)

1	Study of Network Security fundamentals -Ethical Hacking, Social Engineering practices.	**2 lab hours**
2	Study of System threat attacks -Denial of Services.	**2 lab hours**
3	Study of Sniffing and Spoofing attacks, Study of Techniques uses for Web Based Password Capturing.	**4 lab hours**
4	Study of Different attacks causes by Virus and Trojans.	**2 lab hours**
5	Study of Anti-Intrusion Technique –Honey pot.	**4 lab hours**

6	Study of Symmetric Encryption Scheme –RC4.	**4 lab hours**
7	Implementation of S-DES algorithm for data encryption.	**4 lab hours**
8	Implementation of Asymmetric Encryption Scheme –RSA.	**4 lab hours**
9	Study of IP based Authentication.	**2 lab hours**
10	Design a security model for an enterprise.	**4 lab hours**

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Differentiate between various software vulnerabilities	**PO2**
CO2	Identify software process vulnerabilities for an organization	**PO1, PO2**
CO3	Monitor resources consumption in a software	**PO4**
CO4	Interrelate security and software development process	**PO3, PO5**

Reasoning and Communication Skills	PSO4	1
Global Perspective	PSO3	1
Research Oriented	PSO2	3
Application of Concepts	PSO1	3
Life-long Learning	PO12	
Project management and finance	PO11	
Communication	PO10	
Individual or team work	PO9	
Ethics	PO8	
Environment and sustainability	PO7	
The engineer and society	PO6	
Modern tool usage	PO5	2
Conduct investigations of complex	PO4	3
Design/development of solutions	PO3	3
Problem analysis	PO2	3
Engineering Knowledge	PO1	2
	Course Title	& Enterpris
	Course Code	ETC 654A

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS 610A	COMPUTER VISION	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of image processing				
Co-requisites	--				

Course Objectives

Upon completion of the course the students will be able to:-
1. To introduce students the fundamentals of image formation;
2. To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition;
3. To develop an appreciation for various issues in the design of computer vision and object recognition systems; and
4. To provide the student with programming experience from implementing computer vision and object recognition applications.

Course Outcomes

On completion of this course, the students will be able to:-

CO1. Understand and master basic knowledge, theories and methods in image processing and computer vision.

CO2. Identify, formulate and solve problems in image processing and computer vision.

CO3.Implement and test some fundamental computer vision algorithms e.g. image filtering, restoration, image segmentation, camera calibration.
CO4. Design and demonstrate a working computer vision system through team research project, and project report, presentation.
CO5. Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.

Catalog Description

This course introduces students to fundamental problems in image processing and computer vision, as well as their state-of-the-art solutions. Topics covered in detail include: image formation, image filtering, camera geometry, thres holding and image segmentation, edge, point and feature detection, geometric frameworks for vision, 3D visual reconstruction etc. The course features extensive practical components including computer labs and Term Research projects that provide students with the opportunity to practice and refine their skills in image processing and computer vision.

Course Content

Unit I: 8 lecture hours

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis. Edge detection, Edge detection performance, Hough transform, corner detection

Unit II: 12 lecture hours

Segmentation, Morphological filtering, Fourier transforms. Feature extraction, shape, histogram, colour, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing.

Unit III: 12 lecture hours

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

Unit IV: 8 lecture hours

Recent trends in Activity Recognition, computational photography, Biometrics.

Text Books

1. Computer Vision: Algorithms and Applications by Richard Szeliski.

Reference Books/Materials

1. Deep Learning, by Good fellow, Bengio, and Courville.
2. Dictionary of Computer Vision and Image Processing, by Fisher et al.
3. Haralick & Shapiro, “Computer and Robot Vision”, Vol II
4. EmanueleTrucco and AllessandroVerri “Introductory Techniques for 3-D Computer Vision”, Prentice Hall, 1998.
5. Olivier Faugeras, “Three-Dimensional Computer Vision”, The MIT Press, 1993.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Explain in detail DBMS architecture.	**PO1**
CO2	Explain in detail query processing and techniques involved in query optimization	**PO4**
CO3	Explain the principles of concurrency control.	**PO5**
CO4	Explain the principles of recovery management.	**PO2**
CO5	Know recent developments and active research topics in database.	**PO6**

		Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Orientated	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS 610A	COMPUTER VISION	2	2		3	3	3							3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS656A	COMPUTER VISION LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning of Image Processing & Computer Vision				
Co-requisites	--				

Course Objectives

The students will be able to get an idea on:

1. To introduce students the fundamentals of image formation;
2. To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition;
3. To develop an appreciation for various issues in the design of computer vision and object recognition systems; and
4. To provide the student with programming experience from implementing computer vision and object recognition applications.

Course Outcomes

Upon completion of the course the students will be able to:

CO1.Understand and master basic knowledge, theories and methods in image processing and computer vision.
CO2. Identify, formulate and solve problems in image processing and computer vision.
CO3.Implement and test some fundamental computer vision algorithms e.g. image filtering, restoration, image segmentation, camera calibration.
CO4. Design and demonstrate a working computer vision system through team research project, and project report, presentation.
CO5.Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.

Catalog Description

This course introduces students to fundamental problems in image processing and computer vision, as well as their state-of-the-art solutions. Topics covered in detail include: image formation, image filtering, camera geometry, thresholding and image segmentation, edge, point and feature detection, 3D visual reconstruction etc. The course features extensive practical components including computer labs and term Research projects that provide students with the opportunity to practice and refine their skills in image processing.

Course Content

1	Write a program for image enhancement.	**2 lab hours**
2	Write a program for image compression.	**2 lab hours**
3	Write a program for color image processing.	**2 lab hours**
4	Write a program for image segmentation.	**2 lab hours**
5	Write a program for image morphology.	**2 lab hours**
6	Write a program for Image Restoration.	**4 lab hours**
7	Write a program for Edge detection.	**4 lab hours**
8	Write a program for Blurring 8 bit color versus monochrome.	**4 lab hours**
9	Write a Program with illustration of Line Detection Using Hough Lines.	**4 lab hours**
10	Write a program for Image Restoration.	**4 lab hours**
11	To create a program for segmentation of an image using watershed transforms.	

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and master basic knowledge, theories and methods in image processing and computer vision.	**PO1**
CO2	Identify, formulate and solve problems in image processing and computer vision.	**PO4**
CO3	Implement and test some fundamental computer vision algorithms e.g. image filtering, restoration, image segmentation, camera calibration.	**PO5, PSO2, PO9,PSO1**
CO4	Design and demonstrate a working computer vision system through team research project, and project report, presentation.	**PO2**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Orientated	Global Perspective	Reasoning and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS 656A	Computer Vision Lab	2	2		3	3				3				3	3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS612A	Human and Computer Intraction	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. Learn the foundations of Human Computer Interaction.

2. Familiar with the design technologies for individuals and persons with disabilities.

3. Aware of mobile Human Computer interaction.

Course Outcomes

Upon completion of the course, students should be able to:
CO1. Explain the capabilities of both humans and computers from the viewpoint of human information processing.
CO2. Describe typical human–computer interaction (HCI) models and styles, as well as various historic HCI paradigms.
CO3. Apply an interactive design process and universal design principles to designing HCI systems.
CO4. Describe and use HCI design principles, standards and guidelines.
CO5. Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.
CO6. Discuss tasks and dialogs of relevant HCI systems based on task analysis and dialog design.
CO7. Analyze and discuss HCI issues in groupware, ubiquitous computing, virtual reality, multimedia, and Word Wide Web-related environments.

Catalog Description

This course teaches students to design user interfaces based on the capabilities of computer technology and the needs of human factors. Students design a user interface for a system and implement a prototype from a list of informal requirements. The project is developed over three assignments by a design process based on current human–computer interaction principles.

Course Content

Unit I: **8 lecture hours**

Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

Unit II: **12 lecture hours**

Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

Unit III: **12 lecture hours**

Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

Unit IV: **8 lecture hours**

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

Recent Trends: Speech Recognition and Translation, Multimodal System.

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, "Mobile Design and Development", First Edition , O□Reilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O□Reilly, 2009.(UNIT-V)

Reference Books/Materials

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Explain the capabilities of both humans and computers from the viewpoint of human information processing.	**PO1**
CO2	Describe typical human–computer interaction (HCI) models and styles, as well as various historic HCI paradigms.	**PO4**
CO3	Apply an interactive design process and universal design principles to designing HCI systems.	**PO5**
CO4	Describe and use HCI design principles, standards and guidelines.	**PO2**
CO5	Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.	**PO3**
CO6	Discuss tasks and dialogs of relevant HCI systems based on task analysis and dialog design.	**PSO3**
CO7	Analyze and discuss HCI issues in groupware, ubiquitous computing, virtual reality, multimedia, and Word Wide Web-related environments.	**PSO4**

Course Code	Course Title	Engineering	Problem analysis	Design/development of	Conduct investigations	Modern tool usage	The engineer and	Environment and	Ethics	Individual or team	Communication	Project management	Life-long Learning	Application of Concepts	Research Orientated	Global Perspective	Reasoning and Communication Skills
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
A	Computer Interactio	1	1	2	3	2										2	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS614A	**GPU Computing**	L	T	P	C
Version 1.0		3	1	-	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

To learn parallel programming with Graphics Processing Units (GPUs)

Course Outcomes

On completion of this course, the students will be able to

1. Learn concepts in parallel programming.
2. Implementation of programs on GPUs.
3. Analyze an algorithms to provide parallel solutions to computationally challenging problems.

4. Debug and Profiling parallel programs.

Catalog Description

This course will introduce parallel computing paradigms with focus on GPU programming to harness the massively parallel GPU architecture in solving computationally demanding tasks. The NVIDIA CUDA and industry standard Open CL frameworks will be introduced and used with most of the labs. This is a project based course where the students will work on scientific computational problems.

Course Content

Unit I: **13 lecture hours**

Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA Open CL / Open ACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps /Wave fronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D /3D thread mapping, Device properties, Simple Programs

Unit II: **7 lecture hours**

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

Unit III: **10 lecture hours**

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Work lists, Linked-lists. Synchronization across CPU and GPU **Functions**: Device functions, Host functions, Kernels functions, Using libraries(such as Thrust), and developing libraries.

Unit IV: **10 lecture hours**

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

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning.
Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing.

Text Books

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

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Learn concepts in parallel programming	**PO1**
CO2	Implementation of programs on GPUs	**PO3; PO5**
CO3	Analyze an algorithms to provide parallel solutions to computationally challenging problems.	**PO2**
CO4	Profiling parallel programs	**PO4**

Course Code	Course Title	Engineering	Problem analysis	Design/development of	Conduct investigations	Modern tool usage	The engineer and	Environment and	Ethics	Individual or team	Communication	Project management	Life-long Learning	Application of Concepts	Research Orientated	Global Perspective	Reasoning and Communication Skills
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
4A	Computi	3	3	3	3	3								3	2	2	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS 616A	**Digital Forensics**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Concepts of Security				
Co-requisites	--				

Course Objectives

1. Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect, and prevent digital crimes.
3. Have knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.
4. Students will learn different techniques and procedures that enable them to perform a digital investigation.

Course Outcomes

On completion of this course, the students will be able to

CO1. Explain the origins of forensic science.
CO2. Identify the process in taking digital evidence.
CO3. Describe how to conduct an investigation using methods of memory, operating system, network and email forensics.
CO4. Assess the different forensics tools.
CO5. Differentiate among different types of security attacks.
CO6. Describe the concept of ethical hacking.

Catalog Description

The aim of this course is to equip you with the knowledge and techniques to computer forensics practices and evidence analysis. It prepares you to use various forensic investigation approaches and tools necessary to start a computer forensics investigation. It also aims at increasing the knowledge and understanding in cyber security and ethical hacking.

Course Content

Unit I: **12 lecture hours**

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

Unit II: **12 lecture hours**

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

Unit III: **10 lecture hours**

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

Unit IV: **8 lecture hours**

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case.
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.
Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.

Text Books

1. John Sammons, The Basics of Digital Forensics, Elsevier

Reference Books/Materials

1. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Explain the origins of forensic science	PO2
CO2	Identify the process in taking digital evidence.	PO2

CO3	Describe how to conduct an investigation using methods of memory, operating system, network and email forensics.	**PO2**
CO4	Assess the different forensics tools.	**PO5**
CO5	Differentiate among different types of security attacks.	**PO4**
CO6	Describe the concept of ethical hacking.	**PO4**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
6A	Forensic		3		3	3								3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS658A	Soft Computing Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Algorithms, Programming Skill in C/C++/ JAVA, MATLAB				
Co-requisites	Basic Mathematics				

Course Objectives

- Learn basic concepts of Soft Computing and fuzzy logic as a part of artificial intelligence.
- Provides a practical approach to fuse real life approach with techniques of genetic algorithm and fuzzy logic.

Course Outcomes

On completion of this course, the students will be able to

CO1.Understand the structure and organization of neural network.
CO2.Execute and evaluate the performance of network using fuzzy operations.
CO3.Demonstrate and measure correlation using datasets
CO4.Demonstrate fundamental and operational feature of deep learning and genetic Algorithms

Catalog Description

This course complements ETCS604A. It enables them to select and design network for solving real life problem with optimal solution(s). The list of experiments helps to understand details of component of network.

List of Experiments (Indicative)

1	Create a perception with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weight.	**2 lab hours**
2	Write a program to implement artificial neural network without back propagation.	**2 lab hours**
3	Write a program to implement artificial neural network with	**2 lab hours**

	back propagation.	
4	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.	**2 lab hours**
5	Implement travelling sales person problem (TSP) using genetic algorithms.	**2 lab hours**
6	Plot the correlation plot on dataset and visualize giving an overview of relationships among data on soya bins data. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.	**2 lab hours**
7	Implement linear regression and multi-regression for a set of data points.	**2 lab hours**
8	Implement crisp partitions for real-life iris dataset.	**2 lab hours**
9	Write a program to implement Hebb's rule.	**2 lab hours**
10	Write a program to implement Delta rule.	**2 lab hours**
11	Write a program to implement logic gates.	**2 lab hours**
12	Implement SVM classification by fuzzy concepts.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the structure and organization of neural network.	**PO1, PO2**
CO2	Execute and evaluate the performance of network using fuzzy operations.	**PO3, PO4**
CO3	Demonstrate and measure correlation plot on dataset	**PO5**
CO4	Demonstrate fundamental and operational feature of deep learning and genetic Algorithms	**PO3**

Code	Course Title	PO1 Engineering	PO2 Problem analysis	PO3 Design/development of	PO4 Conduct investigations	PO5 Modern tool usage	PO6 The engineer and	PO7 Environment and	PO8 Ethics	PO9 Individual or team	PO10 Communication	PO11 Project management	PO12 Life-long Learning	PSO1 Application of Concepts	PSO2 Research Orientated	PSO3 Global Perspective	PSO4 Reasoning and Communication Skills
8A	Compute rLab03	2	3	3	2	2								3	3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS660A	Mini Project With Seminar	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

The course is designed to provide an opportunity to students to demonstrate the ability to devise, select and use a range of methodologies and tools to the Chosen/Given project, applying the theoretical knowledge to a real life situation. Experiential Learning outside classroom through self-exploration, practical experience, Industry, field experience, live experience, research, design projects etc.

The learning process in the Project seeks out and focuses attention on many latent attributes, which do not surface in the normal class room situations. These experiential learning attributes through project includes Intellectual ability, Professional judgment and decision making ability, Inter-disciplinary approach, Skills for data handling, Ability in written and oral presentation, Sense of responsibility Developing professional Skills Application of theory, concepts in given industry /practical / field scenario.

Course Outcomes

On completion of this course, the students will be able to

CO1. Use applied scientific knowledge to identify and implement relevant principles of mathematics and computer science.
CO2. Use the relevant tools necessary for engineering practice.
CO3. Define overall needs and constraints to solve a problem and develop/ design a prescribed engineering sub-system.
CO4. Communicate effectively and learn to be a team player.

Catalog Description

Students are expected make a project based on the latest advancements related to the parent branch of Engineering. Students may opt for an in-disciplinary project (if feasible).
The project may be a complete hardware or a combination of hardware and software under the guidance of a Supervisor from the Department. This is expected to provide a good training for the student(s) in technical aspects

Student will be continuously evaluated during the semester in form of Project Progress Seminars. At the end of the semester, assessment of the research/project work of each student will be made

by the board of examiners including supervisors on the basis of a viva-voce examination and the report submitted by the student.

Course Content

The assignment to normally include:

1. Review and finalization of the Approach to the Problem relating to the assigned topic.
2. Preparing an Action Plan for conducting the investigation, including team work.
3. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
4. Final development of product/process, testing, results, conclusions and future directions.
5. Preparing a report in the standard format for being evaluated by the Department.
6. Final project presentation before a Departmental Committee.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Use applied scientific knowledge to identify and implement relevant principles of mathematics and computer science.	**PO3**
CO2	Use the relevant tools necessary for engineering practice.	**PO5**
CO3	Define overall needs and constraints to solve a problem and develop/ design a prescribed engineering sub-system.	**PO2**

CO4	Communicate effectively and learn to be a team player.	**PO10**

Course Code	Course Title	Engineering	Problem analysis	Design/development of	Conduct investigations	Modern tool usage	The engineer and	Environment and	Ethics	Individual or team	Communication	Project management	Life-long Learning	Application of Concepts	Research Orientated	Global Perspective	Reasoning and Communication Skills
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO2	PSO4
EEC300 0A	Project with		3	3		3					3			3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS617A	Mobile Applications and Services	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Wireless Communication and Mobile Computing				
Co-requisites	Java Programming / KOTLIN				

Course Objectives

1. This course present the mobile platforms and their ecosystems
2. It explores emerging technologies and tools used to design and implement feature-rich mobile applications for smart phones and tablets.
3. It also take into account both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile.

Course Outcomes

On completion of this course, the students will be able to

CO1. Identify the target platform and users and be able to define and sketch a mobile application.
CO2. Understand the fundamentals, frameworks, and development lifecycle of mobile application platforms
CO3. Design and develop a mobile application prototype
CO4. Exposed to technology and business trends impacting mobile applications

Catalog Description

The main objective of this part is to give students an introduction to programming on the Android platform and help them build skills needed for approaching and solving coding problems on limited devices. Ergonomic user interface and efficient resource usage (memory, CPU, battery, network, physical disks, etc.) in achieving mobile tasks will be discussed in details.

Course Content

Unit I: **8 lecture hours**

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

Unit II: **8 lecture hours**

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

Unit III: **10 lecture hours**

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

Unit IV: **14 lecture hours**

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

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

Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT.

Text Books

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

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Identify the target platform and users and be able to define and sketch a mobile application.	**PO5**
CO2	Understand the fundamentals, frameworks, and development lifecycle of mobile application platforms .	**PO3**
CO3	Design and develop a mobile application prototype	**PO7**
CO4	Exposed to technology and business trends impacting mobile applications	**PO12**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS617A	Applications and			2		2		2					2	3		3	

Engineering Knowledge
Problem analysis
Design/development of
Conduct investigations of
Modern tool usage
The engineer and society
Environment and
Ethics
Individual or team work
Communication
Project management and
Life-long Learning
Application of Concepts
Research Oriented
Global Perspective
Reasoning and Communication Skills

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS619A	**Compiler for HPC**	L	T	P	C

Version 1.0		3	1	0	4
Pre-requisites/Exposure	Computer Organization and Architecture, Basics of Compiler Design				
Co-requisites	--				

Course Objectives

1. Introduce structure of compilers and high-performance compiler design for students.
2. Concepts of cache coherence and parallel loops in compilers are included.
3. Know the most common machine independent optimizations.
4. Know scheduling techniques and register allocation for exploiting Instruction Level Parallelism
5. Know the most common memory locality optimizations.

Course Outcomes

On completion of this course, the students will be able to

CO1.Be familiar with the structure of compiler.
CO2. Understand the performance characteristics of modern processors.
CO3. Have experience with algorithms for automatically taking advantage of SIMD, SIMT, and MIMD parallelism design, formulate, solve and implement high performance versions of standard.

Course Overview:

Optimizing compilers play a critical role in modern computer systems ranging from mobile devicesto supercomputers. Compilers can optimize for performance, power consumption and/or code size. Practically all computer scientists and engineers may benefit for a deep knowledge of compiler optimizations: programmers hardware features that are easy to use by compilers, and finally compiler writers develop new compiler optimizations. This course covers optimizations and aspects of the compiler back-end and middle-end such as: data-flow analysis, control Flow analysis, instruction level parallelism, memory hierarchy optimizations, data level parallelism and thread level parallelism.

Course Content

Unit I: **8 lecture hours**

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

Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph.

Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.

Unit II: 12 hours

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

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

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

Unit III: 12 hours

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

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

Unit IV: 8 hours

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

Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.
Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machines.

TEXTBOOKS:

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

REFERENCES BOOKS:

1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series, 2011
2. Charles Severance, Kevin Dowd, High Performance Computing, O'Reilly Media, 2nd Edition,1998.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Be familiar with the structure of compiler.	**PO1**
CO2	Understand the performance characteristics of modern processors.	**PO2, PO4**
CO3	Have experience with algorithms for automatically taking advantage ofSIMD, SIMT, and MIMD parallelism design, formulate, solve and implement high performance versions of standard.	**PO3, PO5**

Reasoning and Communication Skills		
Global Perspective	PSO4	
Research Orientated	PSO3	1
Application of Concepts	PSO2	
Life-long Learning	PSO1	2
Project management and finance	PO12	
Communication	PO11	
Individual or team work	PO10	
Ethics	PO9	
Environment and sustainability	PO8	
The engineer and society	PO7	
Modern tool usage	PO6	
Conduct investigations of complex	PO5	3
Design/development of solutions	PO4	3
Problem analysis	PO3	2
Engineering Knowledge	PO2	2
	PO1	2
	Course Title	Computer for HPC
	Course Code	EEG 619A

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS 621A	OPTIMIZATION TECHNIQUES	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basic knowledge in optimization techniques				
Co-requisites	--				

Course Objectives

1. Insight into the mathematical formulation of real-world problems.
2. Optimize these mathematical problems using nature-based algorithms. And the solution is useful specially for NP-Hard problems.
3. To Create an Engineering design methodology using a mathematical formulation of a design problem to support selection of the optimal design among alternatives.
4. The goal is to provide students with solid foundations to deal with a wide variety of optimization problems that arise in multiple areas of science, engineering and business, and to provide a thorough knowledge of the most common algorithms.

Course Outcomes

On completion of this course, the students will be able to

CO1. Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.

CO2. Ability to go in research by applying optimization techniques in problems of Engineering and Technology.

CO3. Ability to solve the mathematical results and numerical techniques of optimization theory to concrete Engineering problems by using computer software.

CO4. Cast engineering minima/maxima problems into optimization framework.

CO5. An ability to apply design and development principles in the construction and implementation of software systems of varying complexity to meet desired needs.

CO6. An ability to continue to learn and use new techniques, skills, and engineering and scientific tools for research in electrical engineering and computer science.

CO7. A dedication to advance engineering research to discover new knowledge, develop new methodologies, promote innovative thinking, and research output in engineering and science.

CO8. Learn efficient Genetic Algorithm procedures to solve optimization problems.

Catalog Description

The purpose of this course is to develop a knowledge in the field of optimization techniques their basic concepts,principles. linear programming and queuing theory. The course introduces theory and numerical methods for continuous multivariate optimization (constrained and unconstrained). The goal is to provide students with solid foundations to deal with a wide variety of optimization problems that arise in multiple areas of science, engineering, and business, and to provide a thorough knowledge of the most common algorithms.

Course Content

Unit I: **12 lecture hours**

Engineering application of Optimization, Formulation of design problems as mathematical programming problems. General Structure of Optimization Algorithms, Constraints, The Feasible Region.

Unit II: **8 lecture hours**

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

Unit III: **10 lecture hours**

Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.Real life Problems and their mathematical formulation as standard programming
problems.

Unit IV: **10 lecture hours**

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

Text Books

1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.

2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.

Reference Books/Materials

Sheldon M. Ross, "Probability and Statistics for Engineers and Scientist", Elsevier Academic Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz I	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.	**PO1**
CO2	Ability to go in research by applying optimization techniques in problems of Engineering and Technology.	**PO2**
CO3	Ability to solve the mathematical results and numerical techniques of optimization theory to concrete Engineering problems by using computer software.	**PO4**
CO4	Cast engineering minima/maxima problems into optimization framework.	**PO3**
CO5	An ability to apply design and development principles in the construction and implementation of software systems of varying complexity to meet desired needs.	**PO2**
CO6	An ability to continue to learn and use new techniques, skills, and engineering and scientific tools for research in electrical engineering and computer science.	**PO5**

CO7	A dedication to advance engineering research to discover new knowledge, develop new methodologies, promote innovative thinking, and research output in engineering and science.	**PO3**
CO8	Learn efficient Genetic Algorithm procedures to solve optimization problems.	**PO5**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1A	Techniqu	3	3	3	3	3								3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETMC 675A	Business Analytics	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Probability and Set Theory				
Co-requisites	--				

Course Objectives

1. Understand and critically apply the concepts and methods of business analytics
2. Identify, model and solve decision problems in different settings
3. Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity
4. Create viable solutions to decision making problems

Course Outcomes

` On completion of this course, the students will be able to

CO1. Enable all participants to recognise, understand and apply the language, theory and models of the field of business analytics

CO2. Foster an ability to critically analyse, synthesise and solve complex unstructured business problems

CO3. Encourage an aptitude for business improvement, innovation and entrepreneurial action

CO4. Encourage the sharing of experiences to enhance the benefits of collaborative learning

CO5. Instil a sense of ethical decision-making and a commitment to the long-run welfare of both organisations and the communities they serve

Catalog Description

The problems faced by decision makers in today's competitive business environment are often extremely complex and can be addressed by numerous possible courses of action. Evaluating these alternatives and gaining insight from past performance is the essence of business analytics. This course is designed as an introduction to Business Analytics, an area of business administration that considers the extensive use of data, methods, and fact-based management to support and improve decision making. While business intelligence focuses on data handling, queries and reports to discover patterns and generate information associated with products, services and customers, business analytics uses data and models to explain the performance of a business and how it can be improved. This course discusses the benefits of employing analytics and a structured approach to problem-solving in management situations.

Course Content

UNIT I **8 hours**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II **8 hours**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for
Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

UNIT III **7 hours**

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

UNIT IV **7 hours**

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.
Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

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

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Enable all participants to recognise, understand and apply the language, theory and models of the field of business analytics	**PO1**
CO2	Foster an ability to critically analyse, synthesise and solve complex unstructured business problems	**PO2, PO4**
CO3	Encourage an aptitude for business improvement, innovation and entrepreneurial action	**PO7**
CO4	Encourage the sharing of experiences to enhance the benefits of collaborative learning	**PO9**
CO5	Instil a sense of ethical decision-making and a commitment to the long-run welfare of both organisations and the communities they serve.	**PO8**

Reasoning and Communication Skills		2
Global Perspective	PSO4	2
Research Oriented	PSO3	3
Application of Concepts	PSO2	3
Life-long Learning	PSO1	
Project management and finance	PO12	
Communication	PO11	
Individual or team work	PO10	
Ethics	PO9	3
Environment and sustainability	PO8	3
The engineer and society	PO7	3
Modern tool usage	PO6	
Conduct investigations of complex problems	PO5	
Design/development of solutions	PO4	3
Problem analysis	PO3	
Engineering Knowledge	PO2	3
	PO1	3
	Course Title	Business Analytics
	Course Code	BTCS0073 A

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETME 817A	INDUSTRIAL SAFETY	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics knowledge of industrial engineering				
Co-requisites	--				

Course Objectives:

Upon completion of the course the students will be able to:

1. Familiar with standard workplace hazard/warning signs and labels.
2. Familiar with standard categories of hazardous materials.
3. Understand the documentation used with hazardous materials, such as the MSDS.
4. Describe the different levels of danger that exist with electrical shock.
5. Describe several appropriate actions to take in the event of an electrical accident.

Course Outcomes:

Upon the completion of this course the students will be able to:

1. Analyze the effect of release of toxic substances
2. Understand the industrial laws, regulations, and source models.
3. Apply the methods of prevention of fire and explosions.
4. Understand the relief and its sizing methods and methods of hazard identification and preventive measures& types.

Catalog Description

The basic purpose of this course is to deal with the safety practices in the electronics industry which includes electrical safety, HAZMAT, flammable and combustible liquids, safe handling of electronic components in the manufacturing environment including ESD control, product testing/certification, blood borne pathogens, fire safety, laser, and radiation safety. Audit available.

Course Content

Unit I: **12 lecture hours**

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, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety colour codes. Fire prevention and fire fighting, equipment, and methods.

Unit II: **12 lecture hours**

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 relationship with replacement economy, Service life of equipment. Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods.

Unit III: **8 lecture hours**

Lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle, and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree.

Unit IV: **8 lecture hours**

Draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal, and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes. Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning, and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps, and advantages of preventive maintenance.

TEXTBOOKS:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand, and Company.
3. Pump-hydraulic Compressors, Aludels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term	Presentation/	End Term

			Exam	**Assignment/ etc.**	**Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Analyze the effect of release of toxic substances	**PO1**
CO2	Understand the industrial laws, regulations, and source models.	**PO2**
CO3	Apply the methods of prevention of fire and explosions.	**PO3**
CO4	Understand the relief and its sizing methods and methods of hazard identification and preventive measures& types.	**PO4**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EHME 817A	Industrial Safety	2	2	2	3									3	2		

Engineering Knowledge
Problem analysis
Design/development of solutions
Conduct investigations of
Modern tool usage
The engineer and society
Environment and sustainability
Ethics
Individual or team work
Communication
Project management and finance
Life-long Learning
Application of Concepts
Research Oriented
Global Perspective
Reasoning and Communication Skills

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETMA 676A	Operations Research	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Describe the linear programming duality. and the simplex and revised simplex algorithms
2. Describe the linear programming applications and formulations
3. Describe the transportation problem and its application
4. Describe the Network Analysis
5. To acquaint the students with the use of quantitative models in game theory

Course Outcomes

On completion of this course, the students will be able to

CO1- Understand the origin and development of Operations Research
CO2- Analyze the real life systems with limited constraints
CO3-Identify a problem in your locality, formulate it as an LPP and solve
CO4- Understanding the various laws and theorems related to electric networks
CO5The students will be able to recognize strategic environments and to use Game Theory.

Catalog Description

This course covers some core areas of Operational Research, namely Linear programming,, Transportation problem network analysis and Game Theory. Emphasis will be placed both on the mathematical techniques and on problem formulation through examples from applications.

Course Content

Unit I: **14 lecture hours**

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

Unit II: **8 lecture hours**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit III: **11 lecture hours**

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

Unit IV: **12 lecture hours**

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

Text Books

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Understand the origin and development of Operations Research	PO1, PO2

CO2	Analyze the real life systems with limited constraints	**PO12**
CO3	Identify a problem in your locality, formulate it as an LPP and solve	**PO4, PO2**
CO4	Understanding the various laws and theorems related to electric networks	**PO3**
CO5	The students will be able to recognize strategic environments and to use Game Theory	**PO5, PO2**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
6A	Research ns	3	2	3	3	2								3	2		

Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETMC 677A	Cost Management Of Engineering Projects	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure					
Co-requisites					

Course Objectives

The objective of this course is to help you in developing your knowledge and understanding of Cost Management Principles.

1. Recognize and apply appropriate theories, principles and concepts relevant to cost management.
2. Exercise appropriate judgment in selecting and presenting information using various methods relevant to cost management.
3. Plan, design and execute practical activities using techniques and procedures appropriate to cost management.
4. Respond to change within the external and internal business environments and its effect on cost management.
5. Develop appropriate effective written and oral communication skills relevant to cost management.
6. Use organization skills (including task and time management) relevant to cost management both individually and in a group situation.
7. Solve problems relevant to cost management using ideas and techniques some of which are at the forefront of the discipline.

Course Outcomes

On completion of this course, the students will be able to

CO1. To appreciate the use of different costs for different purposes.
CO2.Explain traditional and contemporary approaches to cost allocation.
CO3. Describe different product costing scenarios in job-order and process environments.
CO4. Identify relevant information for decision making purposes in order to produce financial analyses for a range of decisions such as product-mix, pricing, outsourcing and special orders.
CO5. Use standard costs to prepare budgets for planning and control purposes.

Catalog Description

The Cost Management course addresses the identification, elaboration, planning, and management of the project budget. Including selected processes from the PMI Integration, Cost,

Scope and Risk Knowledge Areas, this class addresses the development of a Project Cost Estimate, Project Budget, and the Project Budget Baseline. In addition it addresses the preparation of a spending profile that supports variance analysis and corrective action using Earned Value Management. Using a combination of theory based lecture and hands on exercises, students are provided with an effective skill set for developing and controlling the project budget baseline.

Course Content

UNIT I **8 hours**

Introduction and Overview of the Strategic Cost Management Process
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control;

UNIT II **8 hours**

Provision of data for Decision-Making Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance.

UNIT III **7 hours**

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing,
Life Cycle Costing. Costing of service sector.

UNIT IV **7 hours**

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXT BOOKS:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To appreciate the use of different costs for different purposes.	**PO1**
CO2	Explain traditional and contemporary approaches to cost allocation	**PO4**
CO3	Describe different product costing scenarios in job-order and process environments.	**PO7**
CO4	Identify relevant information for decision making purposes in order to produce financial analyses for a range of decisions such as product-mix, pricing, outsourcing and special orders.	**PO11**
CO5	Use standard costs to prepare budgets for planning and control purposes.	**PO3, PO5**

Reasoning and Communication Skills	PSO4	
Global Perspective	PSO3	
Research Oriented	PSO2	2
Application of Concepts	PSO1	3
Life-long Learning	PO12	
Project management and finance	PO11	3
Communication	PO10	
Individual or team work	PO9	
Ethics	PO8	
Environment and sustainability	PO7	3
The engineer and society	PO6	
Modern tool usage	PO5	3
Conduct investigations of complex problems	PO4	3
Design/development of solutions	PO3	3
Problem analysis	PO2	
Engineering Knowledge	PO1	3
	Course Title	CO3: MANAGEMENT OF ENGINEERING PROJECTS
	Course Code	ETMC 677A

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETME 821A	Waste To Energy	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of waste and energy				
Co-requisites	--				

Course Objectives:

The subject expects students to achieve the following objectives.

1. Understand of the concept of Waste to Energy.
2. Link legal, technical and management principles for production of energy form waste.
3. Learn about the best available technologies for waste to energy.
4. Analyse of case studies for understanding success and failures.
5. Facilitate the students in developing skills in the decision-making process.

Course Outcomes:

Upon the completion of this course the students will be able to:

CO1.Apply the knowledge about the operations of Waste to Energy Plants.
CO2.Analyse the various aspects of Waste to Energy Management Systems.
CO3.Carry out Techno-economic feasibility for Waste to Energy Plants.
CO4. Apply the knowledge in planning and operations of Waste to Energy plants.

Catalog Description

This course gives introductory knowledge about Waste to Energy conversion system,and utilization in various field. It enables the students to understand the waste to energy management system systems. This course is also helping students to answer fundamental questions of waste To Energy at the time of the interview.

Course Content

Unit I: **08 lecture hours**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Unit II: **12 lecture hours**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit III: **06 lecture hours**

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

Unit IV: **12 lecture hours**

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

TEXTBOOKS:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Handbook - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

REFERENCE BOOKS:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Apply the knowledge about the operations of Waste to Energy Plants.	**PO1**
CO2	Analyze the various aspects of Waste to Energy Management Systems.	**PO4**
CO3	Carry out Techno-economic feasibility for Waste to Energy Plants.	**PO2**
CO4	Apply the knowledge in planning and operations of Waste to Energy plants.	**PO7**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Research Oriented	Global Perspective	Reasoning and Communication Skills
821A	Energy from waste to	2	3		3			3						3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS659A	Dissertation-I/Industrial Project	L	T	P	C
Version 1.0		0	-	0	10
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To learn how to carry out literature survey
2. To be associated with an area of research/research project and contribute towards domain knowledge.
3. To learn the art of technical report writing
4. To learn the art of verbal communication with the help of modern presentation techniques

Course Outcomes

On completion of this course, the students will be able to

CO1. Carry out the extensive literature survey.
CO2. Learn to write and present technical reports/articles.
CO3. Learn to analyze various methods and techniques applicable to the topic to study and contribute to domain knowledge.
CO4. Have practical knowledge on the applications of topic of study on society.

Catalog Description

This is the first part of the major dissertation/industrial project wherein every student shall be expected to contribute to domain knowledge incrementally. It is expected that the research/project work should be focused in a particular area for concept, design, implementation and/or analysis. Each student will have to undertake a research/project work under a supervisor. Research/project work may be carried out within department or in any other academic / research / industrial / commercial organization under the guidance of the thesis supervisor who must be a faculty member of the department or under a joint supervision including at least one such faculty member. The work will have to be carried out during the 5th semester of study. The student will have to submit a typewritten or printed report on the work done by him / her according to a schedule to be announced by the department. The project-report should be duly approved by the supervisor concerned and should embody results of research / development work carried out by the student.

Student will be continuously evaluated during the semester in form of Dissertation/project Progress Seminars. At the end of the semester, assessment of the research/project work of each student will be made by the board of examiners including supervisors on the basis of a viva-voce examination and the report submitted by the student.

Course Content

The assignment to normally include:

1. Review and finalization of the Approach to the Problem relating to the assigned topic.
2. Preparing an Action Plan for conducting the investigation, including team work.
3. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
4. Final development of product/process, testing, results, conclusions and future directions.
5. Preparing a report in the standard format for being evaluated by the Department.
6. Final Dissertation Presentation before a Departmental Committee.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Carry out the extensive literature survey.	PO2
CO2	Learn to write and present technical reports/articles.	PO5
CO3	Learn to analyze various methods and techniques applicable to the topic to study and contribute to domain knowledge.	PO2
CO4	Have practical knowledge on the applications of topic of study on society.	PO6

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
ETCS669A	Industrial I	Engineering	Problem analysis	Design/development of	Conduct investigations	Modern tool usage	The engineer and	Environment and	Ethics	Individual or team	Communication	Project management	Life-long Learning	Application of Concepts	Research Orientated	Global Perspective	Reasoning and Communication Skills
			3			3	3							3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS662A	**Dissertation-II**	L	T	P	C
Version 1.0		-	-	32	16
Pre-requisites/Exposure	Dissertation-I				
Co-requisites	--				

Course Objectives

1. To learn how to carry out literature survey
2. To be associated with an area of research/research project and contribute towards domain knowledge.
3. To learn the art of technical report writing
4. To learn the art of verbal communication with the help of modern presentation techniques.

Course Outcomes

On completion of this course, the students will be able to

CO1. Carry out the extensive literature survey.
CO2. Learn to write and present technical reports/articles.
CO3. Learn to analyze various methods and techniques applicable to the topic to study and contribute to domain knowledge.
CO4. Learn to analyze/evaluate the result of the experiment carried out and present the results using data visualization methods.

Catalog Description

This will be culmination of Dissertation I of semester V. Research work may be carried out with in department or in any other academic / research / industrial / commercial organization under the guidance of the thesis supervisor who must be a faculty member of the depart mentor under a joint supervision including at least one such faculty member. The student will have to submit typewritten or printed report on the work done by him / her according to a schedule to be announced by the department. The project-report should be duly approved by the supervisor concerned and should embody results of research / development work carried out by the student.

Student will be continuously evaluated during the semester in form of Dissertation Progress Seminars. At the end of the semester, assessment of the research work of each student will be made by the board of examiners including supervisors on the basis of a viva-voce examination and the report submitted by the student.

Students are required to publish their research work in form of research publication. The result will be declared only after acceptance or publication of full length paper in peer reviewed Conference or Journal.

Course Content

The assignment to normally include:

1. Review and finalization of the Approach to the Problem relating to the assigned topic.
2. Preparing an Action Plan for conducting the investigation, including team work.
3. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
4. Final development of product/process, testing, results, conclusions and future directions.
5. Preparing a report in the standard format for being evaluated by the Department.
6. Final Dissertation Presentation before a Departmental Committee.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Carry out the extensive literature survey.	**PO2**
CO2	Learn to write and present technical reports/articles.	**PO5**
CO3	Learn to analyze various methods and techniques applicable to the topic to study and contribute to domain knowledge.	**PO2**
CO4	Learn to analyze/evaluate the result of the experiment carried out and present the results using data visualization methods.	**PO6**

Reasoning and Communication Skills	PSO4	
Global Perspective	PSO3	
Research Orientated	PSO2	3
Application of Concepts	PSO1	3
Life-long Learning	PO12	
Project management and finance	PO11	
Communication	PO10	
Individual or team work	PO9	
Ethics	PO8	
Environment and sustainability	PO7	
The engineer and society	PO6	3
Modern tool usage	PO5	3
Conduct investigations of complex problems	PO4	
Design/development of solutions	PO3	
Problem analysis	PO2	3
Engineering Knowledge	PO1	
	Course Title	Dissertation-II
	Course Code	ETCS662A

1=weakly mapped
2= moderately mapped
3=strongly mapped