K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING AND TECHNOLOGY

Bachelor of Science (Honours) Data Science

B.Sc. (H) (DS)
Programme Code: 84

Approved in the 23rd Meeting of Academic Council Held on 23 June 2020

2020-23

Academic Council
Member
Secretary
K.R. Mangalam University

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

K.R. MANGALAM UNIVERSITY
THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING

AND

TECHNOLOGY

Bachelor of Science (Honours) Data Science

B.Sc. (H) (DS)
Programme Code: 84

Approved in the 23rd Meeting of Academic Council Held on 23 June 2020

2020-23

PREFACE

Data Science is experiencing rapid and unplanned growth, spurred by the proliferation of complex and rich data in science, industry and government. With data being collected everywhere, including from smart phones, computers and televisions, there is a growing need to have qualified scientists who can identify and apply algorithms and statistical models to interpret big data. More than just analyzing information, data scientists utilize machine learning and software tools to process and manipulate data to help organizations visualize and find meaning in their data.. In consultation with Deans, Faculty Members, Industry Experts, and University Alumni, the Academic council constituted department-wise committees to draft the curriculum of B.Sc. (H) Data Science. The primary emphasis is to designing a course that combines courses from the disciplines of Statistics, Mathematics, and Computer Science and prepares students for careers in Big Data Science & Analytics

The B.Sc.(H) Data Science program is spread over three years in six semesters. The total number of credits are 148. The program is designed as per LOCF guidelines laid by UGC. The core course includes specialized courses pertaining to Data Science and along with few cores courses that are taught in B.Sc (H) Computer Science. The generic electives offered deal into statistical mathematics necessary to strengthen the development of data science algorithms. Departmental Specific Electives addresses the need to familiarize students with emerging areas in computer science. The laboratories, besides supplementing the theory course should also expose the student to the use of the latest software tools.

The present curriculum focuses on unique interdisciplinary educational experience allows students the opportunity to acquire the broad base of knowledge and skills which employers are seeking.The course is designed to attract international students making K.R. Mangalam a global place of higher learning and research in engineering and technology.

About K.R Mangalam University

The K.R. Mangalam Group has made a name for itself in the field of education. 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.

K.R. Mangalam University is the fastest-growing higher education institute in Gurugram, India. K. R. Mangalam University was established under the Haryana Private University Act 2006, received the approval of Haryana Legislature vide Amendment Act # 36 of 2013 and consent of the Hon'ble Governor of Haryana on 11th April 2013, which was published in the Gazette notification vide Leg. No.10/2013, dated 3rd May 2013.

Since its inception in 2013, the University has been striving to fulfil its prime objective of transforming young lives through ground-breaking pedagogy, global collaborations, and world-class infrastructure. Resources at K.R Mangalam University have been continuously upgraded to optimize opportunities for the students. Our students are groomed in a truly interdisciplinary environment where they grow up with integrative skills through interaction with students from engineering, social sciences, management and other study streams.

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 Indian student community with particular focus on Haryana.

About School of Engineering & Technology (SOET)

School of Engineering and Technology (SOET), K.R. Mangalam University is dedicated to fostering innovation, excellence, and advancement in engineering and technology. Empowering the new generation of change-makers by imparting exceptional understanding and intellect to facilitate the creation of highly sophisticated futuristic solutions. Our well-qualified academicians, accomplished researchers and industry insiders are focused on imparting their extensive knowledge and expertise to students through various lectures, workshops, industrial visits, projects, and competitions throughout the year ensuring that students receive a comprehensive education that blends theory with practical application.

These programs offered at SOET have the distinct objective of equipping the students with knowledge, skills and attitudes 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, and experienced researchers to deliver a unique hands-on and multi-disciplinary learning experience.

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

School Vision

To create, disseminate, and apply knowledge in science and technology to meet the higher education needs of India and the global society, To serve as an institutional model of excellence in scientific and technical education characterized by integration of teaching, research and innovation.

School Mission

M1: To create an environment where teaching and learning are prioritized, with all support activities being held accountable for their success.

M2: To strengthen the institution's position as the school of choice for students across the State & Nation.

M3: To promote creative, immersive, and lifelong learning skills while addressing societal concerns.

M4: To promote co- and extra-curricular activities for overall personality development of the students.

M5: To promote and undertake all-inclusive research and development activities.

M6: To instill in learners an entrepreneurial mindset and principles.

M7: Enhance industrial, institutional, national, and international partnerships for symbiotic relationships.

M8: To help students acquire and develop knowledge, skills and leadership qualities of the 21st Century and beyond.

Programmes offered by the School

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

B.Sc (H) Data Science

This program is focuses on three main components: Big Data, Machine Learning, and Modelling in Data Science. It is an interdisciplinary programme which uses scientific processes, approaches, methods, systems and algorithms to extract requisite insights and information from structured and unstructured data. The curriculum is designed in a way to help students apply tools and statistics to meet organizational challenges. An initiative to make the teaching-learning framework better and enhance the student learning outcomes, the School has taken a thoughtful step by introducing the concept of Learning Outcome Based Curriculum Framework (LOCF) and Choice Based Credits System (CBCS) system.

Eligibility Criteria: The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board with mathematics as one of the subjects and with an overall aggregate of 50% or more.
Course Outline: Python Programming / Data Modelling/ Probability and Statistics / Artificial Intelligence / Databases / Predictive Modelling / Statistical Data Analysis/ Neural Networks.
Career Options: Opportunities exist in the IT industry, freelancers, education and forensics.
Program Duration
The maximum completion period of the B.Sc.(H) Data Science offered by the University shall be three years.

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

Scheme of Studies and Syllabi
The scheme of studies and syllabi of B.Sc.(H) Data Science for all semesters are given in the following pages. These are arranged 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 and modes of evaluation/examination scheme.

Three Years B.Sc. (H) (Data Science) Program at a Glance

	Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI	Total
Course	8	9	8	9	10	9	53
Credit	26	25	23	26	21	28	149

Scheme of Studies and Syllabi as per Learning Outcome Based Curriculum Framework (LOCF) and Choice Based Credit System (CBCS)

SEMESTER I

S.NO		COURSE CODE	COURSE TITLE	L	T	P	C
1	SE	UCCS 155A	Communication Skills	4	0	0	4
2	SE	UCDM301A	Disaster Management	3	0	0	3
3	SE	UCES125A	Environmental Studies	3	0	0	3
4		ETMA163A	GENERIC ELECTIVE -I (Basics of Mathematics)	4	2	0	6
5	SE	ETMC121A	Management Thoughts and Applications	3	0	0	3
6	CC	ETCS103A	Programming for Problem Solving	4	0	0	4
7	CC	ETCS153A	Programming for Problem Solving Lab	0	0	2	1
8			ONLINE COURSE - I (Data Science from Swayam)	2	0	0	2
				23	**2**	**2**	**26**

SEMESTER II

S.NO		COURSE CODE	COURSE TITLE	L	T	P	C
1	CC	ETCS308A	Web Technologies	3	0	0	3
2	CC	ETCS501A	Languages of Data Modeling	3	1	0	4
3	CC	ETCS112A	Object Oriented Programming	3	1	0	4
4	GE	ETPH112A	ELECTRICITY AND MAGNETISM(GE-II)	4	2	0	6
5	SE	ETCA365A	Linux Environment Lab	0	0	2	1
6	SE	ETCS551A	LANGUAGES OF DATA MODELING LAB	0	0	2	1
7	SE	ETCS166A	OBJECT ORIENTED PROGRAMMING LAB	0	0	2	1
	OE		OPEN ELECTIVE	4			6
				17	**4**	**8**	**25**

SEMESTER III

1	CC	ETCS211A	OPERATING SYSTEMS	4	-	-	4
2	CC	ETCS217A	DATA STRUCTURES	4	-	-	4
3	CC	ETCS304A	COMPUTER NETWORKS	4	-	-	4
4	SE	ETMA215A	PROBABILITY AND STATISTICS	4	-	-	4
5	CC	ETCS219A	FOUNDATION OF COMPUTER SYSTEMS	3	1	-	4
6	SE	ETCS255A	OPERATING SYSTEMS LAB	-	-	2	1
7	SE	ETCS365A	COMPUTER NETWORKS LAB	-	-	2	1
8	SE	ETCS 257A	DATA STRUCTURES LAB	-	-	2	1
				19	**1**	**6**	**23**

SEMESTER IV

1	CC	ETCS506A	PYTHON PROGRAMMING	3	1	-	4
2	CC	ETCS401A	ARTIFICAL INTELLIGENCE	4	-	-	4
3	CC	ETCS307A	DATABASE MANAGEMENT SYSTEMS	4	-	-	4
4	SE	ETMA214A	LINEAR ALGEBRA	5	1	-	6
5	CC	ETCS 220A	ANALYSIS AND DESIGN OF ALGORITHMS	4	-	-	4
6	SE	ETCS555A	PYTHON PROGRAMMING LAB	-	-	2	1
7	SE	ETCS451A	ARTIFICAL INTELLIGENCE LAB	-	-	2	1
8	SE	ETCS 355A	DATABASE MANAGEMENT SYSTEMS LAB	-	-	2	1
9	SE	ETCS262A	Analysis and Design of Algorithms Lab	-	-	2	1
				20	**2**	**6**	**26**

SEMESTER V

1	CC	ETCS502A	STATISTICAL DATA ANALYSIS	3	1	-	4
2	CC	ETCS503A	DATA MINING AND PREDICTIVE MODELING	3	1	-	4
3	CC	ETCS552A	STATISTICAL DATA ANALYSIS LAB	-	-	2	1
4	CC	ETCS553A	DATA MINING AND PREDICTIVE MODELING LAB	-	-	2	1
5	CC	ETCS301A	Programming in MATLAB	2	-	-	2
6	CC	ETCS350A	Programming in MATLAB LAB	-	-	2	1
7	DE		DSE -1	3	-	-	3
8			DSE -1 LAB	-	-	2	1
9			DSE – 2	3	-	-	3
10			DSE – LAB	-	-	2	1

		TOTAL	**27**	**2**	**10**		**21**

(i)	CC	ETCS409A	Advanced Computer Networks	3	-	-	3
	SE	ETCS452A	Advanced Computer Networks Lab	-	-	2	1
(ii)	CC	ETCS410A	Mobile and Wireless Communication	3	-	-	3
	SE	ETCS453A	Mobile and Wireless Communication Lab	-	-	2	1
(iii)	CC	ETCS411A	Machine Learning	3	-	-	3
	SE	ETCS455A	Machine Learning Lab	-	-	2	1

(i)	CC	ETCS517A	Soft Computing	3	-	-	3
	SE	ETCS559A	Soft Computing Lab	-	-	2	1
(ii)	CC	ETCS519A	Big Data Analytics and Visualization	3	-	-	3
	SE	ETCS563A	Big Data Analytics and Visualization	-	-	2	1
(iii)	CC	ETCS515A	Ethical Hacking	3	-	-	3
	SE	ETCS557A	Ethical Hacking Lab	-	-	2	1

SEMESTER VI

1	CC	ETC520A	Internet Technologies	3	-	-	3
2	CC	ETCS202A	SOFTWARE ENGINEERING	4	-	-	4
3	CC	ETCS222A	Computer Organization & Architecture	4	-	-	4
4	CC	ETCS408A	Neural Network	4	-	-	4
5	CC	ETCS260A	Computer Organization & Architecture Lab	-	-	2	1

6	CC	ETCS252A	SOFTWARE ENGINEERING LAB	-	-	2	1
7			DSE -3	4	-	-	4
8			DSE -3 LAB	-	-	2	1
9	SE	ETCS464A	MAJOR PROJECT	-	-	-	6
			TOTAL	**19**	**0**	**18**	**28**
			TOTAL CREDITS	**149**			

(i)	CC	ETCS422A	Cloud Computing	4	-	-	4
	SE	ETCA362A	Cloud Computing Lab	-	-	2	1
(ii)	CC	ETCS424A	Data Warehousing and Data Mining	4	-	-	4
	SE	ETCS463A	Data Warehousing and Data Mining Lab	-	-	2	1
(iii)	CC	ETCS421A	Internet of Things	4	-	-	4
	SE	ETCS457A	Internet of Things Lab	-	-	2	1

OE	OPEN ELECTIVE
CC	CORE COURSE
SE	SKILL ENHANCEMENT
GE	GENERIC ELECTIVE

Semester I

UCCS 155A	**Communication Skills**	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. Understand the basics of Grammar to improve written and oral communication skills.
2. Understand the correct form of English with proficiency
3. Improve student's personality and enhance their self-confidence.
4. Improve professional communication.
5. Enhance academic writing skills.

Course Outcomes

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

CO1. Understand the basics of Grammar to improve written and oral communication skills

CO2. Understand the correct form of English with proficiency

CO3. Improve student's personality and enhance their self-confidence

CO4. Improve professional communication

CO5. Enhance academic writing skills

Catalog Description

This learning program with its practice-based learning tasks will facilitate the learners to enhance their communication skills in a modern and globalized context, enhance their linguistic and communicative competence and hone their interpersonal skills.

Course Content

UNIT I **10 lecture hours**

Introduction to Communication: Importance of Communication Skills, Meaning, Forms & Types of Communication; Process of Communication; Principles of Effective Communication/7Cs, Barriers in Communication (Interpersonal, Intrapersonal and Organizational).

UNIT II **10 lecture hours**

Academic Writing: Précis (Summary – Abstract – Synopsis – Paraphrase – Précis: Methods), Letter & Résumé (Letter Structure & Elements – Types of letter: Application & Cover - Acknowledgement – Recommendation – Appreciation – Acceptance – Apology – Complaint –Inquiry).Writing a proposal and synopsis. Structure of a research paper. Citations and plagiarism.

UNIT III **10 lecture hours**

Technology-Enabled Communication: Using technology in communication tasks, E-mails, tools for constructing messages, Computer tools for gathering and collecting information; Different virtual medium of communication.

UNIT IV **10 lecture hours**

Building Vocabulary: Word Formation (by adding suffixes and prefixes); Common Errors; Words Often Confused; One word substitution, Homonyms and Homophones; Antonyms &Synonyms, Phrasal Verbs, Idioms & Proverbs (25 each); Commonly used foreign words(15 in number);

UNIT V **10 lecture hours**

Personality Development: Etiquettes& Manners; Attitude, Self-esteem & Self-reliance; Public Speaking; Work habits (punctuality, prioritizing work, bringing solution to problems), Body Language: Posture, Gesture, Eye Contact, Facial Expressions; Presentation Skills/ Techniques.

Text book [TB]:

1. Kumar, Sanjay and Pushplata. Communication Skills. Oxford University Press, 2015.

Reference Books/Materials

1. Mitra, Barun K. Personality Development and Soft Skills. Oxford University Press, 2012.
2. Tickoo, M.L., A. E.Subramanian and P.R.Subramaniam. Intermediate Grammar, Usage and Composition. Orient Blackswan, 1976.
3. Bhaskar, W.W.S., AND Prabhu, NS., " English Through Reading", Publisher: MacMillan,1978
4. Business Correspondence and Report Writing" -Sharma, R.C. and Mohan K. Publisher: Tata McGraw Hill1994
5. Communications in Tourism & Hospitality- Lynn Van Der Wagen, Publisher: HospitalityPress
6. Business Communication-K.K.Sinha
7. Essentials of Business Communication By Marey Ellen Guffey, Publisher: ThompsonPress
8. How to win Friends and Influence People By Dale Carnegie, Publisher: Pocket Books
9. Basic Business Communication By Lesikar&Flatley, Publisher Tata McGraw Hills

10. Body Language By Allan Pease, Publisher SheldonPress

Modes of Evaluation: Quiz I/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	Understand the basics of Grammar to improve written and oral communication skills	**PO10**
CO2	Understand the correct form of English with proficiency	**PO10**
CO3	Improve student's personality and enhance their self-confidence	**PO12**
CO4	Improve professional communication.	**PO10**
CO5	Enhance academic writing skills	**PO10**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Titl	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

	e																	
UCCS 155A	Communication Skills										3		3			2		

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

UCDM301	**Disaster Management**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective:

1. To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences.
2. Understanding of the International Strategy for Disaster Reduction (UN-ISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy.
3. To ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.
4. To ensure skills and ability to design, implement and evaluate research on disaster.

Course Outcomes:

After completing the program, the student will able to understand

CO1. Capacity to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.

CO2. The course examines disaster profile of our country and illustrates the role played by various governmental and non- governmental organizations & its effective management.

CO3. It also acquaints learners with the existing legal framework for disaster management.

CO4. Capacity to analyze and evaluate research work on the field of emergencies and disaster while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.

Catalog Description:

This course incorporates different types of disasters so that students are well aware of the circumstances around them. We have included one project in the syllabus so that they can thoroughly study the pre & post disastrous situations as well as the role of society in these difficult situations.

Course Content

Unit I: **8 lecture hours**

Introduction to Disasters: Concept and definitions- Disaster, Hazard, vulnerability, resilience, and risks.

Different Types of Disaster: Causes, effects and practical examples for all disasters.

- Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc
- Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Epidemic and Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc.

Unit II: **8 lecture hours**

Disaster Preparedness and Response Preparedness

- Disaster Preparedness: Concept and Nature
- Disaster Preparedness Plan
- Prediction, Early Warnings and Safety Measures of Disaster.
- Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies.
- Role of IT in Disaster Preparedness
- Role of Engineers on Disaster Management.
- Relief and Recovery
- Medical Health Response to Different Disasters

Unit III: **6 lecture hours**

Rehabilitation, Reconstruction and Recovery

- Reconstruction and Rehabilitation as a Means of Development.
- Damage Assessment
- Post Disaster effects and Remedial Measures.
- Creation of Long-term Job Opportunities and Livelihood Options,
- Disaster Resistant House Construction
- Sanitation and Hygiene
- Education and Awareness,
- Dealing with Victims' Psychology,
- Long-term Counter Disaster Planning
- Role of Educational Institute.

Unit IV: 10 lecture hours

Disaster Management in India

- **Disaster Management Act, 2005:**
  Disaster management framework in India before and after Disaster Management Act, 2005, National Level Nodal Agencies, National Disaster Management Authority

- **Liability for Mass Disaster**

  - Statutory liability
  - Contractual liability
  - Tortiousliability
  - Criminal liability
  - Measure of damages

- **Epidemics Diseases Act, 1897: Main provisions, loopholes.**

- **Project Work**: The project/ field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived based on the geographic location and hazard profile of the region where the institute is located.
-

Reference Books:

- Government of India, Department of Environment, Management of Hazardous Substances Control
- Act and Structure and Functions of Authority Created There under.
- Indian Chemical Manufacturers' Association & Loss Prevention Society of India, Proceedings of the National Seminar on Safety in Road Transportation of Hazardous Materials: (1986).

- Author Title Publication Dr.Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.
- Tushar Bhattacharya Disaster Science and Management McGraw Hill Education (India) Pvt. Ltd.
- Jagbir Singh Disaster Management: Future Challenges and Opportunities K W Publishers Pvt. Ltd.
- J. P. Singhal Disaster Management Laxmi Publications.
- Shailesh Shukla, ShamnaHussain Biodiversity, Environment and Disaster Management Unique Publications
- C. K. Rajan, NavalePandharinath Earth and Atmospheric Disaster Management: Nature and Manmade B S Publication
- IndianlawInstitute(UpendraBaxiandThomasPaul(ed.),MassDisastersandMultinationalLiability: The Bhopal Case(1986)
- IndianLawInstitute,UpendraBaxi(ed.),EnvironmentProtectionAct:AnAgendaforImplementation (1987)
- Asian Regional Exchange for Prof. Baxi.,Nothing to Lose But our Lives: Empowerment to Oppose
- Industrial Hazards in a Transnational world(1989)
- Guru dip Singh, Environmental Law: International and National Perspectives(1995), Lawman (India)Pvt.Ltd.
- Leela Krishnan, P, The Environmental Law in India, Chapters VIII,IX and X(1999),Butter worths, New Delhi

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

Components	CAT	Mid Term Exam	Attendance/ Class performance	End Term Exam
Weightage (%)	20	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	Capacity to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.	PS02
CO2	The course examines disaster profile of our country and illustrates the role played by various governmental and non-	P03

	governmental organizations & its effective management.	
CO3	It also acquaints learners with the existing legal framework for disaster management.	**P012**
CO4	Capacity to analyze and evaluate research work on the field of emergencies and disaster while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used**.**	**P06**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

Code	Title																	
UCDM301A	Disaster Management			2			3						2		2			

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

UCES125A	**Environmental Studies**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Environment				
Co-requisites	--				

Course Objectives

1. To aware the students about the environment.
2. To learn the students concepts and methods from ecological and physical sciences and their application in environmental problem solving.
3. To think across and beyond existing disciplinary boundaries, mindful of the diverse forms of knowledge and experience that arises from human interactions with the world around them.
4. Communicate clearly and competently matters of environmental concern and understanding to a variety of audiences in appropriate forms.

Course Outcomes

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

CO1. To comprehend and become responsive regarding environmental issues.

CO2.Acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe and secure environment no specie can survive and sustain.

CO3. Enable the students to discuss their concern at national and international level with respect to formulate protection acts and sustainable developments policies.

CO4.To know that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels.

CO5. Become consciousness about healthy and safe environment.

Catalog Description

This course imparts the basic concepts of environment which enable them to solve basic problems related to their surroundings. This course helps them to get an idea adverse effect of industrialization, population and degradation of natural resources on the environment. The course introduces the concepts of renewable and non-renewable resources.

Course Content

UNIT I **10 Lectures**

Environment and Natural Resources:

Multidisciplinary nature of environmental sciences; Scope and importance; Need for public awareness.
Land resources; land use change; Land degradation, soil erosion and desertification.
Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

UNIT II **10 Lectures**

Ecosystems and Biodiversity:

Ecosystem: Definition and Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession.
Case studies of the following ecosystems:
a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots ; India as a mega-biodiversity nation; Endangered and endemic species of India; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity; Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

UNIT III **10 Lectures**

Environmental Pollution and Environmental Policies:

Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution Nuclear hazards and human health risks; Solid waste management: Control measures of urban and industrial waste; Pollution case studies.

Sustainability and sustainable development; Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture; Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

UNIT IV **10 Lectures**

Human Communities and the Environment and Field work:

Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in environmental conservation; Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.

Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, Delhi Ridge, etc.

Text Books

1. Kaushik and Kaushik, Environmental Studies, New Age International Publishers (P) Ltd. New Delhi.

Reference Books/Materials

1. A.K. De, Environmental Chemistry, New Age International Publishers (P) Ltd. New Delhi.
2. S.E. Manahan, Environmental Chemistry, CRC Press.
3. S.S Dara and D.D. Mishra, Environmental Chemistry and Pollution Control, S.Chand& Company Ltd, New Delhi.
4. R. Gadi, S. Rattan, S. Mohapatra, Environmental Studies Kataria Publishers, New Delhi.

Modes of Evaluation: Quiz I/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	The learners will be able to comprehend and become responsive regarding environmental issues.	**PO7**
CO2	Students will acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe and secure environment no specie can survive and sustain.	**PO8**
CO3	It enables the students to discuss their concern at national and international level with respect to formulate protection acts and sustainable developments policies.	**PO10**
CO4	Students come to know that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels.	**PO6**
CO5	Students become consciousness about healthy and safe environment.	**PO7**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course	PO	PO	PO	PO4	PO	PO	PO	PO	PO	PO10	PO11	PO12	PS	PS	PS	PSO4	PSO5

Code	Title	1	2	3		5	6	7	8	9				O1	O2	O3		
UCES 125A	Environmental Studies						2	3	3		3					1	2	

1=weakly mapped

2= moderately mapped

3=strongly mapped.

ETMA163A	**Basics of Mathematics**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Provide the brief idea to students of Complex numbers and its applications
2. To understand and learn about the differential calculus and find the curve tracing.
3. Deliver a brief knowledge of Matrices and its properties.
4. Apply the concept of eigenvalue and eigenvector to find higher power of the matrix.
5. Recognize and find the general solution of ordinary differential equation

Course Outcomes

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

CO1. Understand and able to apply the basic concept of complex variable.
CO2. Recognize and able to apply the concepts of continuity and differentiability for complex functions and solve the analytic function and its properties.

CO3. Applied the differential calculus method for curve tracing and radios of curvatures.
CO4. Use the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to Diagonalizable matrices when this is possible.
CO5. Explain the qualitative long-term behavior of the solutions to an ODE or system of ODE's.
CO6. Demonstrate knowledge and understanding ordinary differential equations and how they relate to different modeling situations.

Catalog Description

Applied mathematics-I is the mathematical study of basic concepts, principles, and application, relate or unify various disciplines. The core of the program the following principles and their mathematical formulations: complex number and variables, ordinary differential equations, differential calculus and matrices.The concepts of applied mathematics-Iare extremely useful in physics, economics and social sciences, natural sciences, and engineering. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics.Important objectives of the linear algebra are to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **10 lecture hours**

Determinants: Definition, Minors, Co-
factors, Properties of Determinants, Applications of determinants in finding area of triangle. Matrices: Definition, Types of Matrices, Addition, Subtraction, Scalar Multiplication and Multiplication of Matrices, Adjoint, Inverse, Solution of system of linear equation by Cramer's Rule.

.

Unit II: **10 lecture hours**

Sequence and Series: Introduction, Sequences, Series, Arithmetic Progression (A.P), Geometric Progression (G.P), Relationship Between A. M. and G.M., Sum to N terms of Special Series, Principle of Mathematical Induction.

Unit III: **10lecture hours**

.

Differentiation: Derivative of a function, Derivatives of sum, differences, product, and quotient
of functions, Derivative of polynomial, trigonometric, exponential, logarithmic, inverse trigonometric and implicit functions, Logarithmic Differentiation, Derivatives of functions in parametric forms, Differentiation by substitution.

Unit IV: **10 lecture hours**

Integration: Indefinite integrals, Methods of integration: by substitution, by parts, by partial fractions, Integration of algebraic and transcendentalfunctions.

Text Books

1. Kresyzig, "Advanced Engineering Mathematics", John Wiley and Sons.
2. Jain and Iyengar, "Advanced Engineering Mathematics", Narosa Publication

Reference Books/Materials

1. B.S.Grewal, " Higher Engineering Mathematics", Khanna Publishers.
2. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Company.

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 and able to apply the basic concept of complex variable.	**PO1**
CO2	Recognize and able to apply the concepts of continuity and differentiability for complex functions and solve the analytic function and its properties.	**PO8**
CO3	Applied the differential calculus method for curve tracing and radios of curvatures.	**PO2**
CO4	Use the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to Diagonalizable matrices when this is possible.	**PO4**

CO5	Explain the qualitative long-term behavior of the solutions to an ODE or system of ODE's.	**PO3**
CO6	Demonstrate knowledge and understanding ordinary differential equations and how they relate to different modeling situations.	**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	Innovation and Industry Friendly	
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	P 3
ETMA163A	Basics of Mathematics	3	3	3	3				1					3		

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

ETMC 121A	**Management Thoughts and Applications**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Management				
Co-requisites	--				

Course Objectives

1. The course aims at providing fundamental knowledge and exposure to the concepts, theories and practices in the field of management.
2. Observe and evaluate the influence of historical forces on the current practice of management.
3. To understand the concept of Managerial function.

Course Outcomes

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

CO1. Practice the process of management's four functions: planning, organizing, leading, and controlling.

CO2. Identify and properly use vocabularies within the field of management to articulate one's own position on a specific management issue and communicate effectively with varied audiences.

CO3. Evaluate leadership styles and motivation theory to anticipate the consequences of each leadership style and motivation theory.

CO4. Apply course concepts and theory in a practical context.

Catalog Description

This course introduces the student to the management process. The course takes an integrated approach to management by examining the role of the manager from a traditional and contemporary perspective while applying decision-making and critical-thinking skills to the challenges facing managers in today's globally diverse environment. The course examines the techniques for controlling, planning, organizing resources and leading the workforce.

Course Content

Unit I: 10 lecture hours

Introduction: Concept, Nature, Process and Significance of Management; Managerial Levels, Skills, Functions and Roles; Management v/s Administration; Coordination as Essence of Management; Development of Management Thought: Classical, Neo-Classical, Behavioral, Systems and Contingency Approaches.

Unit II: 12 lecture hours

Planning: Nature, Scope and Objectives of Planning; Types of Plans; Planning Process; Business Forecasting; MBO; Concept, Types, Process and Techniques of Decision-Making; Bounded Rationality.

Organizing: Concept, Nature, Process and Significance; Principles of an Organization; Span of Control; Departmentation; Types of an Organization; Authority-Responsibility; Delegation and Decentralization; Formal and Informal Organization.

Unit III: 12 lecture hours

Staffing: Concept, Nature and Importance of Staffing; Motivating and Leading: Nature and Importance of Motivation; Types of Motivation; Theories of Motivation-Maslow, Herzberg, X, Y and Z; Leadership - Meaning and Importance; Traits of a Leader; Leadership Styles - Likert's Systems of Management; Tannenbaum & Schmidt Model and Managerial Grid.

Unit IV: 8 lecture hours

Controlling: Nature and Scope of Control; Types of Control; Control Process; Control Techniques - Traditional and Modern; Effective Control System.

TEXT BOOK:

1. Koontz, Cannice, and Weihrich (2014). Management- A Global, Innovative and Entrepreneurial Perspective (14th Edition). New Delhi: Tata McGraw Hill Publishing Company.

REFERENCE BOOKS:

1. Stoner, Freeman and Gilbert Jr. (2013). Management (6th Edition). New Delhi: Pearson Prentice Hall of India.
2. Chopra R. K., Mohan Puneet, & Sharma Vandana (2010). Principles & Practices of Management. New Delhi: Sun India Publication.
3. Tripathi P. C. & Reddy P. N. (2015). Principles & Practices of Management (5th Edition). New Delhi: Tata McGraw Hill Publishing House.
4. Gupta, C.B (2016). Management Concepts and Practices. New Delhi: Sultan Chand and Sons.

Modes of Evaluation: Quiz I/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	Practice the process of management's four functions: planning, organizing, leading, and controlling	**PO3**
CO2	Identify and properly use vocabularies within the field of management to articulate one's own position on a specific management issue and communicate effectively with varied audiences.	**PO10**
CO3	Evaluate leadership styles and motivation theory to anticipate the consequences of each leadership style and motivation theory.	**PO4**
CO4	Apply course concepts and theory in a practical context.	**PO11**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETMC 121A	MANAGEMENT THOUGHTS AND APPLICATIONS			2	1						2	1		3		3		

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

ETCS103A	**Programming for Problem Solving**	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Advanced of Computer communication				
Co-requisites	--				

Course Objectives

1. Provide an understanding of the role computation can play in solving problems.

2. Master the fundamentals of writing codes.

3. Learn programming languageto solve simple numerical method problems, namely rot finding

of function, differentiation of function and simple integration.

4. Discover how to work with arrays, functions, structures

5. Position students so that they can compete for projects and excel in subjects with programming components.

Course Outcomes

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

CO1.To formulate simple algorithms for arithmetic and logical problems.

CO2. To translate the algorithms to programs (in C language).

CO3.To test and execute the programs and correct syntax and logical errors.

CO4. To implement conditional branching, iteration and recursion.

CO5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

Catalog Description

Computer software plays an important role in our daily lives: Our mobile phones, laptop computers,online banking, Internet applications such as YouTube, video games and movies, cars, and almost all aspects of daily life are touched by software. In your personal and professional life, you will utilize computer software. It is also likely that you will select, or even influence the design of, software that is used in your professional or personal life. This thematic sequence will give you a deep understanding of how software works and is created, its limitations, and its potential. You will be able to read software and therefore be able to make informed decisions when selecting or participating in the design of business, scientific, or information systems that utilize computer software. This is a course in which you learn computer programming concepts that are fundamental in nearly any computer programming language. These concepts can then be used in other courses to help you create computer applications that can be used to solve real-world problems

Course Content

UNIT I 12 LECTURE HOURS

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm:

Flowchart / Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

UNIT II 8 LECTURE HOURS

Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops. Arrays: Arrays (1-D, 2-D), Character arrays and Strings

UNIT III **10 LECTURE HOURS**

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required) Function: Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference. Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function, Quick sort or Merge sort.

UNIT IV **10 LECTURE HOURS**

Structure: Structures, Defining structures and Array of Structures Pointers: Idea of pointers, Definingpointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

TEXT BOOKS:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

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 formulate simple algorithms for arithmetic and logical problems.	**PO1, PO2**
CO2	To translate the algorithms to programs (in C language).	**PO3, PO4**

CO3	To test and execute the programs and correct syntax and logical errors.	**PO10**
CO4	To implement conditional branching, iteration and recursion.	**PSO1**
CO5	To decompose a problem into functions and synthesize a complete program using divide and conquer approach	**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	Innovation and Industry Friendly	Ethics 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	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS103A	Programming for problem solving	2	2	2	2						2			3	3	

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

ETCS153A	Programming for problem solving lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning				
Co-requisites	--				

Course Objective

Master the fundamentals of writing Python scripts.

Learn core Python scripting elements such as variables and flow control structures.

Discover how to work with lists and sequence data.

Position students so that they can compete for projects and excel in subjects with programming components.

Course Outcomes

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

CO 1 To learn the syntax and semantics of Python programming language

CO 2 To use the structural programming approach in solving the problem.

CO 3 To use the object oriented programming approach in solving problems

CO 4 To handle exceptions gracefully

CO 5 To develop searching and sorting algorithms

Course Content

List of Experiments

1	Develop programs to implement list	**2 lab hours**
2	Develop programs to implement Dictionary	**2 lab hours**
3	Develop programs to implement tuples	**2 lab hours**
4	Develop programs to understand the control structures of python	**2 lab hours**

5	Develop programs to implement function with stress on scoping	**2 lab hours**
6	Develop programs to implement classes and objects	**2 lab hours**
7	Develop programs to implement exception handling.	**2 lab hours**
8	Develop programs to implement linear search and binary search.	**2 lab hours**
9	Develop programs to implement insertion sort	**2 lab hours**
10	Develop programs to implement bubble sort.	**2 lab hours**
11	Develop programs to implement quick sort.	**2 Labs**
12	Develop programs to implement heap sort.	**2 Labs**

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

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

Examination Scheme:

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To learn the syntax and semantics of Python programming language	**PO2**
CO2	To use the structural programming approach in solving the problem.	**PO3**
CO3	To use the object oriented programming approach in solving problems	**PO5**
CO 4	To handle exceptions gracefully	**PSO1**
	To develop searching and sorting algorithms	**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	Innovation and Industry Friendly	Ethics 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	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS150A	Programming for problem solving Lab		2	3		3				3				3		

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

Semester II

ETCS308A	**Web Technologies**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of HTML				
Co-requisites	--				

Course Objectives

1. Analyze a web page and identify its elements and attributes.
2. Create web pages using XHTML and Cascading Style Sheets.

3. Build dynamic web pages using JavaScript (Client side programming).
4. Create XML documents and Schemas.
5. Build interactive web applications using AJAX.

Course Outcomes

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

CO1. Create a well-designed and well-formed, professional Web site utilizing the most current standards and practices
CO2. Demonstrate knowledge in web technologies including HTML, XHTML, CSS, image editing software, web authoring software, and client-side scripting
CO3. Create client-side scripts to add interactivity to Web pages
CO4. Select appropriate Web tools for a Web development project
CO5. Identify Web authoring obstacles created by the availability of various web browsers and markup language versions

Catalog Description

This course is an introduction to Web site development and the technologies behind it. Students will learn how to design and develop Web pages using current technologies and tools. Topics covered will include the World Wide Web, HTML, Cascading Style Sheets (CSS) and XML. The focus of this course is on dynamic HTML, a collection of web technologies such as HTML and scripting languages used together to create interactive and animated Web pages. Students will learn to program client-side scripts using JavaScript and the Document Object Model to transform static Web pages created with HTML and CSS into dynamic Web pages.

Course Content

Unit I: 8 lecture hours

Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, Features of Web 2.0, Common terminology: IP Addressing, URLs, Domain names. Website Creation and maintenance, Web Hosting and Publishing Concepts, Search Engines and their working. HTML: Introduction to HTML, HTML Document structure tags, HTML comments, Text formatting, inserting special characters, anchor tag, adding images and sound, lists: types of lists, tables, frames and floating frames, Developing Forms, Image maps, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets,

Unit II: 12 lecture hours

Client-side scripting: JavaScript - Data Types, Control Statements, operators, Built-in and User Defined Functions, Objects in JavaScript, Handling Events. HTML Document Object Model. Page Styling:

Separation of content and presentation in HTML, Cascading Style Sheets - Types of Style Sheets – Internal, inline and External style sheets, customizing common HTML elements, types of CSS selectors

Unit III: 12 lecture hours

Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation, Browser architecture and Web site structure

Unit IV: 8 lecture hours

XML: Introduction to XML-Mark up languages, Features of Mark-up languages, XML Naming rules, Building block of XML, Document, Difference between HTML & XML, Components of XML, XML Parser, DTD's Using XML with HTML and CSS.
Introduction to Web Services, UDDI, SOAP, WSDL, Web Service Architecture, Developing and deploying web services. AJAX –Introduction AJAX programming, Improving web page performance using AJAX.

Text Books

1. Internet and World Wide Web, Deitel H.M., P.J.Deitel , Pearson

Reference Books/Materials

1.Web Technologies, Uttam K. Roy, Oxford University Press

2. HTML Black Book, Stephen Holzner, Wiley Dreamtech.

3. Web Technology, Rajkamal, Tata McGraw-Hill.

4. Web Technologies: A Computer Science Perspective, Jeffrey C. Jackson, Pearson.

5. XML: How to Program, Deitel&Deitel Nieto

Modes of Evaluation: Quiz I/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	Create a well-designed and well-formed, professional Web site utilizing the most current standards and practices	**PO1**
CO2	Demonstrate knowledge in web technologies including HTML, XHTML, CSS, image editing software, web authoring software, and client-side scripting	**PO4**
CO3	Create client-side scripts to add interactivity to Web pages	**PO5**
CO4	Select appropriate Web tools for a Web development project	**PO2**
CO5	Identify Web authoring obstacles created by the availability of various web browsers and markup language versions	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
ETCS 308A	WEB TECHNOLOGIES	2	2	2	3	3								2	3			

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

ETCS501A	Languages of Data Modeling	L	T	P	C
Version 1.0		3	1	-	4
Pre-requisites/Exposure	-				
Co-requisites	-				

Course Objectives

1. Understand the different issues involved in the design and implementation of a database system.
2. Study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
3. Understand and use data manipulation language to query, update, and manage a database.
4. Develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5. Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.
6. Design and build a simple UML diagram to demonstrate the database system.

Course Outcomes

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

CO1. For a given query write relational algebra expressions for that query and optimize the developed expressions

CO2. For a given specification of the requirement design the databases using E-R method and normalization.

CO3. For a given specification construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, and DB2.

CO4. For a given query optimize its execution using Query optimization algorithms

CO5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.

CO6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

CO7. Design UML diagrams using its related symbols for a given set of databases.

Catalog Description

Data modeling is the analysis of data objects and their relationships to other data objects. Data modeling is often the first step in database design and object-oriented programming as the designers first create a conceptual model of how data items relate to each other. Data modeling involves a progression from conceptual model to logical model to physical schema. It helps in the visual representation of data and enforces business rules, regulatory compliances, and government policies on the data. Data Models ensure consistency in naming conventions, default values, semantics, security while ensuring quality of the data.

Course Content

Unit I: **12 lecture hours**

Introducing Data Modeling: Introduction to data modeling, data modeling taxonomy: Entity expansion, Input Data Analysis-structuring, Output Data Analysis – structuring, Normalization, overview of model-driven database design, domain models and design patterns, benefits and pitfalls of model-driven design.

Unit II: **10 lecture hours**

Designing Logical Data Models: Entity-Relationship Model – Entity Types, Entity Sets, Attributes Relationship Types, Relationship Instances and ER Diagrams. Extended E-R features: Generalization, Specialization and Aggregations. Concepts of hierarchical, network and relational data models.

Unit III: **8 lecture hours**

Designing Physical Data Models: Concepts of hierarchical, network and relational data models. Function dependency, Dependency preservation, Lossless and lossy decomposition, Multivalued dependency, Normalization 1NF, 2NF, 3NF, BCNF, 4NF, 5NF

Unit IV: **10 lecture hours**

Unified Modeling Language: Overview, Building Blocks, Architecture, Modeling Types, Basic Notations, Standard Diagrams, Class Diagram, Object Diagram, and Component Diagram.

Text Books:

Date, C.J., "An Introduction to Database Systems", Narosa Publishing House. New Delhi.

Reference Books/Materials

1. Desai, B'., "An Introduction to Database Concepts", Galgotia Publications. New Delhi.

2. Elmsari and Navathe, "Fundamentals of Database Systems", Addison Wesley, New York.3

3. Ullman, J.D., "Principles of Database Systems", Galgotia Publications. New Delhi.

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	For a given query write relational algebra expressions for that query and optimize the developed expressions	**PO2**
CO2	For a given specification of the requirement design the databases using E-R method and normalization.	**PO3**
CO3	For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.	**PO5**
CO4	For a given query optimize its execution using Query optimization algorithms	**PO2**
CO5	For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.	**PO4**
CO6	Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.	**PO5**
CO7	Design UML diagrams using its related symbols for a given set of databases.	**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	Ethics	Analysis
Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS 501A	Languages of Data Modeling		2	3	3	3								3		

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

ETCS112A	**Object Oriented Programming**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Computer Programming				
Co-requisites	--				

Course Objectives

This course introduces the concepts of object-oriented programming to students with a background in the procedural paradigm. The course begins with a brief review of control structures and data types with emphasis on structured data types and array processing. It then moves on to introduce the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of

object-oriented design. Other topics include an overview of programming language principles, simple analysis of algorithms, basic searching and sorting techniques, event-driven programming, memory management and an introduction to software engineering issues.

Course Outcomes

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

CO1 Explain the steps in creating an executable program for a computer, including the intermediate representations and their purpose.

CO2. Manipulate binary patterns and understand the use of binary to represent numbers. CO 3. Apply good programming style and understand the impact of style on developing and maintaining programs. CO4. Effectively use a version control system and the Linux command line tools for incremental development.

CO5. Explain the benefits of object-oriented design and understand when it is an appropriate methodology to use.

CO6. Design object-oriented solutions for small systems involving multiple objects.

CO7. Identify the relative merits of different algorithmic designs.

Catalog Description

This is a course in which you learn computer programming concepts that are fundamental in nearly any computer programming language. These concepts can then be used in other courses to help you create computer applications that can be used to solve real-world problems

Course Content

Unit I: **12 lecture hours**

Introduction: Introducing Object-Oriented Approach related to other paradigms (functional, data decomposition), Characteristics of Object-Oriented Languages.

Basic terms and ideas: Abstraction, Encapsulation, Information hiding, Inheritance, Polymorphism, Review of C, Difference between C and C++, Cin, Cout, new, delete operators.

Unit II: **8 lecture hours**

Classes and Objects: Abstract data types, Object & classes, attributes, methods, C++ class declaration, State identity and behavior of an object, Constructors and destructors, instantiation of objects, Default

parameter value, Copy Constructor, Static Class Data, Constant Classes, C++ garbage collection, dynamic memory allocation.

Unit III: 12 lecture hours

Inheritance and Polymorphism: Inheritance, Types of Inheritance, Class hierarchy, derivation – public, private & protected, Agrégations, composition vs classification hiérarchies, Polymorphism, Type of Polymorphism – Compile time and runtime, Method polymorphism, Polymorphism by parameter, Operator overloading, Parametric polymorphism, Generic function – template function, function name overloading, Overriding inheritance methods.

Unit IV: 8 lecture hours

Files and Exception Handling: Persistent objects, Streams and files, Namespaces, Exception handling, Generic Classes Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterates, Other STL Elements, The Container Classes, General Theory of Operation, Vectors.

Text Books

1. A.R. Venugopal, Rajjkumar, T. Ravishanker "Mastering C++", TMH
2. R. Lafore, "Object Oriented Programming using C++", BPB Publications
3. Schildt Herbert, "C++ Programming", 2nd Edition, Wiley DreamTech

Reference Books/Materials

1. D. Parasons, "Object Oriented Programming with C++", BPB Publication
2. Steven C. Lawlor, "The Art of Programming Computer Science with C++", Vikas Publication
3. YashwantKanethkar, "Object Oriented Programming using C++", BPB

Modes of Evaluation: Quiz I/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	CO1 Explain the steps in creating an executable program for a computer, including the intermediate representations and their purpose.	**PO2**
CO2	CO2. Manipulate binary patterns and understand the use of binary to represent numbers. CO 3. Apply good programming style and understand the impact of style on developing and maintaining programs. CO4. Effectively use a version control system and the Linux command line tools for incremental development.	**PO3**
CO3	CO5. Explain the benefits of object-oriented design and understand when it is an appropriate methodology to use.	**PO4**
CO4	CO6. Design object-oriented solutions for small systems involving multiple objects.	**PO5**
CO5	CO7. Identify the relative merits of different algorithmic designs.	**PO4**
CO6	CO1 Explain the steps in creating an executable program for a computer, including the intermediate representations and their purpose.	**PO4**
CO7	CO2. Manipulate binary patterns and understand the use of binary to represent numbers. CO 3. Apply good programming style and understand the impact of style on developing and maintaining programs. CO4. Effectively use a version control system and the Linux command line tools for incremental development.	**PO9, PSO 1**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 112A	Object oriented programming		2	3	3	3				3				3	2			2

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETPH112A	**Electricity and Magnetism(GE-II)**	L	T	P	C
Version 1.0		4	2	-	6
Pre-requisites/Exposure	Basics of Physics				
Co-requisites	--				

Course Objectives

1. The abstraction from forces to fields using the examples of the electric and magnetic fields, with some applications
2. To learn how charges behave through electric circuits.
3. Consolidate the understanding of fundamental concepts in Electricity and Magnetism more rigorously as needed for further studies in physics, engineering and technology.
4. Expand and exercise the students' physical intuition and thinking process through the understanding of the theory and application of this knowledge to the solution of practical problems

Course Outcomes

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

CO1. Acquire fundamental knowledge of electrostatic interaction using Gauss Law and able to

apply on physical systems.
CO2. Better insight about magnetic and dielectric behaviour of materials.
CO3. Better understanding of electrical circuits/theorems which enhances problem solving approach.
CO4. Develop the ability to correlates the daily life phenomenon to physics using mathematical tools.

Catalog Description

This course imparts the basic concepts of Physics. The course is design to point to a plausible physical origin of simple electromagnetic phenomena in nature, based on what the candidate has learned in the course about fundamental laws and concepts in electricity and magnetism. The course of Electricity and Magnetism help organizing the data in variety of ways to solve the problem efficiently. The course is focused on theoretical discussions of Electricity and Magnetism and applications of discussed phenomenon. It also discusses about daily life physics like magnetism, current etc.

Course Content

Unit I: **10 Lecture hours**

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

Conservative nature of Electrostatic Field .Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.

Unit II: **10 Lecture hours**

Electrostatic energy of system of charges.Electrostatic energy of a charged sphere.Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors.Parallel-plate capacitor.Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges.Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics.

Unit III: **10 Lecture hours**

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.

Unit IV: 10 Lecture hours

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: The venin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping.CDR.

Text Books

1. Physics for Scientists and Engineers (6th Ed.), Raymond A. Serway and John W. Jewett, Thomson Brooks (2004).

2. Engineering Physics Theory and Practical, A. K. Katiyar and C. K. Pandey, Wiley (2015)

Reference Books/Materials

1. Introduction to Electrodynamics (3rd Indian reprint), D.J. Griffiths,., Pearson Education (2003).
2. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw

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	Acquire fundamental knowledge of electrostatic interaction using Gauss Law and able to apply on physical systems.	**PO1& PO2**
CO2	Better insight about magnetic and dielectric behaviour of materials.	**PO4**
CO3	Better understanding of electrical circuits/theorems which enhancesproblem solving approach.	**PO6**
CO4	Develop the ability to correlates the daily life phenomenon to physics using mathematical tools.	**PO7 & 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	Ethics	Analysis
Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETPH112A	Electricity & Magnetism	2	2		2		2	2	3					3		2

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

ETCS551A	Languages of Data Modeling Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	-				
Co-requisites	-				

Course Objectives

1. Understand the different issues involved in the design and implementation of a database system.
2. Understand basics of the DAMA DM-BOK guidelines for Data Modelling
3. Create three distinct levels of data models
4. Apply data modelling skills to practical situations
5. Understand metadata and its purpose
6. Study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
7. Understand and use data manipulation language to query, update, and manage a database.
8. Design and build a simple UML diagram to demonstrate the database system.

Course Outcomes

On completion of this course, the students will be able to
CO1. For a given query write relational algebra expressions for that query and optimize the developed expressions
CO2. For a given specification of the requirement design the databases using E-R method and normalization.
CO3. For a given specification construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, and DB2.
CO4. For a given query optimize its execution using Query optimization algorithms
CO5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
CO6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.
CO7. Design UML diagrams using its related symbols for a given set of databases.

Catalog Description

A student will achieve two important skills required for a Business Analyst - Data Modelling and

Database Design. After completing this course, a student will be able to analyse business cases, develop Entity Relationship Diagram (ERD) and design Relational Database. However, this course is NOT about database development on any specific DBMS. A database design can be implemented using any available tool or DBMS (e.g. Oracle, SQL). Data Modelling and Database Design are independent of any specific tool.

List of Experiments (Indicative)

1	Represent the following concepts of OOSE using suitable UML symbols: Association, Composition, Activity, Classes, Interface etc.	6 lab hours
2	Create a Usecase diagram of Airline Reservation System.	6 lab hours
3	Create a class diagram of Airline Reservation System or any suitable case study.	6 lab hours
4	Create an Activity Diagram for the above problem.	6 lab hours
5	Design JUnit test cases to test a given Java code. Test cases should cover checking of boundary value analysis, complete path coverage etc.	6 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	For a given query write relational algebra expressions for that query and optimize the developed expressions	**PO2**
CO2	For a given specification of the requirement design the databases using E-R method and normalization.	**PO3**
CO3	For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.	**PO5**

CO4	For a given query optimize its execution using Query optimization algorithms	**PO2**
CO5	For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.	**PO4**
CO6	Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.	**PO5**
CO7	Design UML diagrams using its related symbols for a given set of databases.	**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	Ethics	A l s
Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	P 3
ETCS 551A	Languages of Data Modeling Lab		2	3	3	3								3		

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

ETCS166A	Object Oriented Programming Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning				
Co-requisites	--				

Course Objectives

This course will give the learner an insight into how everything can be considered an object and how simply we can write code to implement it. It helps us in making programming relatable to real world, as everything around us can be an object (having properties and functionality) Object-oriented programming aims to implement real world entities like inheritance, hiding, polymorphism etc in programming. The main aim of OOP is to bind together the data and the functions that operates on them so that no other part of code can access this data except that function.

Course Outcomes

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

CO1 Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.

CO2 Understand fundamentals of object-oriented programming including defining classes, invoking methods, using class libraries, etc.

CO3 Be aware of the important topics and principles of software development.

CO4 Develop the ability to write a computer program to solve specified problems.

Catalog Description

This course emphasizes solving problems using the language, and introduces standard programming techniques like alternation, iteration and recursion. It will briefly glimpse the basics of software engineering practices like modularization, commenting, and naming conventions which help in collaborating and programming in teams. This course is enabled the students to formulate algorithms for arithmetic and logical problems, convert these algorithms to C language programs. It also aims on using arrays, pointers and structures to formulate algorithms and programs. In addition to that, apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

List of Experiments (Indicative)

1	Raising a number n to a power p is the same as multiplying n by itself p times. Write a function called power ( ) that takes a double value for n and an int value for p, and returns theresult as double value. Use a default argument of 2 for p, so that if this argument is omitted, the number will be squared. Write a main ( ) function that gets values from the user to test this function.	**2 lab hours**
2	A point on the two dimensional plane can be represented by two numbers: an X coordinate and a Y coordinate. For example, (4,5) represents a point 4 units to the right of the origin along the X axis and 5 units up the Y axis. The sum of two points can be defined as a new point whose X coordinate is the sum of the X coordinates of the points and whose Y coordinate is the sum of their Y coordinates. Write a program that uses a structure called point to model a point. Define three points, and have the user input values to two of them. Than set the third point equal to the sum of the other two, and display the value of the new point. Interaction with the program might look like this: Enter coordinates for P1: 3 4 Enter coordinates for P2: 5 7 Coordinates of P1 + P2 are : 8, 11	**2 lab hours**
3	Create the equivalent of a four function calculator. The program should request the user to enter a number, an operator, and another number. It should then carry out the specified arithmetical operation: adding, subtracting, multiplying, or dividing the two numbers. (It should use a switch statement to select the operation). Finally it should display the result. When it finishes the calculation, the program should ask if the user wants to do another calculation. The response can be 'Y' or 'N'. Some sample interaction with the program might look like this. Enter first number, operator, second number: 10/ 3 Answer = 3.333333 Do another (Y/ N)? Y Enter first number, operator, second number 12 + 100 Answer = 112	**2 lab hours**
4	A phone number, such as (212) 767-8900, can be thought of as having three parts: the area code (212), the exchange (767) and the number (8900). Write a program that uses a structure to store these three parts of a phone number separately. Call the structure phone. Create two structure variables of type phone. Initialize one, and have the user input a number for the other one. Then display both numbers. The interchange might look like this: Enter your area code, exchange, and number: 415 555 1212 My number is (212) 767-8900 Your number is (415) 555-1212	**2 lab hours**
5	Create two classes DM and DB which store the value of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB. Use a friend function to carry out the addition operation. The object that stores the results maybe a DM object or DB object, depending on the units in which the	**2 lab hours**

	results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.	
6	Create a class rational which represents a numerical value by two double valuesNUMERATOR & DENOMINATOR. Include the following public member Functions: • constructor with no arguments (default). • constructor with two arguments. • void reduce( ) that reduces the rational number by eliminating the highest common factor between the numerator and denominator. • Overload + operator to add two rational number. • Overload >> operator to enable input through cin.• Overload << operator to enable output through cout. Write a main ( ) to test all the functions in the class.	**4 lab hours**
7	Consider the following class definition class father { protected : int age; public; father (int x) {age = x;} virtual void iam ( ) { cout<< "I AM THE FATHER, my age is : "<< age<< end1:} }; Derive the two classes son and daughter from the above class and for each, define iam ( ) to write our similar but appropriate messages. You should also define suitable constructors for these classes. Now, write a main ( ) that creates objects of the three classes and then calls iam ( ) for them. Declare pointer to father. Successively, assign addresses of objects of the two derived classes to this pointer and in each case, call iam ( ) through the pointer to demonstrate polymorphism in action.	**4 lab hours**
8	Write a program that creates a binary file by reading the data for the students from the terminal. The data of each student consist of roll no., name (a string of 30 or lesser no. of characters) and marks.	**4 lab hours**
9	A hospital wants to create a database regarding its indoor patients. The information to store include a) Name of the patient b) Date of admissionDisease d) Date of discharge Create a structure to store the date (year, month and date as its members). Create a base class to store the above information. The member function should include functions to enter information and display a list of all the patients in the database. Create a derived class to store the age of the patients. List the information about all the to store the age of the patients. List the information about all the pediatric patients (less than twelve years in age).	**4 lab hours**
10	Make a class Employee with a name and salary. Make a class Manager inherit from Employee. Add an instance variable, named department, of type string. Supply a method to toString that prints the manager's name, department and salary. Make a class Executive inherit from Manager. Supply a method to String that prints the string "Executive" followed by the information stored in the Manager superclass object. Supply a test program that tests these classes and methods.	**2 lab hours**
11	Imagine a tollbooth with a class called toll Booth. The two data items are a type unsigned int to hold the total number of cars, and a type double to hold the total amount of money collected. A constructor	**2 lab hours**

	initializes both these to 0. A member function called payingCar ( ) increments the car total and adds 0.50 to the cash total. Another function, called nopayCar ( ), increments the car total but adds nothing to the cash total. Finally, a member function called displays the two totals. Include a program to test this class. This program should allow the user to push one key to count a paying car, and another to count a nonpaying car. Pushing the ESC kay should cause the program to print out the total cars and total cash and then exit.	
12	Write a function called reversit ( ) that reverses a string (an array of char). Use for loop that swaps the first and last characters, then the second and next to last characters and so on. The string should be passed to reversit ( ) as an argument. Write a program to exercise reversit ( ). The program should get a string from the user, call reversit ( ), and print out the result. Use an input method that allows embedded blanks. Test the program with Napoleon's famous phrase, "Able was I ere I saw Elba)".	**2 lab hours**
13	. Create some objects of the string class, and put them in a Deque-some at the head of the Deque and some at the tail. Display the contents of the Deque using the forEach ( ) function and a user written display function. Then search the Deque for a particular string, using the first That ( ) function and display any strings that match. Finally remove all the items from the Deque using the getLeft ( ) function and display each item. Notice the order in which the items are displayed: Using getLeft ( ), those inserted on the left (head) of the Deque are removed in "last in first out" order while those put on the right side are removed in "first in first out" order. The opposite would be true if getRight ( ) were used.	**2 lab hours**
14	Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data ( ) to initialize base class data Members and another member function display_area ( ) to compute and display the area of figures. Make display_area ( ) as a virtual function and redefine this function in the derived classes to suit their requirements. Using these three classes, design a program that will accept dimensions of a triangle or a rectangle interactively and display the area. Remember the two values given as input will be treated as lengths of two sides in the case of rectangles and as base and height in the case of triangles and used as follows: Area of rectangle = x * y Area of triangle = ½ * x * y	**2 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.	PO2
CO2	Understand fundamentals of object-oriented programming including defining classes, invoking methods, using class libraries, etc.	PO3
CO3	Be aware of the important topics and principles of software development.	PO5, PSO1,
CO4	Develop the ability to write a computer program to solve specified problems.	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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 166A	Object oriented programmingLab		2	3		3				3				3	2			2

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCA365A	**Linux Environment Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	-				
Co-requisites	-				

Course Objectives

The objective of this course is to impart necessary and practical knowledge concerning basic Linux usage.

1. To implement some standard Linux utilities such as ls.cpetc
2. To write shell script programs to solve problems.
3. To learn basics of system administration

Course Outcomes

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

CO1. Understanding the basic set of commands and utilities in Linux/UNIX systems
CO2. Able to create file handling utilities by using Linux shell environment
CO3. Evaluate the concept of shell scripting programs
CO4. Obtain a foundation for System Administration

Catalog Description

This course will provide you with a basic introduction to Linux skills The student will learn how a Linux system is organized, and will demonstrate introductory system administration tasks. The student will be able to reasons why Linux and the open source development model are so important in today's computing environment.

List of Experiments (Indicative)

1	Installing Linux Operating System	**2 lab hours**
2	Exploring the System**:** Starting Up and changing run levels, Using the man utility, Using built-in help switches for commands, Using Auto completion	**2 lab hours**
3	Using cd**,** Using pwd**,** Using mkdir**,** Using rmdir,	
4	Using Touch, Using ls**,** Using mv**,** Using cp**,** Using cat, Using Redirection**,** rm**,** Using vi	**2 lab hours**
5	Searching for files: grep, frep and similar commands	**2 lab hours**
6	Preamble, Virtual terminals**,** Setting up a basic display **,**X clients**,** Window Managers**,** Display Manager**,** xinit and startx**,** system-config-display	**2 lab hours**
7	Manually creating a new user, Manually creating a new groups, automatically creating a new user, automatically creating new groups, using sticky bits, share the file between users and groups..	**2 lab hours**
8	Installing, Querying and Uninstalling Packages, Third party tools, Building Software from Source	**2 lab hours**
9	Determining device type, Creating devices, mounting and umounting devices	**2 lab hours**
10	Different kind of shells (c shell, bash shell, korn shell and others), A simple Script, Using variables in scripts	**2 lab hours**
11	Shell Script: Using Control Structures	**4 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Understanding the basic set of commands and utilities in Linux/UNIX systems	PO5
CO2	Able to create file handling utilities by using Linux shell environment.	PO6
CO3	Evaluate the concept of shell scripting programs	PO3
CO4	Obtain a foundation for System Administration	PO12

		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	Skills	Best Practices	Profession Responsibilities	Ethics	Analysis
Cours	Cours	P	P	P	P	P	P	P	P	P	P	P	P				PS	PS

e Code	e Title	O 1	O 2	O 3	O 4	O 5	O 6	O 7	O 8	O 9	O1 0	O1 1	O1 2	PS O1	PS O2	PS O3	O4	O5
ETC A365 A	Linux Environment Lab			2		3	2						3	2				

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCA164A	**Web Technologies Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of HTML				
Co-requisites	--				

Course Objectives

1. To understand best technologies for solving web client/server problems
2. analyze and design real time web applications
3. use Java script for dynamic effects and to validate form input entry
4. Analyze to Use appropriate client-side or Server-side applications

Course Outcomes

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

CO1. Analyze a web page and identify its elements and attributes. ·

CO2.Create web pages using XHTML and Cascading Style Sheets. ·

CO3.Build dynamic web pages using JavaScript (Client side programming). ·

CO4. Create XML documents and Schemas.

Catalog Description

This course is an introduction to Web site development and the technologies behind it. Students will learn how to design and develop Web pages using current technologies and tools. Topics covered will include the World Wide Web, HTML, Cascading Style Sheets (CSS) and XML.

List of Experiments (Indicative)

1	Write HTML/Java scripts to display your CV in Web Browser	**2 lab hours**
2	Creation and annotation of static web pages using any HTML editor.	**2 lab hours**
3	Write a program to use XML and JavaScript for creation of your homepage.	**2 lab hours**
4	Write a program in XML for creation of DTD which specifies a particular set of rules.	**4 lab hours**
5	Create a Stylesheet in CSS/XSL and display the document in Web Browser	**4 lab hours**
6	Create a Registration Form with Table	**3 lab hours**
7	CSS : Inline Style , Internal Style ,and External Style Sheets	**3 lab hours**
8	JavaScript & HTML:	**10 lab hours**

	· Use user defined function to get array of values and sort them in ascending order · Demonstrate String and Math Object's predefined methods · Demonstrate Array Objects and Date Object's predefined methods · Exception Handling · Calendar Creation : Display all month · Event Handling · Validation of registration form · Open a Window from the current window · Change color of background at each click of button or refresh of a page · Display calendar for the month and year selected from combo box ·OnMouseover event	
9	XML · Create any catalog · Display the catalog created using CSS or XS	**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	Analyze a web page and identify its elements and attributes. ·	**PO1**
CO2	Create web pages using XHTML and Cascading Style Sheets. ·	**PO4**

CO3	Build dynamic web pages using JavaScript (Client side programming). ·	**PO5**
CO4	Create XML documents and Schemas	**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	Employability	Ethics and Behaviour	Knowledge
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCA164A	WEB TECHNOLOGIES LAB	2	2		3	3										3

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

Semester III

ETCS304A	**Computer Networks**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Data Structure and Algorithms				
Co-requisites	Basic Mathematics				

Course Objectives

1. Help in understanding the concepts of communication and computer networks.

Course Outcomes

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

CO1. To develop an understanding of modern network architectures from a design and performance perspective.
C02. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
CO3. To provide an opportunity to do network programming
CO4. Explain the functions of the different layer of the OSI Protocol.
CO5. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component

Catalog Description

Through this subject, student will be able to understand the coarse grained aspects of Data Communication. Student will understand the applications of data structures and algorithms in networks. The internals of communications will be discussed throughout the course duration.

Course Content

Unit I: **8 lecture hours**

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum

Unit II: **12 lecture hours**

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Unit III: **12 lecture hours**

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit IV: **8 lecture hours**

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Text Books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Reference Books/Materials

Modes of Evaluation: Quiz I/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	To develop an understanding of modern network architectures from a design and performance perspective.	PO2, PO12
CO2	To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).	PO12
CO3	To provide an opportunity to do network programming	PO2
CO4	Explain the functions of the different layer of the OSI Protocol.	PO4, PO5

CO5	For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component	**PO11, PO12**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 304A	Computer Networks		3		3	3						3	3	2	2			2

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

ETMA215A	**Probability And Statistics**	L	T	P	C
Version 1.0		4	-	-	4
Pre-requisites/Exposure	Basic algebra				
Co-requisites	--				

Course Objectives

1 To understand distributions in the study of the joint behaviour of two random variables.

2 To establish a formulation helping to predict one variable in terms of the other that is, correlation and linear regression.

3 To understand central limit theorem, which establish the remarkable fact that the empirical frequencies of so many natural populations, exhibit a bell-shaped curve.

Course Outcomes

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

CO1 Apply key concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and variances.

CO2 Define and explain the different statistical distributions and the typical phenomena that each distribution often describes.

CO3 Calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.

CO4 Compute the covariance and correlation between jointly distributed variables.

CO5 Apply the method of least squares to estimate the parameters in a regression model.

CO6 Understand the law of large numbers and the central limit theorem.

Catalog Description

This course aims to provide an understanding of the basic concepts in probability, conditional probability and independent events. It will also focus on the random variable, mathematical expectation, and different types of univariate and bivariate distributions. In this course, student will learn how to describe relationships between two numerical quantities and characterized these relationships graphically, in the form of summary statistics, and through simple linear regression models.

Course Content

UNIT-I **8 lectures**

Probability Functions and Moment Generating Function

Basic notions of probability, Conditional probability and independence, Baye's theorem; Random variables - Discrete and continuous, Cumulative distribution function, Probability mass/density functions; Transformations, Mathematical expectation, Moments, Moment generating function, Characteristic function.

UNIT-II **12 lectures**

Univariate Discrete and Continuous Distributions

Discrete distributions**:** Uniform, Bernoulli, Binomial, Negative binomial, Geometric and Poisson; Continuous distributions**:** Uniform, Gamma, Exponential, Chi-square, Beta and normal; Normal approximation to the binomial distribution.

UNIT-III **8 lectures**

Bivariate Distribution

Joint cumulative distribution function and its properties, Joint probability density function, Marginal distributions, Expectation of function of two random variables, Joint moment generating function, Conditional distributions and expectations.

UNIT-IV **12 lectures**

Correlation, Regression and Central Limit Theorem

The Correlation coefficient, Covariance, Calculation of covariance from joint moment generating function, Independent random variables, Linear regression for two variables, The method of least squares, Bivariate normal distribution, Chebyshev's theorem, Strong law of large numbers, Central limit theorem and weak law of large numbers.

Modeling Uncertainty

Uncertainty, Information and entropy, Uniform Priors, Polya's urn model and random graphs.

Reference Books/Materials

1. Robert V. Hogg, Joseph W. McKean & Allen T. Craig (2013). Introduction to Mathematical Statistics(7th edition), Pearson Education.
2. Irwin Miller &Marylees Miller (2014). John E. Freund's Mathematical Statistics with Applications (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India.
3. Jim Pitman (1993). Probability, Springer-Verlag.
4. Sheldon M. Ross (2014). Introduction to Probability Models (11th edition). Elsevier.
5. A. M. Yaglom and I. M. Yaglom (1983). Probability and Information. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi.

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 key concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and variances.	**PO4**
CO2	Define and explain the different statistical distributions and the typical phenomena that each distribution often describes.	**PO5**
CO3	Calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.	**PO3**
CO4	Compute the covariance and correlation between jointly distributed variables.	**PO2**
CO5	Apply the method of least squares to estimate the parameters in a regression model.	**PO1**
CO6	Understand the law of large numbers and the central limit theorem.	**PO11**

		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	Ethics	Analysis
Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 4	PSO 5
ETMA215A	Probability and Statistics	3	2	2	3	3						2		2		3

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

ETCS211A	**Operating Systems**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Computer Organization & Architecture				
Co-requisites	--				

Course Objectives

1. To learn the mechanisms of OS to handle processes and threads and their communication.
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management
5. To learn to implement simple OS mechanisms

Course Outcomes

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

CO1. Describe the important computer system resources and the role of operating system in their management policies and algorithms.
CO2. To understand various functions, structures and history of operating systems and should be able to specify objectives of modern operating systems and describe how operating systems have evolved over time.
CO3. Understanding of design issues associated with operating systems.
CO4. Understand various process management concepts including scheduling, synchronization, and deadlocks.
CO5. To understand concepts of memory management including virtual memory.
CO6. To understand issues related to file system interface and implementation, disk management

Catalog Description

This course will provide an introduction to the internal operation of modern operating systems. In particular, the course will cover processes and threads, mutual exclusion, CPU scheduling, deadlock, memory management, and file systems.

Course Content

Unit I: **6 lecture hours**

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Unit II: **12 lecture hours**

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time;

Scheduling algorithms: Pre-emptive and Non-preemptive, FCFS, SJF, RR; Multiprocessor

scheduling: Real Time scheduling: RM and EDF.

Unit III: **12 lecture hours**

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free- space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Unit IV: **12 lecture hours**

Process-Synchronization & Deadlocks: Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc. Definition of Deadlocks, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

I/O Systems: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

Text Books

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson

Reference Books/Materials

1. Tannenbaum, "Operating Systems", PHI, 4th Edition.
2. William Stallings, "Operating Systems Internals and Design Principles", PHI
3. HallMadnick, J. Donovan, "Operating Systems", Tata McGraw Hill.
4. W. Tomasi, "Electronic Communication Systems" Pearson Education, 5th Edition

Modes of Evaluation: Quiz I/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	Describe the important computer system resources and the role of operating system in their management policies and algorithms.	PO1
CO2	To understand various functions, structures and history of operating systems and should be able to specify objectives of modern operating systems and describe how operating systems have evolved over time.	PO1
CO3	Understanding of design issues associated with operating systems.	PO3
CO4	Understand various process management concepts including scheduling, synchronization, and deadlocks.	PO4
CO5	To understand concepts of memory management including virtual memory.	PO5
CO6	To understand issues related to file system interface and implementation, disk management.	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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PS	PS	PS	PSO4	PSO5

Code	Title	1	2	3	4	5	6	7	8	9				O1	O2	O3		
ETCS 211A	Operating Systems	2		3	3	3									2	2		

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

ETCS219A	**Foundation Of Computer Systems**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Some concepts from basic math – algebra, geometry, pre-calculus				
Co-requisites	--				

Course Objectives

1. Use mathematically correct terminology and notation.
2. Construct correct direct and indirect proofs.
3. Use division into cases in a proof.
4. Use counterexamples.
5. Apply logical reasoning to solve a variety of problems.

Course Outcomes

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

CO1. Acquire an understanding set theory, functions, and relations.

CO2. Develop the given problem as graph networks and solve with techniques of graph theory.

CO3. Understanding the language of mathematical logic and expressing statements in terms of logic.

CO4. Derive the solution for a given problem using deductive logic and prove the solution based on logical inference.

CO5. Gaining insight into applications of discrete mathematics to various practical problems.

Catalog Description

The course is an introduction to discrete mathematics as a foundation to work within the fields of computer science, information technologies, and software development.

Course Content

Unit I: **10 lecture hours**

Set Theory: Introduction to set theory, Set operations, Algebra of sets, Duality, Finite and Infinite sets, Classes of sets, Power Sets, Multi sets, Cartesian Product, Representation of relations, Types of relation, Equivalence relations and partitions , Partial ordering relations and lattices Function and its types, Composition of function and relations, Cardinality and inverse relations

Unit II: **12 lecture hours**

Graphs And Trees: Introduction to graphs, Directed and Undirected graphs, Homomorphic and Isomorphic graphs, Subgraphs, Cut points and Bridges, Multigraph and Weighted graph, Paths and circuits, Shortest path in weighted graphs, Eurelian path and circuits, Hamilton paths and circuits, Planar graphs, Euler's formula, Trees, Spanning trees, Binary trees and its traversals.

Unit III: **12 lecture hours**

Propositional logic: Basic operations: AND(^), OR(v), NOT(~), Truth value of a compound statement, propositions, tautologies, contradictions, Validity of Arguments

Group theory: Definition and examples of a monoid, Semigroup, Groups and rings, Homomorphism, Isomorphism and Auto morphism, Subgroups and Normal subgroups, Cyclic groups, Co-Sets, Lagrange's theorem.

Unit IV: **10 lecture hours**

Recursion and Recurrence Relation: linear recurrence relation with constant coefficients, Homogeneous solutions, Solutions, Total solution of a recurrence relation using generating functions.

Techniques Of Counting: Permutations with and without repetition, Combination.

Text Books

1. Keneth H. Rosen, "Discrete Mathematics and Its Applications", TMH.
2. C.L. Liu, "Elements of Discrete Mathematics", TMH.

Reference Books/Materials

1. Kolman, Busby & Ross, "Discrete Mathematical Structures", PHI.
2. NarsinghDeo, "Graph Theory with Application to Engineering and Computer Science", PHI.
3. J. P. Trembly& P. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill.
4. Vinay Kumar, "Discrete Mathematics", BPB 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	Acquire an understanding set theory, functions, and relations.	**PO1**

CO2	Develop the given problem as graph networks and solve with techniques of graph theory.	**PO2**
CO3	Understanding the language of mathematical logic and expressing statements in terms of logic.	**PO1**
CO4	Derive the solution for a given problem using deductive logic and prove the solution based on logical inference.	**PO3**
CO5	Gaining insight into applications of discrete mathematics to various practical 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	Employability	Ethics and Behaviour	Knowledge
Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
ETCS219A	Foundation of Computer Systems	3	3	2										2		1

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

ETCS217A	Data Structures	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Computer Programming				
Co-requisites	--				

Course Objectives

1. To be able to compute the efficiency of algorithms in terms of time and space complexities.
2. To understand concepts of searching and sorting algorithms.
3. Using various data structures viz. stacks, queues, linked list, trees and graphs to develop efficient algorithms through efficient representation of data and operations that can be applied.
4. To enable them to develop algorithms for solving problem by applying concepts of data structures.

Course Outcomes

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

CO1. Analyze the algorithms to determine the time and computation complexity and justify the correctness.

CO2. Implement a given Search problem (Linear Search and Binary Search).

CO3. Write algorithms concerning various data structures like Stack, Queue, Linked list, Graph search and traversal techniques and analyze the same to determine the time and computation complexity.

CO4. Write an algorithm for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap sort and compare their performance in term of Space and time complexity.

Catalog Description

This course imparts the basic concepts of 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 course introduces the basic concepts about stacks, queues, lists, trees and graphs. It also discusses about daily problems like searching and sorting techniques

Course Content

Unit I: 8 lecture hours

Introduction to Data Structures: Definition of data structures and abstract data types, Static and Dynamic implementations, Examples and real life applications; Arrays**:** ordered lists, representation of arrays, sparse matrices, polynomial arithmetic

Running time: Analysis of Algorithms and their complexities: Time Complexities, Big – Oh - notation, Running Times, Best Case, Worst Case, Average Case, Factors depends on running time, Introduction to Recursion, Divide and Conquer Algorithm, Time & Space Tradeoff.

Unit II: 12 lecture hours

The Stacks: ADT Stack and its operation, Array based implementation of stacks, Linked List based implementation of stacks, Examples: Infix, postfix, prefix representation, Conversions, Applications, Algorithms and their complexities

Queues and Lists: ADT Queue and its operation, Array based implementation of linear Queues, Circular implementation of Queues, Linked Lists: Singly linked lists: Representation of linked lists in memory, Traversing, Searching, Insertion into, Deletion from linked list Linked List implementation of Queues and Stacks Lists, Straight / circular implementation of doubly linked Queues / Lists, Priority Queues, Applications, Algorithms and their complexities

Unit III: 12 lecture hours

Trees: Basic Terminology, Binary Trees and their representation, expression evaluation, Complete Binary trees, Extended binary trees, traversing binary trees, Searching, Insertion and Deletion in binary search trees (with and without recursion), AVL trees, Threaded trees, B+ trees, algorithms and their analysis.

Graphs: Terminology and Representations, Graphs & Multigraphs, Directed Graphs, Sequential representation of graphs, Adjacency matrices, Transversal Connected Component and Spanning trees, Shortest path, algorithms and their analysis.

Unit IV: 8 lecture hours

Sorting Algorithms: Introduction, Sorting by exchange, selection sort, insertion sort, Bubble sort, Straight selection sort, Efficiency of above algorithms, Shell sort, Performance of shell sort, Merge sort,

Merging of sorted arrays& Algorithms; Quick sort Algorithm analysis, heap sort: Heap Construction, Heap sort, bottom – up, Top – down Heap sort approach;

Searching Algorithms: Straight Sequential Search, Binary Search (recursive & non–recursive Algorithm

Text Books

1. E. Horowitz and S. Sahani, "Fundamentals of Data Structures", Galgotia Book source Pvt. Ltd.
2. R. L. Kruse, B. P. Leung, C. L. Tondo, "Data Structures and program design in C", PHI

Reference Books/Materials

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

Modes of Evaluation: Quiz I/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	Analyze the algorithms to determine the time and computation complexity	PO1
CO2	Implement a given Search problem (Linear Search and Binary Search).	PO4
CO3	Write algorithms concerning various data structures	PO5
CO4	Write an algorithm for internal and external sorting	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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PS	PS	PS	PSO4	PSO5

Code	Title	1	2	3	4	5	6	7	8	9				O1	O2	O3		
ETCS 217A	Data Structures	2	2		3	3										2		3

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

ETCS 255A	**Operating Systems Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Computer Organization & Architecture				
Co-requisites	--				

Course Objectives

1. To learn the mechanisms of OS to handle processes and threads and their communication.
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management
5. To learn to implement simple OS mechanisms

Course Outcomes

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

CO1. Describe the important computer system resources and the role of operating system in their management policies and algorithms.
CO2. To understand various functions, structures and history of operating systems and should be able to specify objectives of modern operating systems and describe how operating systems have evolved over time.
CO3. Understanding of design issues associated with operating systems.

CO4. Understand various process management concepts including scheduling, synchronization, and deadlocks.
CO5. To understand concepts of memory management including virtual memory.
CO6. To understand issues related to file system interface and implementation, disk management

Catalog Description

Based on theory subject **ETCS 211A**, the following experiments are to be performed. It enables them to write algorithms for solving problems with the help of fundamental operating systems.

List of Experiments (Indicative)

1	Write a C program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority	**4 lab hours**
2	Write a C program to simulate multi-level queue scheduling algorithm considering the following scenario. All the processes in the system are divided into two categories – system processes and user processes. System processes are to be given higher priority than user processes. Use FCFS scheduling for the processes in each queue.	**2 lab hours**
3	Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.	**4 lab hours**
4	Write a C program to simulate the following file allocation strategies. a) Sequential b) Indexed c) Linked	**4 lab hours**
5	Write a C program to simulate the MVT and MFT memory management techniques.	**4 lab hours**
6	Write a C program to simulate the following contiguous memory allocation techniques a) Worst-fit b) Best-fit c) First-fit	**2 lab hours**
7	Write a C program to simulate paging technique of memory management	**4 lab hours**
8	Write a C program to simulate the following file organization techniques a) Single level directory b) Two level directory c) Hierarchical	**4 lab hours**
9	Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.	**4 lab hours**
10	Write a C program to simulate page replacement algorithms a) FIFO b) LRU c) LFU	**2 lab hours**

Modes of Evaluation: Quiz I/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	Describe the important computer system resources and the role of operating system in their management policies and algorithms.	**PO1**
CO2	To understand various functions, structures and history of operating systems and should be able to specify objectives of modern operating systems and describe how operating systems have evolved over time.	**PO1**
CO3	Understanding of design issues associated with operating systems.	**PO3**
CO4	Understand various process management concepts including scheduling, synchronization, and deadlocks.	**PO4**
CO5	To understand concepts of memory management including virtual memory.	**PO5**
CO6	To understand issues related to file system interface and implementation, disk management.	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PS	PS	PS	PSO4	PSO5

Code	Title	1	2	3	4	5	6	7	8	9				O1	O2	O3		
ETCS 255A	Operating Systems Lab	2		3	3	3									2	2		

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

ETCS257A	**Data Structures Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Computer Programming				
Co-requisites	--				

Course Objectives

1. To be able to compute the efficiency of algorithms in terms of time and space complexities.
2. To understand concepts of searching and sorting algorithms.
3. Using various data structures viz. stacks, queues, linked list, trees and graphs to develop efficient algorithms through efficient representation of data and operations that can be applied.
4. To enable them to develop algorithms for solving problem by applying concepts of data structures.

Course Outcomes

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

CO1. Analyze the algorithms to determine the time and computation complexity and justify the correctness.

CO2. Implement a given Search problem (Linear Search and Binary Search).
CO3.Write algorithms concerning various data structures like Stack, Queue, Linked list, Graph search and traversal techniques and analyze the same to determine the time and computation complexity.
CO4. Write an algorithm for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap sort and compare their performance in term of Space and time

Catalog Description

This course complements ETCS 217A. It enables them to write algorithms for solving problems with the help of fundamental data structures. The list of experiments help organizing the data in variety of ways using data structures and to solve the given problem efficiently. It also discusses about daily problems like searching and sorting techniques

List of Experiments (Indicative)

1	Write a program for multiplication and transpose of array.	**2 lab hours**
2	Write a program to compute the transpose of a sparse matrix	**2 lab hours**
3	Write a program to implement push and pop operation in Stack.	**2 lab hours**
4	Write a program to convert a Infix notation to post fix notation using stacks	**2 lab hours**
5	Write a program to evaluate postfix notation using stacks	**2 lab hours**
6	Write a program to implement a linear queue	**2 lab hours**
7	Write a program for swapping two numbers using call by value and call by reference strategies.	**2 lab hours**
8	Write a program to insert and delete a node in linked list. The number of nodes to inserted and deleted should be governed by user.	**3 lab hours**
9	Write a program to implement a linear search arrays and linked list.	**2 lab hours**
10	Using iteration and recursion concepts write programs for finding the element in the array using the Binary search method.	**2 lab hours**
11	Write the programs to implement bubble sort.	**2 lab hours**

12	Write a program using iteration and recursion concepts for quick sort.	**2 lab hours**
13	Write a program to implement merge sort.	**2 lab hours**
14	Write a program to simulate various tree traversal techniques.	**3 lab hours**
15	Write a program to simulate various BFS and DFS.	**4 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Analyze the algorithms to determine the time and computation complexity	**PO1**
CO2	Implement a given Search problem (Linear Search and Binary Search).	**PO4**
CO3	Write algorithms concerning various data structures	**PO5**
CO4	Write an algorithm for internal and external sorting	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Cours	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PS	PS	PS	PSO4	PSO5

Code	e Title	1	2	3	4	5	6	7	8	9				O1	O2	O3		
ETCS257A	Data Structures Lab	2	2		3	3										2		4

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

ETCS365A	**Computer Networks Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Computer Programming				
Co-requisites	--				

Course Objectives

1. Learn basic concepts of computer networking and acquire practical notions of protocols with the emphasis on TCP/IP.
2. Provides a practical approach to assemble Ethernet/Internet networking.
3. Understanding of the layered architecture and working of important protocols

Course Outcomes

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

CO1. Understand the structure and organization of computer networks; including the division into network layers, role of each layer, and relationships between the layers.
CO2. Execute and evaluate network administration commands and demonstrate their use in different network scenarios.
CO3. Demonstrate and measure different network scenarios and their performance behavior.
CO4. Design and setup an organization network using packet tracer.

Catalog Description

This course complements ETCS304A. 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 and protocol.

List of Experiments (Indicative)

1	Study of Network devices in detail	**2 lab hours**
2	Connect the computers in Local Area Network using packet tracer	**2 lab hours**
3	Implementation of Data Link Framing method - Character Count.	**2 lab hours**
4	Implementation of Data link framing method - Bit stuffing and Destuffing.	**2 lab hours**
5	Implementation of Error detection method - even and odd parity.	**2 lab hours**
6	Implementation of Error detection method - CRC Polynomials.	**2 lab hours**
7	Implementation of Data Link protocols - Unrestricted simplex protocol	**2 lab hours**
8	Implementation of data link protocols - Stop and Wait protocol	**2 lab hours**
9	Implementation of routing algorithms - Dijkstra's algorithm	**2 lab hours**
10	Study of Network IP Addressing using packet tracer	**2 lab hours**
11	Design TCP client and server application to transfer file	**2 lab hours**
12	Design UDP client and server application to transfer file	**2 lab hours**
13	Working on Network Protocol Analyzer Tool (Ethereal/Wireshark)	**4 lab hours**

14	Working on NMAP Tool for Port scanning	**4 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Understand the structure and organization of computer networks; including the division into network layers, role of each layer, and relationships between the layers.	**PO2**
CO2	Execute and evaluate network administration commands and demonstrate their use in different network scenarios.	**PO3**
CO3	Demonstrate and measure different network scenarios and their performance behavior.	**PO5**
CO4	Design and setup an organization network using packet tracer.	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
ETCS 365A	Computer Networks Lab		3	3		2			3					3	3			3

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

Semester IV

ETCS506A	Python Programming	L	T	P	C
Version 1.0		3	1		4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

- Provide an understanding of the role computation can play in solving problems.
- Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
- Position students so that they can compete for research projects and excel in subjects with programming components.

Course Outcomes

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

CO1. Develop solutions to simple computational problems using Python programs.
CO2. Solve problems using conditionals and loops in Python. Develop Python programs by defining functions and calling them.
CO3. Use Python lists, tuples and dictionaries for representing compound data.
CO4. Develop Python programs using files.

Catalog Description

Introduction to Computer and Programming in Python is intended for students with little or no programming experience. It aims to provide students with an understanding of the role computation can play in solving problems and to help students, regardless of their major, feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals. The class will use the Python 3.5 programming language.

UNIT I

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm:

Flowchart / Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

UNIT II

Introduction to Python: The basic elements of python, Branching Programs, Control Structures, Strings and Input, Iteration, String Manipulation, Guess and Check, Approximations, Bisection, Functions, Scoping and Abstraction: Functions and scoping, Specifications, Recursion, Global variables, Modules, Files

Unit III

Classes and Object: Oriented Programming: Abstract Data Types and Classes, Inheritance, Encapsulation and Information Hiding, Handling Exceptions, Decorators

Unit IV

Simple Algorithms and Data structures: File Handling, Search Algorithms, Sorting, Algorithms, Hash Tables,

TEXT BOOKS:

1. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India

Reference Books

1. R. Nageswara Rao, "Core Python Programming", Dreamtech
2. Wesley J. Chun. "Core Python Programming, Second Edition", Prentice Hall
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley
4. Kenneth A. Lambert, "Fundamentals of Python,First Programs", CENGAGE Publication

Modes of Evaluation: Quiz I/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	Develop algorithmic solutions to simple computational problems	**PO1**
CO2	Demonstrate programs using simple Python statements and expressions	**PO1**
CO3	Explain control flow and functions concept in Python for solving problems	**PO2**
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data	**PO3**
CO5	Explain files, exception, modules and packages in Python for solving problems	**PO4**

		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	Skills	Best Practices	Profession Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 150A	Introduction to Computer Science and Programming in Python Lab	3	3	2	3									2				2

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

ETCS401A	**Artifical Intelligence**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Computer Programming				
Co-requisites	--				

Course Objectives

1. To have clear understanding of the problem-solving processes.
2. To explore Search strategies ranging from blind or uninformed search to heuristic or informed search are discussed.
3. To understand real world always entails uncertainty and the concept of uncertainty is introduced.
4. To know about Probabilistic reasoning, representing knowledge under uncertainty, Bayesian Networks, Exact and approximate inference in Bayesian Networks
5. To gain idea of supervised, unsupervised and reinforcement learning is covered.
6. To introduce the students to the challenges involved in designing intelligent

Course Outcomes

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

CO1. Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.
CO2. Apply these techniques in applications which involve perception, reasoning and learning.
CO3. Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
CO4. Acquire the knowledge of real world Knowledge representation.
CO5. Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.
CO6. Use different machine learning techniques to design AI machine and enveloping applications for real world problems.
CO7.Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.

Catalog Description

The course introduces the theoretical building blocks necessary to create intelligent machines. While we may struggle to define intelligence in an absolute sense, we can agree upon multiple approaches toward creating AI; from an initial attempt at acting humanly to a broader context of acting rationally. Solving problems which are seemingly simple for humans can seem like insurmountable hurdles for machines.

Course Content

Unit I: **8 lecture hours**

Scope of AI: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques-search knowledge, abstraction. Problem Solving (Blind): State space search; production systems, search space control; depthfirst, breadth-first search. Heuristic Based Search: Heuristic search, Hill climbing, best-first search, A* Algorithm, Problem Reduction, Constraint Satisfaction

Unit II: **12 lecture hours**

Knowledge Representation: Predicate Logic: Unification, Modus Ponens, Modus Tokens, Resolution in Predicate Logic, Conflict Resolution Forward Chaining, Backward Chaining, Declarative and Procedural Representation, Rule based Systems. Structured Knowledge Representation: Semantic Nets: Slots, exceptions and default frames, conceptual dependency

Unit III: **12 lecture hours**

Handling Uncertainty: Non-Monotonic Reasoning, Probabilistic reasoning: Bayesian Inference, use of uncertainty factors. Natural Language Processing: Introduction, Syntactic Processing, Semantic Processing, Pragmatic Processing.

Unit IV: **8 lecture hours**

Learning: Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets. Expert Systems: Need and justification for expert systems, knowledge acquisition, Case Studies: MYCIN, RI.

Text Books

1. Artificial Intelligence, E. Rich and K. Knight, TMH.

Reference Books/Materials

1. Artificial Intelligence, P. H. Winston,Pearson Education.
2. Introduction to AI and Expert Systems, D. W. Patterson, PHI.
3. Principles of AI, N. J. Nilsson, Narosa Publishing House

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 various searching techniques, constraint satisfaction problem and example problems- game playing techniques.	**PO1**
CO2	Apply these techniques in applications which involve perception, reasoning and learning.	**PO4**

CO3	Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.	**PO5**
CO4	Acquire the knowledge of real world Knowledge representation.	**PO2**
CO5	Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.	**PO3**
CO6	Use different machine learning techniques to design AI machine and enveloping applications for real world problems.	**PO3**
CO7	Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.	**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	Employability	Ethics and Behaviour	Knowledge
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS401 A	ARTIFICAL INTELLIGENCE	2	3	2	3	3								3		

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

ETCS307A	Database Management Systems	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Data Base				
Co-requisites	--				

Course Objectives

1. To understand the different issues involved in the design and implementation of a database system.

2. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.

3. To understand and use data manipulation language to query, update, and manage a database.

4. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.

5. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

6. For a given query write relational algebra expressions for that query and optimize the developed expression.

Course Outcomes

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

CO1. Independently understand basic database technology.

CO2.Describe the fundamental elements of relational database management systems

CO3. Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.

CO4.Design ER-models to represent simple database application scenarios

CO5. Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.

CO6.Improve the database design by normalization.

CO7. Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

CO8. Students will be able to work in a group on the design, and implementation of a database system project.

Catalog Description

Database Management Systems (DBMS) are vital components of modern information systems. Database applications are pervasive and range in size from small in-memory databases to terra bytes or even larger in various applications domains. The course focuses on the fundamentals of knowledge base and relational database management systems, and the current developments in database theory and their practice. The course reviews topics such as conceptual data modelling, relational data model, relational query languages, relational database design and transaction processing and current technologies.

Course Content

Unit I: **12 lecture hours**

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

Unit II: **8 lecture hours**

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

Unit III: **12 lecture hours**

Storage strategies: Indices, B-trees, hashing, Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestampbased schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery

Unit IV: **8 lecture hours**

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Text Books

1."Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J.D. Ullman, Computer Science Press.

Reference Books/Materials

1. "Fundamentals of Database Systems", R. Elmasri and S. Navathe, Pearson Education

Modes of Evaluation: Quiz I/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	Independently understand basic database technology.	PO2
CO2	Describe the fundamental elements of relational database management systems	PO3
CO3	Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.	PO4

CO4	Design ER-models to represent simple database application scenarios	**PO5**
CO5	Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.	**PO4**
CO6	Improve the database design by normalization.	**PO4**
CO7	Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.	**PO9**
CO8	Students will be able to work in a group on the design, and implementation of a database system project.	**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	Skills	Best Practices	Profession Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 307A	Database Management Systems	1	2	3	3	3				3				3	2	1		2

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETMA214A	**Linear Algebra**	L	T	P	C
Version 1.0		5	1	0	6
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

6. Provide the brief idea to students of vector spaces, Basis and dimensions.
7. To understand the consequences of linear transformation and matrix representation of a linear transformation.
8. Find the Eigen values and eigen vectors of LT. Diagonalization, Cayley Hamilton theorem.
9. Find the inner product spaces and Orthonormal basis.
10. Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Course Outcomes

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

CO7. Applied the methods tosolvethe vector and matrix algebra, including linear dependence / independence, basis and dimension of a subspace, rank and nullity, for analysis of matrices and systems of linear equations.
CO8. Appreciate and identify linear transformations of finite dimensional vector spaces and compose their matrices in specific bases.
CO9. Recognize the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to diagonalise matrices when this is possible; discriminate between diagonalizable and non-diagonalizable matrices.
CO10. Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.
CO11. Determine the concepts of Halbert space and inner product space.
CO12. Apply the mathematical modelling and reasoning to solve basic problems.

Catalog Description

This course covers matrix theory and linear algebra, emphasizing topics useful in other disciplines. Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices. The concepts of linear algebra are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics.Important objectives of the linear algebra are to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **08 lecture hours**

Vector Space: Definition and examples, Subspace, Linear span, Quotient space and direct sum of subspaces, Linearly independent and dependent sets, Bases and dimension.

Linear transformations: Definition and examples, Algebra of linear transformations, Matrix of a linear transformation, Change of coordinates, Rank and nullity of a linear transformation and rank-nullity theorem.

Unit II: **12 lecture hours**

Further Properties of Linear Transformations: Isomorphism of vector spaces, Isomorphism theorems, Dual and second dual of a vectorspace, Transpose of a linear transformation, Eigen vectors and eigenvalues of a lineartransformation, Characteristic polynomial and CayleyHamilton theorem, Minimalpolynomial.

Unit III: **10 lecture hours**

Inner Product Spaces: Inner product spaces and orthogonality, Cauchy-Schwarz inequality, Gram-Schmidt orthogonalisation, Diagonalization of symmetric matrices.

Unit IV: **10 lecture hours**

Adjoint of a Linear Transformation and Canonical Forms: Adjoint of a linear operator; Hermitian, unitary and normal linear transformations; form, Triangular form, Trace and transpose, Invariant subspaces.

Text Books

1. R. Vasishtha, J.N. Sharma, A. K. Vasishtha; Linear Algebra; Krishna Prakashan, Meerut.
2. Kenneth Hoffman, Ray Alden Kunz; Linear Algebra; Prentice-Hall of India Pvt.

Reference Books/Materials

1. Joseph A. Gallian; Contemporary Abstract Algebra; Narosa Publishing House.
2. S. Lang; Introduction to Linear Algebra; Springer.
3. S. Kumaresan; Linear Algebra- A Geometric Approach; Prentice Hall of India.

.

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	Applied the methods to solve the vector and matrix algebra, including linear dependence / independence, basis and dimension of a subspace, rank and nullity, for analysis of matrices and systems of linear equations.	PO1
CO2	Appreciate and identify linear transformations of finite dimensional vector spaces and compose their matrices in specific bases.	PO8
CO3	Recognize the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to diagonalise matrices when this is possible; discriminate between diagonalizable and non-diagonalizable matrices.	PO2

CO4	Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.	**PO4**
CO5	Determine the concepts of Halbert space and inner product space.	**PO3**
CO6	Apply the mathematical modelling and reasoning to solve basic problems	**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	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETMA214A	Linear Algebra	2	3		3				2					3		

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

ETCS220A	**Analysis And Design Of 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 Analyze the asymptotic performance of algorithms.
CO 2 Write rigorous correctness proofs for algorithms.
CO 3 Demonstrate a familiarity with major algorithms and data structures.
CO 4 Apply important algorithmic design paradigms and methods of analysis.
CO 5 Synthesize efficient algorithms in common engineering design situations.

Catalog Description

This course introduces basic methods for the design and analysis of efficient algorithms emphasizing methods useful in practice. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures. The following important computational problems will be discussed: sorting, searching, elements of dynamic programming and greedy algorithms, advanced data structures, graph algorithms (shortest path, spanning trees, tree traversals), string matching, elements of computational geometry, NP completeness

Course Content

Unit I: 8 lecture hours

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade- offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Unit II: 12 lecture hours

Fundamental Algorithmic Strategies: Brute -Force, Greedy, Dynamic Programming, Branch-and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

Unit III: **12 lecture hours**

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Unit IV: **8 lecture hours**

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Text Books

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.

Reference Books/Materials

1. Schaum's outline series, "Data Structure", McGraw Hills.

2. 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	Analyze the asymptotic performance of algorithms.	PO1
CO2	Write rigorous correctness proofs for algorithms.	PO4

CO3	Demonstrate a familiarity with major algorithms and data structures.	**PO5**
CO4	Apply important algorithmic design paradigms and methods of analysis.	**PO2**
CO5	Synthesize efficient algorithms in common engineering design situations.	**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	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 220A	Analysis and design of algorithms	2	2		3	3								3		

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

ETCS 555A	**Python Programming lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

- Provide an understanding of the role computation can play in solving problems.
- Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
- Position students so that they can compete for research projects and excel in subjects with programming components.

Course Outcomes

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

CO1. Develop solutions to simple computational problems using Python programs.
CO2. Solve problems using conditionals and loops in Python. Develop Python programs by defining functions and calling them.
CO3. Use Python lists, tuples and dictionaries for representing compound data.
CO4. Develop Python programs using files.

Catalog Description

Introduction to Computer and Programming in Python is intended for students with little or no programming experience. It aims to provide students with an understanding of the role computation can play in solving problems and to help students, regardless of their major, feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals. The class will use the Python 3.5 programming language.

Course Content

LIST OF EXPERIMENTS

1	Develop programs to understand the control structures of python	**2 lab hours**
2	Develop programs to implement list	**2 lab hours**
3	Develop programs to implement Dictionary	**2 lab hours**
4	Develop programs to implement tuples	**2 lab hours**
5	Develop programs to implement function with stress on scoping	**2 lab hours**
6	Develop programs to implement classes and objects	**2 lab hours**
7	Develop programs to implement exception handling	**2 lab hours**

8	Develop programs to implement linear search and binary search	**2 lab hours**
9	Develop programs to implement insertion sort	**2 lab hours**
10	Develop programs to implement bubble sort	**2 lab hours**
11	Develop programs to implement quick sort	**2 lab hours**

TEXT BOOKS:

2. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India

Reference Books

5. R. Nageswara Rao, "Core Python Programming", Dreamtech
6. Wesley J. Chun. "Core Python Programming, Second Edition", Prentice Hall
7. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley
8. Kenneth A. Lambert, "Fundamentals of Python,First Programs", CENGAGE Publication

Modes of Evaluation: Quiz I/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	Develop algorithmic solutions to simple computational problems	**PO1**
CO2	Demonstrate programs using simple Python statements and expressions	**PO1**
CO3	Explain control flow and functions concept in Python for solving problems	**PO2**
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data	**PO3**
CO5	Explain files, exception, modules and packages in Python for solving problems	**PO4**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 150A	Introduction to Computer Science and Programming in Python Lab	3	3	2	3									2				2

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

ETCS451A	**Artificial Intelligence Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Prolog/ Python				
Co-requisites	--				

Course Objectives

1. To have clear understanding of the problem-solving processes.
2. To explore Search strategies ranging from blind or uninformed search to heuristic or informed search are discussed.
3. To understand real world always entails uncertainty and the concept of uncertainty is introduced.
4. To know about Probabilistic reasoning, representing knowledge under uncertainty, Bayesian Networks, Exact and approximate inference in Bayesian Networks
5. To gain idea of supervised, unsupervised and reinforcement learning is covered.
6. To introduce the students to the challenges involved in designing intelligent

Course Outcomes

On completion of this course, the students will be able to
CO1. Demonstrate working knowledge in Prolog in order to write simple Prolog programs
CO2. Understand different types of AI agents know various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms)
CO3. Understand the fundamentals of knowledge representation (logic-based, frame-based, semantic nets), inference and theorem proving
CO4. Know how to build simple knowledge-based systems
CO5.Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information

Catalog Description

While AI applications can be developed in any number of different languages, certain language features make programming AI applications straightforward. Prolog is structured in such a way that AI program development is supported by Prolog language features. Other languages, such as Java, support AI programming through code libraries. This course will provide students with an introduction to AI via programming features that support basic AI applications. The main of this course is make students familiar with AI programming and be able to use it in future models to implement various AI applications.

List of Experiments (Indicative)

1	Write a program to solve 8-queens problem in Prolog.	**2 lab hours**
2	Solve any problem using depth first search in Prolog.	**2 lab hours**
3	Solve any problem using best first search in Prolog.	**2 lab hours**
4	Solve 8-puzzle problem using best first search in Prolog.	**2 lab hours**
5	Solve Robot (traversal) problem using means End Analysis.	**2 lab hours**
6	Solve traveling salesman problem in Prolog.	**2 lab hours**
7	Write a Program to Implement Tic-Tac-Toe game in	**2 lab hours**

	Prolog/python.	
8	Write a Program to Implement Water-Jug problem.	**3 lab hours**
9	Write a Program to Implement Monkey Banana Problem using Python.	**2 lab hours**
10	Write a Program to Implement N-Queens Problem.	**4 lab hours**
11	Write a Program to Implement Missionaries-Cannibals Problems.	**4 lab hours**
14	Make a minor project using AI.	**3 lab hours**
15	Study about various applications of AI.	**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	Demonstrate working knowledge in Prolog in order to write simple Prolog programs	**PO1**
CO2	Understand different types of AI agents know various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms)	**PO4**
CO3	Understand the fundamentals of knowledge representation (logic-based, frame-based, semantic nets), inference and theorem proving	**PO5**
CO4	Know how to build simple knowledge-based systems	**PO2**
CO5	Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information.	**PSO3**

		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	Employability	Ethics and Behaviour	Knowledge
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS451A	ARTIFICIAL INTELLIGENCE LAB	2	3		3	3										3

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

ETCS220A	Analysis And Design Of 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 Analyze the asymptotic performance of algorithms.
CO 2 Write rigorous correctness proofs for algorithms.
CO 3 Demonstrate a familiarity with major algorithms and data structures.
CO 4 Apply important algorithmic design paradigms and methods of analysis.
CO 5 Synthesize efficient algorithms in common engineering design situations.

Catalog Description

This course introduces basic methods for the design and analysis of efficient algorithms emphasizing methods useful in practice. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures. The following important computational problems will be discussed: sorting, searching, elements of dynamic programming and greedy algorithms, advanced data structures, graph algorithms (shortest path, spanning trees, tree traversals), string matching, elements of computational geometry, NP completeness

Course Content

Unit I: 8 lecture hours

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade- offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Unit II: **12 lecture hours**

Fundamental Algorithmic Strategies: Brute -Force, Greedy, Dynamic Programming, Branch-and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

Unit III: **12 lecture hours**

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Unit IV: **8 lecture hours**

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Text Books

3. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
4. Fundamentals of Algorithms – E. Horowitz et al.

Reference Books/Materials

1. Schaum's outline series, "Data Structure", McGraw Hills.

2. 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	Analyze the asymptotic performance of algorithms.	**PO1**
CO2	Write rigorous correctness proofs for algorithms.	**PO4**
CO3	Demonstrate a familiarity with major algorithms and data structures.	**PO5**
CO4	Apply important algorithmic design paradigms and methods of analysis.	**PO2**
CO5	Synthesize efficient algorithms in common engineering design situations.	**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	Innovation and Industry Friendly	Ethics and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 220A	Analysis and design of algorithms	2	2		3	3								3		

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

ETCS262A	Analysisand Designof Algorithms Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning				
Co-requisites	--				

Course Objectives

1. To understand concept of different sorting algorithms.
2. To understand the concept of dynamic programming.
3. To understand concept of divide and conquer.
4. To understand Dictionary (ADT)
5. To understand concept of greedy algorithms.
6. To understand concept & features like max heap, min heap

Course Outcomes

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

CO 1 Student will be able to implement optimal solution for various dynamic problems.

CO 2 To understand various sorting techniques.

CO 3 Analyze working of various operations on graphs.

CO 4 To understand concept of string matching in data structure

Course Content

List of Experiments

1	To analyze time complexity of insertion sort	**2 lab hours**
2	To analyze time complexity of Quick sort	**2 lab hours**
3	To analyze time complexity of merge sort	**2 lab hours**
4	Implement Largest Common Subsequence.	**2 lab hours**
5	To Implement Optimal Binary Search Tree.	**2 lab hours**
6	To Implement Matrix Chain Multiplication.	**2 lab hours**

7	To Implement Strassen's matrix multiplication Algorithm.	**2 lab hours**
8	To implement Knapsack Problem.	**2 lab hours**
9	To implement Activity Selection Problem.	**2 lab hours**
10	To implement Dijkstra's Algorithm.	**2 lab hours**
11	To implement Warshall's Algorithm.	**2 Labs**
12	To implement Bellman Ford's Algorithm.	**2 Labs**
13	To implement Depth First Search Algorithm.	**1 Lab**
14	To implement Breadth First Search Algorithm.	**1 Lab**
15	To implement NaïveString MatchingAlgorithm.	**1 Lab**
16	To implement Rabin Karp String MatchingAlgorithm	**1 Lab**

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	Student able to implement program for graph representation.	**PO2**
CO2	To understand operations like insert and search record in the database.	**PO3**
CO3	Analyze working of various operations on AVL Tree.	**PO5**
CO 4	To understand concept of file organization in data structure	**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	Employability	Ethics and Behaviour	Knowledge
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS262 A	Analysis and design of algorithms Lab		2	3		3				3				3		

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

ETCS355A	Database Managemet Systems Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To explain basic database concepts, applications, data models, schemas and instances.
2. To demonstrate the use of constraints and relational algebra operations.
3. To facilitate students in Database design.
4. To familiarize issues of concurrency control and transaction management.

Course Outcomes

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

CO1. Apply the basic concepts of Database Systems and Applications.

CO2. Use the basics of SQL and construct queries using SQL in database creation and interaction.

CO3. Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.

CO4. Analyze and Select storage and recovery techniques of database system.

Catalog Description

This course introduces the core principles and techniques required in the design and implementation of database systems. This introductory application-oriented course covers the relational database systems RDBMS - the predominant system for business scientific and engineering applications at present. It includes Entity-Relational model, Normalization, Relational model, Relational algebra, and data access queries as well as an introduction to SQL. It also covers essential DBMS concepts such as: Transaction Processing, Concurrency Control and Recovery. It also provides students with theoretical knowledge and practical skills in the use of databases and database management systems in information technology applications.

List of Experiments (Indicative)

S.No	Experiment	No of Hours
1	Design a Database and create required tables. For e.g. Bank, College Database	4
2	Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.	2
3	Write a SQL statement for implementing ALTER, UPDATE and DELETE.	2

4	Write the queries to implement the joins.	4
5	Write the queries for implementing the following functions: MAX (), MIN (), AVG (), COUNT ().	2
6	Write the queries to implement the concept of Integrity constrains	4
7	Write the queries to create the views.	2
8	Perform the queries for triggers.	4
9	Perform the following operation for demonstrating the insertion, updating and deletion using the referential integrity constraints.	2
10	Do some more practice based on your class work.	2

Text Books

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

Reference Books/Materials

1. "Principles of Database and Knowledge – Base Systems", Vol 1 by J.D. Ullman, Computer Science Press.
2. "Fundamentals of Database Systems", R. Elmasri and S. Navathe, Pearson 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	Apply the basic concepts of Database Systems and Applications	**PO5**
CO2	Use the basics of SQL and construct queries using SQL in database creation and interaction	**PO3**

CO3	Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system	**PO3**
CO4	Analyze and Select storage and recovery techniques of database system.	**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	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 355A	Database Management Systems Lab		3	3		2								3		

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

ETCS262A	**Analysisand Designof Algorithms Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning				
Co-requisites	--				

Course Objectives

7. To understand concept of different sorting algorithms.
8. To understand the concept of dynamic programming.

9. To understand concept of divide and conquer.
10. To understand Dictionary (ADT)
11. To understand concept of greedy algorithms.
12. To understand concept & features like max heap, min heap

Course Outcomes

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

CO 1 Student will be able to implement optimal solution for various dynamic problems.

CO 2 To understand various sorting techniques.

CO 3 Analyze working of various operations on graphs.

CO 4 To understand concept of string matching in data structure

List of Experiments (Indicative)

1	To analyze time complexity of insertion sort	**2 lab hours**
2	To analyze time complexity of Quick sort	**2 lab hours**
3	To analyze time complexity of merge sort	**2 lab hours**
4	Implement Largest Common Subsequence.	**2 lab hours**
5	To Implement Optimal Binary Search Tree.	**2 lab hours**
6	To Implement Matrix Chain Multiplication.	**2 lab hours**
7	To Implement Strassen's matrix multiplication Algorithm.	**2 lab hours**
8	To implement Knapsack Problem.	**2 lab hours**
9	To implement Activity Selection Problem.	**2 lab hours**
10	To implement Dijkstra's Algorithm.	**2 lab hours**
11	To implement Warshall's Algorithm.	**2 Labs**

12	To implement Bellman Ford's Algorithm.	**2 Labs**
13	To implement Depth First Search Algorithm.	**1 Lab**
14	To implement Breadth First Search Algorithm.	**1 Lab**
15	To implement Naive String Matching Algorithm.	**1 Lab**
16	To implement Rabin Karp String Matching Algorithm	**1 Lab**

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	Student able to implement program for graph representation.	**PO2**
CO2	To understand operations like insert and search record in the database.	**PO3**
CO3	Analyze working of various operations on AVL Tree.	**PO5**
CO 4	To understand concept of file organization in data structure	**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	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS262A	Analysis and design of algorithms Lab		2	3		3				3				3		

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

ETCS 202A	**Software Engineering**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	None				
Co-requisites	--				

Course Objectives

1. The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.
2. Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams

Course Outcomes

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

CO1. To learn and understand the Concepts of Software Engineering
CO2. To Learn and understand Software Development Life Cycle
CO3. To apply the project management and analysis principles to software project development.
CO4. To apply the design & testing principles to software project development.
CO5. Ability to execute tests, design test cases, use test tools, etc.
CO6. To Study about Software maintenance tools

Catalog Description

This course covers the fundamentals of software engineering, including understanding system requirements, finding appropriate engineering compromises, effective methods of design, coding, and testing, team software development, and the application of engineering tools.

Course Content

Unit I: 10 lecture hours

Introduction: Software Crisis, Software Processes & Characteristics, Software life cycle models, Waterfall, Prototype, Evolutionary and Spiral Models

Software Requirements analysis & specifications: Requirement engineering, requirement elicitation techniques, requirements analysis using DFD, Data dictionaries & ER Diagrams, Requirement documentation, Nature of SRS, Characteristics & organization of SRS.

Unit II: 12 lecture hours

Software Metrics: Software measurements: What & Why, Token Count, Size Estimation like lines of Code & Function Count, Halstead Software Science Measures, Design Metrics, Data Structure Metrics, Information Flow Metrics, Cost Estimation Models: COCOMO,COCOMO-II.

System Design: Design Concepts, design models for architecture, component, data and user interfaces; Problem Partitioning, Abstraction, Cohesiveness, Coupling, Top Down and Bottom-Up design approaches; Functional Versus Object Oriented Approach, Design Specification.

Coding: TOP-DOWN and BOTTOM-UP structure programming, Information Hiding, Programming Style, and Internal Documentation, Verification.

Unit III: **11 lecture hours**

Unified Approach and Unified Modeling Language: The Unified Approach: Layered Approach to OO Software Development, UML: UML Diagrams for Structure Modeling, UML Diagrams for Behavior Modeling, UML Diagram for Implementation and deployment modeling.

Software Reliability: Importance, Hardware Reliability & Software Reliability, Failure and Faults, Reliability Models, Basic Model, Logarithmic Poisson Model, Software Quality Models, CMM & ISO 9001.

Unit IV: **12 lecture hours**

Software Testing: Testing process, Design of test cases, functional testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing, Path Testing, Data flow and mutation testing, Unit Testing, Integration and System Testing, Debugging, Alpha & Beta Testing, Testing Tools & Standards.

Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Regression Testing, Reverse Engineering, Software Re-engineering, Configuration Management, Documentation.

Text Books

1. K. K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International.
2. R. S. Pressman, "Software Engineering – A practitioner's approach", McGraw Hill Int. Ed.
3. W.S. Jawadekar, "Software Engineering – Principles and Practices", McGraw Hill

Reference Books/Materials

1. Stephen R. Schach, "Classical & Object Oriented Software Engineering", IRWIN, TMH.
2. James Peter, W. Pedrycz, "Software Engineering: An Engineering Approach", John Wiley & Sons.
3. I. Sommerville, "Software Engineering", Addison Wesley.
4. K. Chandrasehakhar, "Software Engineering & Quality Assurance", BPB.

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 learn and understand the Concepts of Software Engineering	**PO1**
CO2	To Learn and understand Software Development Life Cycle	**PO1**
CO3	To apply the project management and analysis principles to software project development.	**PO3, PO11**
CO4	To apply the design & testing principles to software project development.	**PO3**
CO5	Ability to execute tests, design test cases, use test tools, etc.	**PO4**
CO6	To Study about Software maintenance tools	**PO2, PO5**

		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	Employability	Ethics and Behavior	Knowledge

							y									
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 202A	Software Engineering	3	3	3	3	3						2		3	2	3

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

ETCS 252A	**Software Engineering Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	None				
Co-requisites	--				

Course Objectives

1. The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.
2. Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams

Course Outcomes

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

CO1. To learn and understand the Concepts of Software Engineering
CO2. To Learn and understand Software Development Life Cycle
CO3. To apply the project management and analysis principles to software project development.
CO4. To apply the design & testing principles to software project development.
CO5. Ability to execute tests, design test cases, use test tools, etc.
CO6. To Study about Software maintenance tools

Catalog Description

Based on theory subject **ETCS 202A**, the following experiments are to be performed. It enables students to understand the Software Engineering concept and use them practically to develop quality software.

List of Experiments (Indicative)

1	To identify the role of the software in today's world across a few significant domains related to day-to-day life Create SRS document of admission management for your university	**2 lab hours**
2	To identify the problem related to software crisis for a given scenario	**2 lab hours**
3	To identify the suitable software development model for the given scenario.	**2 lab hours**
4	To identify the various requirement development activities viz. elicitation, analysis, specification and verification for the given scenario	**4 lab hours**
5	To identify the various elicitation techniques and their usage for the Banking case study.	**4 lab hours**
6	Identify the elements in Software Requirements Specification for a given document.	**2 lab hours**
7	Draw E-R Diagram for Hockey League.	**2 lab hours**
8	Draw a context diagram and a level-1 diagram that represent the selling system at the store**.**	**2 lab hours**
9	Find out all software metrics for a Quadratic Equation program written in 'C'.	**2 lab hours**
10	Identify the design principle that is being violated in relation to the given scenario.	**2 lab hours**
11	To identify the usage of stubs or drivers in the context of an integration testing scenario.	**2 lab hours**
12	Identify the different types of performance testing.	**2 lab hours**
13	Identify the usage of regression testing.	**2 lab hours**

14	Write various white box test cases to test the internal behaviour of above program.	**2 lab hours**
15	Write various Black box test cases to test the functionalities of above program.	**2 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	To learn and understand the Concepts of Software Engineering	**PO1**
CO2	To Learn and understand Software Development Life Cycle	**PO1**
CO3	To apply the project management and analysis principles to software project development.	**PO3, PO11**
CO4	To apply the design & testing principles to software project development.	**PO3**
CO5	Ability to execute tests, design test cases, use test tools, etc.	**PO4**
CO6	To Study about Software maintenance tools	**PO2, PO5**

		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	Employability	Ethics and Behavior	Knowledge
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 252A	Software Engineering Lab	3	3	3	3	3						2		3	2	3

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

Semester V

ETCS502A	**Statistical Data Analysis**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of statistics				
Co-requisites	--				

Course Objectives

1. To develop the students ability to deal with numerical and quantitative issues indata analysis.

2. To enable the use of statistical, graphical and algebraic techniques wherever relevant.
3. To have a proper understanding of Statistical/Machine learning applications in various filed such as economics, healthcare etc.
4. To learn strategies in data wrangling and feature engineering to improve predictive models.

Course Outcomes

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

CO1.Demonstrate their understanding of descriptive statistics by practicalapplication of quantitative reasoning and data visualization.
CO2. Demonstrate their knowledge of the basics of inferential statistics by making valid generalizations from sample data.
CO3. Recognize pitfalls in using statistical methodology.
CO4.Greater appreciation for the importance of statistical literacy in today's data rich world.

Catalog Description

Statistics is the science that turns data into information and information into knowledge. This class covers applied statistical methodology from an analysis-of-data viewpoint. Topics covered include frequency distributions; measures of location; mean, median, mode; measures of dispersion; variance; graphic presentation; elementary probability; populations and samples; sampling distributions; one sample univariate inference problems, and two sample problems; categorical data; regression and correlation; and analysis of variance. Use of computers in data analysis is also explored.
This is an introductory course in statistics designed to provide students with the basic concepts of data analysis and statistical computing. Topics covered include basic descriptive measures, measures of association, probability theory, confidence intervals, and hypothesis testing. The main objective is to provide students with pragmatic tools for assessing statistical claims and conducting their own statistical analyses.

Course Content

Unit I: **12 lecture hours**

Introduction to the course: Descriptive Statistics, Probability Distributions, Inferential Statistics, Inferential Statistics through hypothesis tests, Permutation & Randomization Test, Regression, ANOVA (Analysis of Variance).

Unit II: **12 lecture hours**

Machine Learning: Introduction and Concepts, Differentiating algorithmic and model based frameworks, Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K-Nearest Neighbor's Regression & Classification.

Unit III: **12 lecture hours**

Supervised Learning with Regression and Classification techniques Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines**.**

Unit IV: **10 lecture hours**

Unsupervised Learning and Challenges for Big Data Analytics: Clustering, Associative Rule Mining, Challenges for big data analytics. Prescriptive analytics: Creating data for analytics through designed experiments, Creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning**.**

Text Books

1. Glen Cowan, "Statistical Data Analysis", Clarendon Press.
2. Kamber and Han, "Data Mining Concepts and Techniques", Hartcourt India P. Ltd.

Reference Books/Materials

1. Lyman Ott, "An introduction to statistical data methods and data analysis", BrooksCole.

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	Demonstrate their understanding of descriptive statistics by practicalapplication of quantitative reasoning and data visualization.	**PO1**
CO2	Demonstrate their knowledge of the basics of inferential statistics by making valid generalizations from sample data.	**PO3**
CO3	Recognize pitfalls in using statistical methodology	**PO2**

CO4	Greater appreciation for the importance of statistical literacy in today's data rich world.	**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	Ethics	Analysis
Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS502 A	Statistical Data Analysis	3	3	2			3							3		3

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

ETCS503A	**Data Mining and Predictive Modeling**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of statistics				
Co-requisites	--				

Course Objectives

1. To identify the scope and essentiality of Data Warehousing and Mining.
2. To analyse data, choose relevant models and algorithms for respective applications.
3. To develop research interest towards advances in data mining.
4. To learn strategies in data wrangling and feature engineering to improve predictive models.
5. To use resampling methods to assess the performance of predictive models.

Course Outcomes

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

CO1. Identify appropriate data mining algorithms to solve real world problems.
CO2. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
CO3. Describe complex data types with respect to spatial and web mining.
CO4.Benefit the user experiences towards research and innovation, integration.

Catalog Description

Data Mining and Predictive Analytics is a graduate-level course designed to introduce students to various data mining concepts and algorithms. It emphasizes on classifiers, clustering, and association analysis applicable to the distinct nature of healthcare data. The terms data mining and predictive analytics refer to the computational process of discovering patters in large datasets using interdisciplinary methods such as artificial intelligence, machine learning, and statistics. Ultimate goal of data mining is to extract previously unknown information from data residing in a preferably electronic dataset.

Course Content

Unit I: 12 lecture hours

Data Mining: Motivation, Importance, Knowledge Discovery Process (KDD), KDD and Data Mining, Data Mining vs. Query Tools, Kind of Data, Data preprocessing, Functionalities, Interesting Patterns, Classification of data mining systems, Major issues.

Unit II: 12 lecture hours

Classification and Prediction: Classification & Prediction, Issues Regarding Classification & Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back Propagation, Classification Parameters.

Unit III: 12 lecture hours

Cluster Analysis: Types of Data in Cluster Analysis, Partitioning Method, Hierarchical Method,

density Based Method, Grid Based Method, Model Based Clustering Method and Outlier Analysis.

Mining Association Rules: Association Rule Mining, Market Basket Analysis, Types of Association Rules, Methods for Mining Association.

Unit IV: 10 lecture hours

Predictive modeling and Analysis - Regression Analysis, Multicollinearity, Correlation analysis, Rank correlation coefficient, Multiple correlation, Least square, Curve fitting and good ness of fit.

Text Books

1. Kamber and Han, "Data Mining Concepts and Techniques", Hartcourt India P. Ltd.

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	Identify appropriate data mining algorithms to solve real world problems.	PO1
CO2	Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.	PO3
CO3	Describe complex data types with respect to spatial and web mining.	PO2
CO4	Benefit the user experiences towards research and innovation, integration	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	Ethics	Analysis
Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS503 A	Data Mining and Predictive Modeling	3	3	2			3							3		3

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

ETCS552A	**Statistical Data Analysis Lab**	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	Basics of Python/R programming				
Co-requisites	--				

Course Objectives

In this course, students are introduced to statistical data analysis methods, approaches and tools. Students develop skills in statistical analytics skills that will allow them to:

1. Enhance thier ability to extract more meaningful data from your experimental data sets.
2. Gain confidence in the use of basic statistical methods.
3. Learn how to best utilize R/Python functions to analyze experimental data.
4. Understand the language of data statistics.

Course Outcomes

On completion of this course, the students will have the

CO1. Ability to identify the characteristics of datasets and apply various statistical methods.
C02. Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
CO3. Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
CO4.Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies.

Catalog Description

This is an introductory course in statistics designed to provide students with the basic concepts of data analysis and statistical computing. Topics covered include basic descriptive measures, measures of association, probability theory, confidence intervals, and hypothesis testing. The main objective is to provide students with pragmatic tools for assessing statistical claims and conducting their own statistical analyses.

Course Content

List of Experiments

1. Setting Up of Modeling Frameworks (Weka, Orange and R), I/O Formats, Basic Introduction to Interfaces.

2. Linear models in R, Writing Basic Interface for a Learner.

3. Models Using Weka or Orange on UCI Benchmark Data Sets. Writing Interfaces for a Classifier as Derived from a Learner.

4. K-Means Clustering, Writing Interface for a Cluster.

5. Coding any of the learning algorithms and testing them on suitable UCI Data Sets. Suggestions for algorithms: Decision trees, Naïve Bayesian, q-learning etc.

Text Books

1. Glen Cowan, “Statistical Data Analysis”, Clarendon Press.
2. Kamber and Han, “Data Mining Concepts and Techniques”, Hartcourt India P. Ltd.

Reference Books/Materials

1. Lyman Ott, “An introduction to statistical data methods and data analysis”, BrooksCole.

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	Ability to identify the characteristics of datasets and apply various statistical methods.	PO1
CO2	Ability to select and implement machine learning techniques and computing environmentthat are suitable for the applications under consideration	PO2
CO3	Ability to solve problems associated with batch learning and online learning, and thebig data characteristics such as high dimensionality, dynamically growing data andin particular scalability issues.	PO5
CO4	Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies.	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	Ethics	Analysis
Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS552A	Statistical Data Analysis Lab	3	3	3		2								3		3

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

ETCS553A	**Data Mining and Predictive Modeling Lab**	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	Basics of Python/R programming				
Co-requisites	--				

Course Objectives

In this course, students are introduced to predictive modelling methods, approaches and tools. Students develop skills in predictive analytics that will allow them to:

1. Develop and use advanced predictive analytics methods.
2. Develop expertise in the use of popular tools and software for predictive analytics.
3. Learn how to develop predictive analytics questions, identify and select the most appropriate predictive analytics methods and tools.
4. Apply the methods of predictive analytics to answer the respective questions and presenting data-driven solutions.

Course Outcomes

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

CO1. Understand the data mining process and important issues around data cleaning, pre-processing and integration.

C02. Understand the principle algorithms and techniques used in data mining, such as clustering, association mining, classification and prediction.

CO3. Apply specific statistical and regression analysis methods applicable to predictive analytics to identify new trends and patterns, uncover relationships, create forecasts, predict likelihoods, and test predictive hypotheses.

CO4.Develop and use various quantitative and classification predictive models based on various regression and decision tree methods.

Catalog Description

Analytics is the process of transforming data into insight for making better decisions (INFORMS). There are three primary types of analytics: "Descriptive," which examines historical data and identifies and reports historical patterns and trends; "Predictive," which predicts outcomes and future trends from existing data to help discover new relationships; "Prescriptive," which formulates and evaluates new ways for a business to operate. This course focuses on the second type, Predictive Analytics, which is of particular importance for business because it helps decision makers evaluate possible outcomes (e.g., revenues, profits, market share, probability of making a sale, probability of losing a client, etc.) based on other historical data predictors (e.g., marketing expenditures, quality assurance investments, sales force size, etc.). The process of analytics involves specifying a question, problem, or decision, and finding the right answers using data. The process begins with identifying the appropriate data sources (internal or external, data format), and the appropriate models, tools, and methods for analysis.

Course Content

List of Experiments

1	Demonstration of data preprocessing on datasets.	2 lab hours

2	To list all the categorical (or nominal) attributes and the real valued attributes mining tool.	2 lab hours
3	Create a data classification model using decision tree.	2 lab hours
4	Create a data classification model using Naive Bayes.	2 lab hours
5	Create a data classification model using rule based classifies.	2 lab hours
6	Create a data classification model using statistical classifiers.	2 lab hours
7	Create a data classification model using neural networks.	2 lab hours
8	Create a data classification model.	2 lab hours
9	Demonstrate the working of k-means algorithm for clustering the data.	2 lab hours
10	Create a clustering model using hierarchical clustering algorithm	2 lab hours

Text Books

1. Kamber and Han, "Data Mining Concepts and Techniques", Hartcourt India P. Ltd.

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	Understand the data mining process and important issues around data cleaning, pre-processing and integration.	**PO1**
CO2	Understand the principle algorithms and techniques used in data mining, such as clustering, association mining, classification and prediction.	**PO2**
CO3	Apply specific statistical and regression analysis methods applicable to predictive analytics to identify new trends and patterns, uncover relationships, create forecasts, predict likelihoods, and test predictive hypotheses.	**PO5**
CO4	Develop and use various quantitative and classification predictive models based on various regression and decision tree methods	**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	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

ETCS553 A	Data Mining and Predictive Modeling Lab	3	3	3		2								3		3

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

ETCS 301A	**Programming in MATLAB**	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	-				
Co-requisites	-				

Course Objectives

1. MATLAB is considered as one of the most important tools and modern computer language.
2. This course enables the students to learn many of MATLAB commands.
3. Also, how to use them in programming to solve many problems in different mathematical subjects specially in numerical analysis and other subjects which connected to computer-oriented mathematics.

Course Outcomes

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

CO1. Learn a great numbers of MATLAB commands and how to use them in programming and in many applications in Mathematics.

CO2.Write a MATLAB scripts and create a useful function to be used later in another mathematical subjects.

CO3.Expect the result and the outcome of any command or script.

Catalog Description

Exposing students to many techniques and capabilities in MATLAB will enhance ability to use computing tools and languages to solve engineering problems in academic and professional career.

Course Content

Unit I: **10 lecture hours**

Introduction to MATLAB: Brief Introduction, Installation of MATLAB, History, Use of MATLAB, Key features, MATLAB Window, Command Window, Workspace, Command history, Setting directory, Working with the MATLAB user interface, Basic commands, Assigning variables, Operations with variables, Data files and Data types: Character and string, Arrays and vectors, Column vectors, Row vectors, Arithmetic operations, Operators and special characters, Mathematical and logical operators, Solving arithmetic equations.

Unit II: **8 lecture hours**

Operations: Crating rows and columns Matrix, Matrix operations: Finding transpose, determinant and inverse, Solving matrix, Trigonometric functions, Complex numbers, fractions, Real numbers, Complex numbers, Working with script tools, Writing Script file, Executing script files, The MATLAB Editor, Saving m files

Plots: Plotting vector and matrix data, Plot labelling, curve labelling and editing, Basic Plotting Functions, Creating a Plot Plotting Multiple Data Sets in One Graph, Specifying Line Styles and Colors, Graphing Imaginary and Complex Data Figure, Windows Displaying, Multiple Plots in One Figure, Controlling the Axes, Creating Mesh and Surface About Mesh and Surface Visualizing Subplots

Unit III: **8 lecture hours**

MATLAB Simulink: Introduction of Simulink, Simulink Environment & Interface, Study of Library, Circuit Oriented Design, Equation Oriented Design, Model Subsystem Design, Connect Call back to subsystem, Application. Automating commands with scripts, writing programs with logic and flow control, Control statement, Programming Conditional Statement, Writing functions, Programming, Examples

Unit IV: **6 lecture hours**

Symbolic Math in MATLAB: Calculus: Numerical Integration, Linear Algebra, Roots of Polynomials, Algebraic equations, Differential Equations (1st& 2nd order), Transforms (Fourier, Laplace, etc), Ordinary Differential equations, Examples of few ODEs.

Modes of Evaluation: Quiz I/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	Learn a great numbers of MATLAB commands and how to use them in programming and in many applications in Mathematics.	**PO2**
CO2	Write a MATLAB scripts and create a useful function to be used later in another mathematical subjects.	**PO5**
CO3	Expect the result and the outcome of any command or script.	**PO5**

		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	Skills	Best Practices	Profession Responsibilities	Ethics	Analysis
Course	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

Code																		
ETCS 301A	Programming in MATLAB		3			3								3				

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

ETCS350A	**Programming in MATLAB Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	-				
Co-requisites	--				

Course Objectives

1. MATLAB is considered as one of the most important tools and modern computer language.
2. This course enables the students to learn many of MATLAB commands.
3. Also, how to use them in programming to solve many problems in different mathematical subjects specially in numerical analysis and other subjects which connected to computer-oriented mathematics.

Course Outcomes

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

CO1. Learn a great numbers of MATLAB commands and how to use them in programming and in many applications in Mathematics.

CO2.Write a MATLAB scripts and create a useful function to be used later in another mathematical subjects.

CO3.Expect the result and the outcome of any command or script.

Catalog Description

Exposing students to many techniques and capabilities in MATLAB will enhance ability to use computing tools and languages to solve engineering problems in academic and professional career.

List of Experiments (Indicative)

1	To Know the history, features and local environment of MATLAB	2 lab hours
2	Calculate the area enclosed between the x-axis, and the curve y=x3-2x+5 and the ordinates x = 1 and x = 2.	2 lab hours
3	Find the addition, subtraction and multiplication of 3 * 3 matrix.	2 lab hours
4	Find the transpose of given matrix	2 lab hours
5	Find the inverse of given matrix	2 lab hours
6	Find the rank of matrix	2 lab hours
7	Find the eigen value and eigen vector of matrix	2 lab hours
8	Solve $(D^2 + 5D + 6)y = e^x$	2 lab hours
9	Solve $\int_0^5 \int_0^{x^2} x(x^2 + y^2)dxdy$	2 lab hours
10	Plot the surface for 2 + cos t	2 lab hours

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Learn a great numbers of MATLAB commands and how to use them in programming and in many applications in Mathematics.	**PO2**

CO2	Write a MATLAB scripts and create a useful function to be used later in another mathematical subjects.																**PO5**	
CO3	Expect the result and the outcome of any command or script.																**PO5**	
		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
ETCS 350A	Programming in MATLAB Lab		3			3								3				

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

ETCS409A	**Advanced Computer Networks**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Computer Networks				
Co-requisites	--				

Course Objectives

1. To understand the state of the art in network protocols, network architecture, and networked systems.
2. To develop a strong understanding of the core concepts of computer networks
3. To gain practice of reading the research papers and critically understanding the research of others
4. Describe how computer networks are organized with the concept of layered approach with general principles of data communication
5. Describe how signals are used to transfer data between nodes and implement a simple LAN with hubs, bridges and switches.
6. To understand how packets in the Internet are delivered.

Course Outcomes

On completion of this course, the students will be able to
CO1. Independently understand basic computer network technology.
CO2. Understand and explain Data Communications System and its components.
CO3. Identify the different types of network topologies and protocols.
CO4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
CO5. Identify the different types of network devices and their functions within a network
CO6. Understand and building the skills of subnetting and routing mechanisms.
CO7. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.
CO8. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.

Catalog Description

This is a graduate level course on computer networking and assumes a student has a basic understanding of computer networks concepts. This course is a topics based course which primarily covers topics from Internet Architecture, Internet Congestion Control, Software Defined Networking, Delay Tolerant Networks, Wireless Networking, Quality of Service& Traffic Engineering, Network Performance & Management, Overlay Networks and Network Applications . In addition, this course will cover recent proposals to improve network performance, functionality and scalability to meet emergent applications Requirement.

Course Content

Unit I: 12 lecture hours

Internet Design & Architecture: Overview of network building blocks, Network architecture and design principles, layers and protocols: Internet Layering, Functionality Implementation (like Recovery from crashes, security, reliability etc.) at lower layers vs. Higher layers, Internet design: Challenges and Solutions, Case Study of Future Internet Design Project: Named Data Networking(NDN) Traffic Management: Congestion control principles, TCP congestion control, Load Balancing using Multipath TCP, IProuting: Intra-domain (OSPF/RIP) and Inter-domain (BGP), Adaptive Routing, Multipath and QoS Routing, Traffic Engineering Principles; Route Optimization, TE Issues and Challenges: Robustness, TE Interactions, Interoperability, MPLS Routing, Intradomain Routing: Protocols Characteristics and Limitations; Achieving QoS/Traffic Engineering with IP Routing Protocols.

Unit II: 8 lecture hours

Software Defined Networks (SDNs): Software Defined Networking (SDN): Centralized and Distributed Control and Data Planes, SDN Architecture, SDN Controllers, OpenFlow: Protocol to Program the Networks, Network Programmability, Network Function Virtualization, SDN Frameworks, Use cases for traffic monitoring& classification, bandwidth scheduling and monitoring. Delay Tolerant Networks (DTNs): Delay Tolerant Network Architecture, DTN Routing Protocols: Taxonomy and Design,

Replication Based Routing Protocols, Open Issues and Challenges, DTN Application(s): Message Dissemination in Vehicular Networks, Adhoc Network for Disaster Rescue Management, Multimedia Content Delivery Network

Unit III: 12 lecture hours

Overlay Networks Applications: Overlay Networks: Advantages and Challenges, Resilient Overlay Networks(RON), Lookup Problem inP2P Networks, ScalableP2P Lookup Service for Internet Applications, Chord Protocol, DNS and Naming System, DNS and CDN,HTTP and CDN Case Study: Akamai CDN, An overlay approach to decouple sender and receiver to generalize the Multicast, Anycast and Mobility, Mobile P2P Overlay Networks for DTNs: Challenges, Prophet Based Information Retrieval, Ad-hoc Storage Overlay System

Unit IV: 8 lecture hours

Wireless Networks: Wireless Networking: An Overview, TCP Performance Issues in Wireless Links: Problems and Solutions, Network Centered IP Mobility Solutions, Overview of Wireless Sensor Networks.

Text Books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Reference Books/Materials

1. "Data and Computer Communication" by William Stallings
2. "Computer Networks" by Andrew S Tanenbaum
3. "Internetworking with TCP/IP, Volume 1" by Douglas Comer

Modes of Evaluation: Quiz I/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	Independently understand basic computer network technology.	**PO2**
CO2	Understand and explain Data Communications System and its components.	**PO3**
CO3	Identify the different types of network topologies and protocols.	**PO4**
CO4	Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.	**PO5**
CO5	Identify the different types of network devices and their functions within a network	**PO4**
CO6	Understand and building the skills of subnetting and routing mechanisms.	**PO4**
CO7	Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.	**PO9**
CO8	Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking	**PSO1, PSO2, PSO5**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 409A	Advanced Computer Networks		2	3	3	3				3				3	2			3

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

ETCS452A	**Advanced Computer Networks Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Computer Networks				
Co-requisites	--				

Course Objectives

1. To develop an understanding of computer networking basics.
2. To develop an understanding of different components of computer networks, various protocols, modern technologies and their applications.
3. To recognize the technological trends of Computer Networking.
4. To understand the key technological components of the Network
5. To understand the state of the art in network protocols, network architecture, and networked systems.

Course Outcomes

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

CO1. Describe the general principles of data communication and how computer networks are organized with the concept of layered approach.

CO2. Understand and explain the concept of Data Communication and networks, layered architecture and their applications.

CO3. Describe how packets in the Internet are delivered and analyze the contents in a given data link layer

CO4. Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction

CO5 Describe what classless addressing scheme is with how routing protocols work.

CO6. Estimate the congestion control mechanism to improve quality of service of networking application

Catalog Description

This course will introduce students to the basic design principles on which today's Internet is based upon a long with the current and emerging research topics in computer networking area. In addition, this course will cover recent proposals to improve network performance, functionality and scalability to meet emergent applications requirement. The list of experiments help in understanding different computer network techniques.

List of Experiments (Indicative)

1	Implement the CRC-12, CRC-16 in data link layer	**2 lab hours**
2	Implement the data link protocols: Unrestricted simplex protocol	**2 lab hours**
3	Implement of one-bit sliding window protocol.	**2 lab hours**
4	Implement Dijkstra's algorithm to compute the shortest path thru a graph.	**3 lab hours**
5	Implement the Token Bucket Congestion control algorithm.	**3 lab hours**
6	Implement the Leaky Bucket Congestion control algorithm	**3 lab hours**
7	The Experiments using Mininet for Software Defined Network a. Network Topology creation and REST API introduction. b. Influencing flows via cURL commands. c. Create a network and run a simple performance test.	**4 lab hours**

	d. Use “ovs-vsctl” command to directly control open v switch. e. Dynamically change the network parameters—link delay analysis. f. Dynamically change the forwarding rules. g. Mininet Random Topology Generator.	
8	The experimenets using NS-3 a. Create a simple topology of two nodes (Node1, Node2) separated by a point-to-point link. Setup a UdpClient on one Node1 and a Udp Server on Node2. Let it be of a fixed data rate Rate1. Start the client application, and measure end to end throughput whilst varying the latency of the link. Now add another client application to Node1 and a server instance to Node2. What do you need to configure to ensure that there is no conflict? Repeat step 3 with the extra client and server application instances. Show screenshots of pcap traces which indicate that delivery is made to the appropriate server instance. b. Create a simple dumbbell topology, two client Node1 and Node2 on the left side of the dumbbell and server nodes Node3 and Node4 on the right side of the dumbbell. Let Node5 and Node6 form the bridge of the dumbbell. Use point to point links. Install a TCP socket instance on Node1 that will connect to Node3. Install a UDP socket instance on Node2 that will connect to Node4. Start the TCP application at time 1s. Start the UDP application at time 20s at rate Rate1 such that it clogs half the dumbbell bridge's link capacity. Increase the UDP application's rate at time 30s to rate Rate2 such that it clogs the whole of the dumbbell bridge's capacity. Use the ns-3 tracing mechanism to record changes in congestion window size of the TCP instance over time. Use gnuplot/matplotlib to visualise plots of cwnd vs time. Mark points of fast recovery and slow start in the graphs. Perform the above experiment for TCP variants Tahoe, Reno and New Reno, all of which are available with ns-3. c. Create a wireless mobile ad-hoc network with three nodes Node1, Node2 and Node3. Install the OLSR routing protocol on these nodes. Place them such that Node1 and Node3 are just out	**8 lab hours**

	of reach of each other. Create a UDP client on Node1 and the corresponding server on Node3. Schedule Node1 to begin sending packets to Node3 at time 1s. Verify whether Node1 is able to send packets to Node3. Make Node2 move between Node1 and Node3 such that Node2 is visible to both A and C. This should happen at time 20s. Ensure that Node2 stays in that position for another 15s. Verify whether Node1 is able to send packets to Node3. At time 35s, move Node2 out of the region between Node1 and Node3 such that it is out of each other's transmission ranges again. Verify whether Node1 is able to send packets to Node3. To verify whether data transmissions occur in the above scenarios, use either the tracing mechanism or a RecvCallback() for Node3's socket. Plot the number of bytes received versus time at Node3. Show the pcap traces at Node 2's Wifi interface, and indicate the correlation between Node2's packet reception timeline and Node2's mobility.	

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Describe the general principles of data communication and how computer networks are organized with the concept of layered approach.	PO1
CO2	Understand and explain the concept of Data	PO4

	Communication and networks, layered architecture and their applications.	
CO3	Describe how packets in the Internet are delivered and analyze the contents in a given data link layer	**PO5**
CO4	Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction	**PO2**
CO5	Describe what classless addressing scheme is with how routing protocols work.	**PO3**
CO6	Estimate the congestion control mechanism to improve quality of service of networking application	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

Code																	
ETCS452A	ADVANCED COMPUTER NETWORKS LAB	2	2	2	3	3	3							3	3	3	3	2

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

ETCS410A	**Mobile And Wireless Communication**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Advanced of Computer communication				
Co-requisites	--				

Course Objectives

1. Define mobile technologies in terms of hardware, software, and communications.
2. Utilize mobile computing nomenclature to describe and analyze existing mobile computing frameworks and architectures.
3. Evaluate the effectiveness of different mobile computing frameworks.
4. Describe how mobile technology functions to enable other computing technologies.

Course Outcomes

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

CO1. Utilize mobile computing nomenclature to describe and analyze existing mobile computing frameworks and architectures.

CO2. Evaluate the effectiveness of different mobile computing frameworks.

CO3. Describe how mobile technology functions to enable other computing technologies.

Catalog Description

This course will cover the nomenclature and implementation of mobile computing and mobile communication. Coverage mobile systems will include 2G, 2.5G, 3G, 3G+, and 4G communication systems, mobile satellite communication networks, mobile IP, mobile TCP, digital audio-video broadcasting, and mobile TV. 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 Communication System: Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trends in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks , Wireless Local Loop(WLL), Wireless Local Area network(WLAN), Bluetooth and Personal Area Networks.

Unit II: 8 lecture hours

Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies Distance to frequency reuse ratio, Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Co-channel and adjacent interference, Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular System-cell splitting, Cell sectorization , Repeaters, Micro cell zone concept, Channel antenna system design considerations.

Unit III: 12 lecture hours

Multiple Access Techniques: Introduction, Comparisons of multiple Access Strategies like TDMA,CDMA, FDMA, OFDM, and CSMA Protocols. Wireless Systems: GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture.

Unit IV: **8 lecture hours**

Recent trends: Introduction to Wi-Fi, WiMAX, ZigBee Networks, Software Defined Radio, UWB Radio, Wireless Adhoc Network and Mobile Portability, Security issues and challenges in a Wireless network.

Text Books

1. Wireless Communication, Theodore S. Rappaport, Prentice hall

Reference Books/Materials

1. Wireless Communications and Networking, Vijay Garg, Elsevie

Modes of Evaluation: Quiz I/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	Utilize mobile computing nomenclature to describe and analyze existing mobile computing frameworks and architectures.	**PO1, PO2**
CO2	Evaluate the effectiveness of different mobile computing frameworks.	**PO3, PO4**
CO3	Describe how mobile technology functions to enable other computing technologies.	**PO10, PSO1, PSO2,PSO5**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

Code																		
ETCS 410A	Mobile and Wireless Communication	2	2	2	2						3			2	2			2

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

ETCS453A	**Mobile and Wireless Communication Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical of computer communication				
Co-requisites	--				

Course Objectives

1. Use engineering knowledge to solve real world open-ended problems in wireless system design.
2. Use appropriate channel and traffic models to evaluate the impact of wireless service quality and capacity.
3. Generate solutions for complex design problems via proper choice of system parameters, analyze the results and make recommendations.
4. Design and develop software tools to perform the tasks required by the project; Identify the limitations and enhancements of the tools with respect to the project needs.

Course Outcomes

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

CO1. Learn to the syntax of Java Programming Language and implement applications in it.
CO2. Recognize features of object-oriented design such as encapsulation, polymorphism inheritance and composition of systems based on object identity.

CO3. Articulate re-usable programming components using Abstract Class, Interfaces and other permitted ways in packages.
CO4. Apply access control mechanism to safeguard the data and functions that can be applied by the object.
CO5. Understand multithreading and evaluate exception handing to create new applications.
CO6. Design GUI applications using pre-built frameworks available in Java.

Catalog Description

This course provides a comprehensive introduction to basic principles and techniques in cellular mobile communications. The topics include: communication overview and frequency reuse, the cellular concept, radio propagation environments, techniques of modulation and equalization, multiple access wireless systems: TDMA/FDMA systems, CDMA systems etc.

List of Experiments (Indicative)

1	To set up a satellite communication link & study of change in uplink & downlink frequency.	**2 lab hours**
2	To Study Transmission of Audio & Video Signals & Data communication over satellite link.	**2 lab hours**
3	To Study Transmission of telemetry data like temperature & light intensity over satellite link.	**2 lab hours**
4	To measure the propagation delay of signal in a Satellite communication link.	**2 lab hours**
5	To study different GPS data like longitude, latitude & different types of dilute of precision using GPS receiver.	**2 lab hours**
6	To study selection of various PN codes like Gold, Barker & MLS in CDMA technology.	**4 lab hours**
7	To study generation (spreading) & demodulation (Despreading) of DSSS modulated signal.	**4 lab hours**
8	To study Voice communication over DSSS.	**4 lab hours**
9	To study Minimum shift keying modulation & de modulation.	**4 lab hours**
10	FHSS Modulation & demodulation & transfer of numeric data.	**4 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Use engineering knowledge to solve real world open-ended problems in wireless system design.	**PO1,PO2**
CO2	Use appropriate channel and traffic models to evaluate the impact of wireless service quality and capacity.	**PO3**
CO3	Generate solutions for complex design problems via proper choice of system parameters, analyze the results and make recommendations	**PO5**
CO 4	Design and develop software tools to perform the tasks required by the project; identify the limitations and enhancements of the tools with respect to the project needs.	**PO8, PO9, PSO1,PSO5, 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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
ETCS 453A	Mobile and Wireless Communication Lab	2	3	3		2			2	3				2	2			2

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

ETCS411A	Machine Learning	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	NIL				
Co-requisites					

Course Objectives

1. To develop an appreciation for what is involved in learning from data.
2. To understand a wide variety of learning algorithms.
3. To understand how to apply a variety of learning algorithms to data.
4. To understand how to perform evaluation of learning algorithms and model selection.
5. To become familiar with Dimensionality reduction Techniques.

Course Outcomes

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

CO1. Gain knowledge about basic concepts of Machine Learning
CO2. Identify machine learning techniques suitable for a given problem.
CO3. Solve the problems using various machine learning techniques.
CO4. Apply neural networks for suitable application.
CO5. Use a tool to implement typical clustering algorithms for different types of applications.
CO6. Apply Dimensionality reduction techniques.

Catalog Description

This course imparts comprehensive introduction to various topics in machine learning. It enables them to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Course Content

UNIT I **8 Hours**

Machine learning: overview and survey of its applications. Problem of induction and statistical inference: Input-output functions, Boolean functions, Parametric and nonparametric inference, Probability, uncertainty and Bayes theorem, Introduction to typical learning tasks: regression, pattern recognition, feature selection, classification, clustering, rule induction (association). Model validation techniques: cross-validation, leave-one-out, majority, Measures of performance (sensitivity, specificity, ROC curves, etc.)

UNIT II **8 Hours**

Dimensionality Reduction: Subset Selection, Shrinkage Methods, Principle Components Regression Linear Classification, Logistic Regression, Linear Discriminant Analysis Optimization, Classification-Separating Hyperplanes Classification

UNIT III **9 Hours**

Neural Networks: Non-linear Hypothesis, Biological Neurons, Model representation, Intuition for Neural Networks, Multiclass classification, Cost Function, Back Propagation Algorithm, Back Propagation Intuition, Weights initialization, Neural Network Training.

Support Vector Machines: Optimization Objective, Large Margin Classifiers, Kernels, SVM practical considerations

UNIT IV **10 Hours**

Supervised Learning: Additive model: logistic regression, Generative model: naïve Bayes classifier, Discriminative model: Decision trees, Neural networks.

Unsupervised Learning: Clustering: k-means, hierarchical, self-organizing map, EM algorithm, Feature selection principal component analysis.

Reinforcement Learning: Q-learning, Value function approximation, Policy search.

Text Books:

1. The Elements of Statistical Learning, T. Hastie, R. Tibshirani and J. H. Friedman, Springer.

Reference Books:

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

2. Aurélien Géron, "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, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press

8. http://www.deeplearningbook.org

9. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann Publisher

Modes of Evaluation: Quiz I/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	Gain knowledge about basic concepts of Machine Learning	PO1
CO2	Identify machine learning techniques suitable for a given problem.	PO4
CO3	Solve the problems using various machine learning techniques.	PO5
CO4	Apply neural networks for suitable application.	PO2
CO5	Use a tool to implement typical clustering algorithms for different types of applications.	PO3
CO6	Apply Dimensionality reduction 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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

Code																		
ETCS 411A	Machine Learning	2	3	3	3	3								2	2			2

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

ETCS455A	**Machine Learning Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Programming for Problem Solving Lab				
Co-requisites	--				

Course Objectives

1. Develop the technical and practical skills to apply machine learning to solve real-world problems.
2. Explore regression as a supervised machine learning technique to predict a continuous variable (response or target) from a set of other variables (features or predictors)
3. Discover how variable selection and shrinkage methods are used to improve the efficiency of a regression model when applied to complex data sets
4. Explore classification as a supervised machine learning technique to predict binary (or discrete) response variables from a set of features
5. Understand what neural networks are, its most successful applications, and how it can be used within a business context

Course Outcomes

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

CO1. Understand the implementation procedures for the machine learning algorithms .

CO2. Design Java/Python programs for various Learning algorithms.

CO3. Apply appropriate data sets to the Machine Learning algorithms.

CO4. Identify and apply Machine Learning algorithms to solve real world problems.

Note: The programs can be implemented in either JAVA or Python.

1.For Problems 1 to 6 and 10, programs are to be developed without using the built-in classes or APIs of Java/Python.

2.Datasetscan be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

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	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	**2 lab hours**
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	**2 lab hours**
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	**2 lab hours**
4	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	**2 lab hours**

5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	**2 lab hours**
6	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	**4 lab hours**
7	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	**4 lab hours**
8	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	**4 lab hours**
9	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	**4 lab hours**
10	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	**4 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Understand the implementation procedures for the machine learning algorithms.	**PO2**
CO2	Design Java/Python programs for various Learning algorithms.	**PO3**
CO3	Apply appropriate data sets to the Machine Learning algorithms.	**PO5**
CO4	Identify and apply Machine Learning algorithms to solve real world problems.	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 455A	Machine Learning Lab		3	3		2			2					2	2			2

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

ETCS517A	**Soft Computing**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of fuzzy logic, neural network theory, and Genetic algorithms				
Co-requisites	--				

Course Objectives

The students will be able to get an idea on:

1. Neural Networks, architecture, functions and various algorithms involved.
2. Fuzzy Logic, Various fuzzy systems and their functions.
3. Genetic algorithms, its applications and advances.
4. The unified and exact mathematical basis as well as the general principles of various soft computing techniques.

Course Outcomes

Upon completion of the course the students will be able to:
CO1.Understand soft computing techniques and their role in problem solving.
CO2.Conceptualize and parameterize various problems to be solved through basic soft computing techniques.
CO3. Analyze and integrate various soft computing techniques in order to solve problems effectively and efficiently.

CO4.Develop application on different soft computing techniques like Fuzzy, GA and Neural network
CO5.Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert system.
CO6. To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations.

Catalog Description

This course introduces soft computing methods which, unlike hard computing, are tolerant of imprecision, uncertainty and partial truth. The principal constituents of soft computing are fuzzy logic, neural network theory, and probabilistic reasoning.

Course Content

Unit I: **8 lecture hours**

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

Unit II: **12 lecture hours**

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification

Fuzzy Backpropagation Networks: LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks.

Unit III: **12 lecture hours**

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators-Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.GA based Backpropagation Networks: GA based Weight Determination, K -factor determination in Columns.

Unit IV: **8 lecture hours**

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

Text Books

1. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.

Reference Books/Materials

1. Genetic Algorithms: Search and Optimization, E. Goldberg
2. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
3. Build_Neural_Network_With_MS_Excel_sampleby Joe choong
4. S. N. Sivanandam& S.N. Deepa, "Principles of Soft Computing", Wiley, 2007
5. Rafik Aziz oglyAliev, R. R. Aliev: "Soft Computing and Its Applications", World Scientific, 2001

Modes of Evaluation: Quiz I/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	Understand soft computing techniques and their role in problem solving.	**PO1**
CO2	Conceptualize and parameterize various problems to be solved through basic soft computing techniques.	**PO3**
CO3	Analyze and integrate various soft computing techniques in order to solve problems effectively and efficiently.	**PO5**
CO4	Develop application on different soft computing techniques like Fuzzy, GA and Neural network	**PO2, PSO2, PSO1**

CO5	Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert system.	**PO4**
CO6	To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 517A	Soft Computing	2	2	2	3	3	2							2	2			

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

ETCS559A	**Soft Computing Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning of Soft Computing				
Co-requisites	--				

Course Objectives

The students will be able to get an idea on:

1. Neural Networks, architecture, functions and various algorithms involved.
2. Fuzzy Logic, Various fuzzy systems and their functions.
3. Genetic algorithms, its applications and advances.
4. The unified and exact mathematical basis as well as the general principlesof various soft computing techniques.

Course Outcomes

Upon completion of the course the students will be able to:
CO1.Understand soft computing techniques and their role in problem solving.
CO2.Conceptualize and parameterize various problems to be solved through basic soft computing techniques.
CO3. Analyze and integrate various soft computing techniques in order to solve problems effectively and efficiently.
CO4.Develop application on different soft computing techniques like Fuzzy, GA and Neural network

Catalog Description

This course introduces soft computing methods which, unlike hard computing, are tolerant of imprecision, uncertainty and partial truth. The principal constituents of soft computing are fuzzy logic, neural network theory, and probabilistic reasoning.

List of Experiments (Indicative)

1	Create a perceptron with appropriate no. of inputs and outputs. Train using fixed increment learning algorithm until no change in weights is required. Output the final weights.	**2 lab hours**
2	Create a simple ADALINE network with appropriate no. of input and output nodes. Train using delta learning rule until no change in weights is required. Output the final weights.	**2 lab hours**
3	Train the autocorrelator by given patterns: A1= (-1,1, -1,1), A2= (1,1,1, -1), A3=(-1, -1, -1, 1). Test it using patterns: Ax = (-1,1, -1,1), Ay= (1,1,1,1), Az= (-1, -1,-1,-1).	**2 lab hours**
4	Train the hetro-correlator using multiple training encoding strategy for given patterns: A1= (000111001) B1= (010000111), A2= (111001110) B2= (100000001), A3= (110110101) B3(101001010). Test it using pattern A2.	**2 lab hours**
5	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**
6	Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox.	**4 lab hours**
7	Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox.	**4 lab hours**
8	Implement TSP using GA.	**4 lab hours**
9	Implement one applications for Adaptive Systems	**4 lab hours**

10	Implement fitness function, Cross over and mutation in GA algorithms.	**4 lab hours**
11	Implement genetic algorithm based back propagation network in MATLAB.	

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

Examination Scheme:

Components	Quiz I	Attendance	Mid Term Exam	Presentation/ Projects/ 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 techniques and their role in problem solving.	**PO2**
CO2	Conceptualize and parameterize various problems to be solved through basic soft computing techniques.	**PO3**
CO3	Analyze and integrate various soft computing techniques in order to solve problems effectively and efficiently.	**PO5, PSO1, PO9**
CO4	Develop application on different soft computing techniques like Fuzzy, GA and Neural network	**PO4**

		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	Skills	Best Practices	Profession Responsibilities	Ethics	Analysis
Course	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

Code																		
ETCS 559A	Soft Computing Lab		2	3	3	3				3				2				

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

ETCS519A	**Big Data Analytics and Visualization**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Data Structures and Algorithms				
Co-requisites	Database Management Systems				

Course Objectives

1. Help in understanding the information "hidden" within the voluminous data to make future business decisions.

Course Outcomes

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

CO1. Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.
C02. Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
CO3. Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.

CO4. Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.

CO5. Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.

CO6. Ability to integrate machine learning libraries and mathematical and statistical tools

Catalog Description

Through this subject, student will be able to understand the coarse-grained aspects of analyzing and extracting relevant information from the vast repository. Student will implement the concepts of data structures and algorithms and database management systems to make highly precise decision from the given data set. The internals of smart analysis will be discussed throughout the course duration.

Course Content

Unit I: **8 lecture hours**

Introduction to Big Data: Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Case Study of Big Data Solutions.

Overview of Hadoop: Core Hadoop Components, Hadoop Ecosystem, Physical Architecture, Hadoop limitations

Unit II: **12 lecture hours**

NoSQL: NoSQL business drivers; NoSQL case studies; NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns; Using NoSQL to manage big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer

Unit III: **12 lecture hours**

MapReduce and the New Software Stack: Distributed File Systems -- Physical Organization of Compute Nodes, Large Scale File-System Organization, The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping with Node Failures.

Unit IV: **8 lecture hours**

Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step

Text Books

1. Data Analytics Made Accessible, A.Maheshwari.

2. Hadoop The definite Guide. 3rd edition

Reference Books/Materials

Modes of Evaluation: Quiz I/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 identify the characteristics of datasets and compare the trivial data and big data for various applications	**PO2,PO12**
CO2	Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration	**PO3**
CO3	Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.	**PO5**

CO4	Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.	**PO3, PO4, PO5**
CO5	Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques	**PO3, PO5**
CO6	Ability to integrate machine learning libraries and mathematical and statistical tools	**PO2, PO5, PO12**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PS	PS	PS	PS	PS

Code	Title	1	2	3	4	5	6	7	8	9				O1	O2	O3	O4	O5
ETCS 519A	Big Data Analytics and Visualization		3	3	2	3							3	2				3

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

ETCS563A	**Big Data Analytics and Visualization Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Data Structures and Algorithms;				
Co-requisites	Database Management Systems				

Course Objectives

Understanding of processing of huge data set over clustered system.

Course Outcomes

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

CO1. Identify Big Data and its Business Implications.
CO2. List the components of Hadoop and Hadoop Eco-System.
CO3. Access and Process Data on Distributed File System.
CO4. Manage Job Execution in Hadoop Environment.
CO5. Develop Big Data Solutions using Hadoop Eco System.

Catalog Description

This course complements ETCS518A. It enables them to keenly analyze to reach a point of solving problems with the help of fundamentals. The list of experiments help organizing the flow of understanding and learning to solve the given problem efficiently.

List of Experiments (Indicative)

1	Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).	**2 lab hours**
2	MapReduce application for word counting on Hadoop cluster	**2 lab hours**
3	Unstructured data into NoSQL data and do all operations such as NoSQL query with API.	**2 lab hours**
4	K-means clustering using map reduce	**2 lab hours**
5	Page Rank Computation	**2 lab hours**
6	Mahout machine learning library to facilitate the knowledge build up in big data analysis.	**4 lab hours**
7	Application of Recommendation Systems using Hadoop/mahout libraries	**4 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Identify Big Data and its Business Implications.	**PO7**
CO2	List the components of Hadoop and Hadoop Eco-System.	**PO1, PO3**
CO3	Access and Process Data on Distributed File System.	**PO1, PO2**
CO4	Manage Job Execution in Hadoop Environment.	**PO5**
CO5	Develop Big Data Solutions using Hadoop Eco System.	**PO2, PO3, PO12**

		Engineering Knowledge	Problem analysis	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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 563A	Big Data Analytics and Visualization Lab	2	3		2		2					2	2				3

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

ETCS515A	**Ethical Hacking**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics Algebra				
Co-requisites	--				

Course Objectives

1. To learn penetration testing.
2. To learn difference between threat, vulnerability and attacks.
3. To learn security mechanisms.
4. To learn different types of attacks.
5. To implement tools and methods to improve the security of the system from hackers.
6. To differentiate between authorised and unauthorised users.
7. To understand latest mechanism of secure and safe network.

Course Outcomes

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

CO1. To learn ethical considerations of hacking

CO2. To learn legal considerations of hacking

CO3. To collect information using network scanning

CO4. Identify methods to gain access to systems

CO5. Analyze social engineering methods

CO6. Explain common physical security weaknesses

Catalog Description

This class will immerse the students into an interactive environment where they will be shown how to scan, test, hack and secure their own systems. The lab intensive environment gives each student in-depth knowledge and practical experience with the current essential security systems. Students will begin by understanding how perimeter defenses work and then be led into scanning and attacking their own networks

Course Content

Unit I: **12 lecture hours**

Introduction to Ethical Hacking: Five phases of ethical hacking, different types of hacker attacks, Foot printing and Reconnaissance, Scanning Networks, TCP flag types, types of port scans, scanning countermeasures

Unit II: **8 lecture hours**

Enumeration: Role and enumeration techniques recognize how to establish a sessions, Identify enumeration countermeasures, Perform active and passive enumeration. Sniffers, types of sniffing and protocols vulnerable to sniffing, Recognize types of sniffing attacks, methods for detecting sniffing, different types of social engineering, and social engineering countermeasures.

Unit III: **12 lecture hours**

System Hacking: Identify different types of password attacks, Use a password cracking tool, Identify various password cracking countermeasures, Identify different ways to hide files, Recognize how to detect a rootkit, Identify tools that can be used to cover attacker tracks.

Unit IV: **8 lecture hours**

Trojans and Backdoors: Concept of Trojan infects a system, ports used by Trojans and Trojan countermeasures, symptoms of a virus and its working, Detection methods and virus countermeasures.

Text Books: 1. A Beginners Guide To Hacking Computer Systems

Reference Books:

1. Black Book of Viruses and Hacking 2. Secrets of Super and Professional Hackers 3. Dangerous Google Hacking Database and Attacks 4. Internet Advanced Denial of Service (DDOS) Attack 5. Computer Hacking & Malware Attacks for Dummies

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	To learn ethical consideration of hacking	PO2
CO2	To learn legal consideration of hacking	PO3
CO3	To collect information using network scanning	PO4
CO4	Identify methods to gain access to systems	PO5
CO5	Analyze social engineering methods	PO4
CO6	Explain common physical security weaknesses	PO4, PO9, PSO1, PSO2, PSO3, PSO4

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course	PO	PO	PO	PO4	PO	PO	PO	PO	PO	PO10	PO11	PO12	PS	PS	PS	PSO4	PSO5

Code	Title	1	2	3		5	6	7	8	9				O1	O2	O3		
ETCS 515A	Ethical hacking		2	3	3	3				3				3	1`	2	3	

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

ETCS557A	**Ethical Hacking Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basic algebra				
Co-requisites	--				

Course Objectives

1. To understand the various security issues.
2. To learn different tools and techniques in ethical hacking.
3. To implement security tools.

Course Outcomes

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

CO1. Identify and analyse the stages an ethical hacker requires to take in order to compromise a target system.

CO2. Identify tools and techniques to carry out a penetration testing.

CO3. Critically evaluate security techniques used to protect system and user data.

CO4. Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.

Catalog Description

This course is hands-on application of security tools to test network and systems security. The course focuses on hacking techniques and technology from an offensive perspective. The student will learn to scan, test, hack and secure systems. Students will learn the five phases of ethical hacking: reconnaissance; gaining access; enumeration; maintaining access; and covering their tracks. Throughout the course, students will be immersed in a hacker's mindset, evaluating not just logical, but physical security exploring every possible point of entry to find the weakest link in an organization.

Course Content

1	Implementation on various phases of Ethical hacking.	**2 lab hours**
2	Implementation on networking concept.	**2 lab hours**
3	Implementation on Foot Printing	**2 lab hours**
4	Case Study on Windows linux system security.	**2 lab hours**
5	Implementation on Proxy server	**2 lab hours**
6	Implementation on System hacking and security.	**2 lab hours**
7	Implementation on Windows Linux scripting.	**2 lab hours**
8	Implementation on Network hacking and security.	**2 lab hours**
9	Implementation on Foot Printing and Information gathering.	**2 lab hours**
10	Case study on Google hacking.	**2 lab hours**
11	Case study on Hacking attacks	**2 lab hours**
12	Case study on Web application hacking.	**2 lab hours**
13	Case study on Cryptography	**2 lab hours**

14	Case study on Honeypots	**2 lab hours**
15	Implementation on Wireless and mobile hacking and security.	**2 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Identify and analyze the stages an ethical hacker requires to take in order to compromise a target system.	**PO2**
CO2	Identify tools and techniques to carry out a penetration testing.	**PO3**
CO3	Critically evaluate security techniques used to protect system and user data.	**PO5, PSO1, PSO2, PSO3, PSO4**
CO4	Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.	**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	Skills	Best Practices	Profession Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 557A	Ethical hacking Lab		2	3		3				3				3	1`	2	3	

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

Semester VI

ETC520A	Internet Technologies	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Internet				
Co-requisites	--				

Course Objectives

1. To understand the terms related to the Internet and how the Internet is changing the world.
2. To understand how computers are connected to the Internet and demonstrate the ability to use the World Wide Web.
3. 3. Demonstrate an understanding of and the ability to use electronic mail and other internet based services
4. 4. Understand the design principles of Web pages and how they are created
5. 5. To develop an ability to create basic Web pages with HTML.

Course Outcomes

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

CO1. Analyze a web page and identify its elements and attributes.
CO2.Create web pages using XHTML and Cascading Style Sheets.
CO3.Build dynamic web pages using JavaScript (Client side programming).
CO4. Create XML documents and Schemas.
CO5. Build interactive web applications using AJAX.
CO6. Expose students to the basic tools and applications used in Web publishing.
CO7. Provide internet connection to the system and its installation.
CO8. Suggest appropriate routing algorithm for the network.

Catalog Description

Course Content

Unit I: **12 lecture hours**

Introduction: Overview, Network of Networks, Intranet, Extranet and Internet. World Wide Web, Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. Review of TCP/IP: Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control. IP Datagram, IPv4 and IPv6. IP Subnetting and addressing: Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables. Internet Routing Protocol: Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast. Electronic Mail: POP3, SMTP.

Unit II: 8 lecture hours

PERL: Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling. JavaScript: Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object - string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies: Definition of cookies, Create and Store a cookie with example. Java Applets: Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.

Unit III: 12 lecture hours

Client-Server programming In Java: Java Socket, Java RMI. Threats: Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks. Network security techniques: Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall: Introduction, Packet filtering, Stateful, Application layer, Proxy.

Unit IV: 8 lecture hours

Internet Telephony: Introduction, VoIP. Multimedia Applications: Multimedia over IP: RSVP, RTP, RTCP and RTSP. Streaming media, Codec and Plugins, IPTV. mywbut.com Search Engine and Web Crawler: Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

Text Books

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI, Learning, Delhi, 2013.

Reference Books/Materials

1. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.

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	Analyze a web page and identify its elements and attributes.	**PO2**
CO2	Create web pages using XHTML and Cascading Style Sheets.	**PO3**
CO3	Build dynamic web pages using JavaScript (Client side programming).	**PO4**
CO4	Create XML documents and Schemas.	**PO5**
CO5	Build interactive web applications using AJAX.	**PO4**
CO6	Expose students to the basic tools and applications used in Web publishing.	**PO4**
CO7	Provide internet connection to the system and its installation.	**PO9**
CO8	Suggest appropriate routing algorithm for the network.	**PSO3**

		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	Employability	Ethics and Behaviour	Knowledge
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETC520A	INTERNET TECHNOLOGIES		2	3	3	3				3						3

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

ETCS 202A	**Software Engineering**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	None				
Co-requisites	--				

Course Objectives

1. The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.
2. Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams

Course Outcomes

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

CO1. To learn and understand the Concepts of Software Engineering
CO2. To Learn and understand Software Development Life Cycle
CO3. To apply the project management and analysis principles to software project development.
CO4. To apply the design & testing principles to software project development.
CO5. Ability to execute tests, design test cases, use test tools, etc.
CO6. To Study about Software maintenance tools

Catalog Description

This course covers the fundamentals of software engineering, including understanding system requirements, finding appropriate engineering compromises, effective methods of design, coding, and testing, team software development, and the application of engineering tools.

Course Content

Unit I: 10 lecture hours

Introduction: Software Crisis, Software Processes & Characteristics, Software life cycle models, Waterfall, Prototype, Evolutionary and Spiral Models

Software Requirements analysis & specifications: Requirement engineering, requirement elicitation techniques, requirements analysis using DFD, Data dictionaries & ER Diagrams, Requirement documentation, Nature of SRS, Characteristics & organization of SRS.

Unit II: 10 lecture hours

Software Metrics: Software measurements: What & Why, Token Count, Size Estimation like lines of Code & Function Count, Halstead Software Science Measures, Design Metrics, Data Structure Metrics, Information Flow Metrics, Cost Estimation Models: COCOMO,COCOMO-II.

System Design: Design Concepts, design models for architecture, component, data and user interfaces; Problem Partitioning, Abstraction, Cohesiveness, Coupling, Top Down and Bottom-Up design approaches; Functional Versus Object Oriented Approach, Design Specification.

Coding: TOP-DOWN and BOTTOM-UP structure programming, Information Hiding, Programming Style, and Internal Documentation, Verification.

Unit III: 10 lecture hours

Unified Approach and Unified Modeling Language: The Unified Approach: Layered Approach to OO Software Development, UML: UML Diagrams for Structure Modeling, UML Diagrams for Behavior Modeling, UML Diagram for Implementation and deployment modeling.

Software Reliability: Importance, Hardware Reliability & Software Reliability, Failure and Faults, Reliability Models, Basic Model, Logarithmic Poisson Model, Software Quality Models, CMM & ISO 9001.

Unit IV: **10 lecture hours**

Software Testing: Testing process, Design of test cases, functional testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing, Path Testing, Data flow and mutation testing, Unit Testing, Integration and System Testing, Debugging, Alpha & Beta Testing, Testing Tools & Standards.

Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Regression Testing, Reverse Engineering, Software Re-engineering, Configuration Management, Documentation.

Text Books

1. K. K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International.
2. R. S. Pressman, "Software Engineering – A practitioner's approach", McGraw Hill Int. Ed.
3. W.S. Jawadekar, "Software Engineering – Principles and Practices", McGraw Hill

Reference Books/Materials

1. Stephen R. Schach, "Classical & Object Oriented Software Engineering", IRWIN, TMH.
2. James Peter, W. Pedrycz, "Software Engineering: An Engineering Approach", John Wiley & Sons.
3. I. Sommerville, "Software Engineering", Addison Wesley.
4. K. Chandrasehakhar, "Software Engineering & Quality Assurance", BPB.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:
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	To learn and understand the Concepts of Software Engineering	**PO1**
CO2	To Learn and understand Software Development Life Cycle	**PO1**
CO3	To apply the project management and analysis principles to software project development.	**PO3, PO11**
CO4	To apply the design & testing principles to software project development.	**PO3**
CO5	Ability to execute tests, design test cases, use test tools, etc.	**PO4**
CO6	To Study about Software maintenance tools	**PO2, PO5**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex proble	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	Ethics	Analysis

					ms											
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 202A	Software Engineering	3	3	3	3	3						2		2		

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

ETCS222A	**Computer Organization and Architecture**	L	T	P	C
Version 1.0		3	1	-	4
Pre-requisites/Exposure	Basics of Microprocessor Systems				
Co-requisites	-				

Course Objectives

1. How Computer Systems work & the basic principles?
2. Instruction Level Architecture and Instruction Execution
3. The current state of art in memory system design
4. How I/O devices are accessed and its principles?
5. To provide the knowledge on Instruction Level Parallelism
6. To impart the knowledge on micro programming
7. Concepts of advanced pipelining techniques.

Course Outcomes

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

CO1. Understand the concepts of microprocessors, their principles and practices.

CO2. Write efficient programs in assembly language of the 8086 family of microprocessors.

CO3. Organize a modern computer system and be able to relate it to real examples.

CO4. Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.

CO5. Implement embedded applications using Emulator.

Catalog Description

Computer architecture is the science and art of selecting and interconnecting hardware components to create a computer that meets functional, performance, and cost goals. Computer organization defines the constituent parts of the system, how they are interconnected, and how they interoperate in order to implement the architectural specification. In this course, you will learn the basics of hardware components from basic gates to memory and I/O devices, instruction set architectures and assembly language, and designs to improve performance.

Course Content

Unit I: **12 lecture hours**

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit.Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look- ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

Unit II: **10 lecture hours**

Introduction to x86 architecture.

CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization.

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB

Unit III: 8 lecture hours

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Unit IV: 10 lecture hours

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Text Books

1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

2. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.

Reference Books/Materials

1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

2. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher 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	Understand the concepts of microprocessors, their principles and practices.	**PO2**
CO2	Write efficient programs in assembly language of the 8086 family of microprocessors.	**PO3**
CO3	Organize a modern computer system and be able to relate it to real examples.	**PO4**
CO4	Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.	**PO9**
CO5	Implement embedded applications using Emulator.	**PO5**

		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	Ethics	Analysis
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS 222A	Computer Organization and Architecture		2	3	3	2				3				3		3

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

ETCS423	Neural Networks	L	T	P	C
Version 1.0		4	-	0	4
Pre-requisites/Exposure	Artificial Intelligence and Machine learning				
Co-requisites	--				

Course Objectives

1. To be able to understand the analogy of biological and artificial neural networks.
2. To be able to use learning methods, optimization techniques, activation functions, variable transformations, pattern storage networks during the designing of Machine learning models.
3. To be able to understand the role of data mining and data analytics while designing the algorithms by using neural networks.
4. How neural networks can be used in prediction models and competitive learnings.

Course Outcomes

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

CO1. Understand all terminologies that are used in Neural network designing.
CO2. Use data exploration, data correction methods, optimization techniques, pattern storage algorithms using open platforms/software.
CO3. Design algorithms of supervised and unsupervised learning, classification, and regression while checking which algorithm will work better in which case.
CO4.Write an algorithm for prediction modeling with the best performance.

Catalog Description

This course imparts the basic concepts of neural network algorithms. It enables them to write algorithms for solving problems with the help of supervised and unsupervised learning techniques. The course of neural networks helps to organize the historical data in a variety of ways to solve future problems. The course introduces the basic concepts about neural network activation functions, hyper parameter selection techniques, optimization techniques, it also discusses the pattern storage networks, competitive learning architecture, and applications.

Course Content

Unit I: **8 lecture hours**

Introduction to ANN: what is a neural network? Human Brain, Models of a Neuron, Neural networks viewed as Directed Graphs, Network Architectures, Knowledge Representation,
Artificial Intelligence and Neural Networks, Trends in Computing Comparison of BNN and ANN
Basics of Artificial Neural Networks: characteristics of neural networks terminology, models of neuron Mc Culloch - Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture

Unit II: 12 lecture hours

Backpropagation networks: Architecture of feed forward network, single layer ANN: Adaptive filtering problem, Unconstrained Organization Techniques, multilayer perceptron, back propagation learning, input - hidden and output layer computation, backpropagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning.

Unit III: 12 lecture hours

Activation & Synaptic Dynamics: Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks.

Basic functional units of ANN for pattern recognition tasks: Basic feed forward, Basic feedback and basic competitive learning neural network, Feed forward neural networks – Linear responsibility X-OR problem and solution, Analysis of pattern mapping networks summary of basic gradient search methods, Feedback neural networks - Pattern storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning

Unit IV: 8 lecture hours

Competitive learning neural networks: Components of CL network pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.

Applications of ANN: Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters.

Text Books

1. Neural networks A comprehensive foundations, Simon Haykin, Pearson Education

Reference Books/Materials

1. Artificial neural networks, B. Vegnanarayana, Prentice Hall of India (P) Ltd

2. Neural networks, Fuzzy logic and Genetic Algorithms, S. Rajsekaran , Vijayalakshmi Pari, 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 all terminologies that are used in Neural network designing.	**PO1**
CO2	Use data exploration, data correction methods, optimization techniques, pattern storage algorithms using open platforms/software.	**PO1, PO2, PO4**
CO3	Design algorithms of supervised and unsupervised learning, classification, and regression while checking which algorithm will work better in which case.	**PO5, PSO1, PSO2**
CO4	Write an algorithm for prediction modeling with the best performance.	**PO5, 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	Ethics	Analysis

Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
ETCS42 3	Neural Network	2	3		3	3								3	3	2

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

ETCS 260A	**Computer Organization & Architecture Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Microprocessor Systems				
Co-requisites	--				

Course Objectives

1. Develop and assemble assembly programs.
2. Identify and use proper assembler directives.
3. Design simple assembly programs.
4. Write programs that interface with a programming language.
5. Appreciate the System Software development environment.

Course Outcomes

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

CO1. Understand the concepts of microprocessors, their principles and practices.

CO2. Write efficient programs in assembly language of the 8086 family of microprocessors.

CO3. Organize a modern computer system and be able to relate it to real examples.

CO4. Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.

CO5. Implement embedded applications using Emulator.

Catalog Description

This course is an attempt to familiarize students with some of the important Assemblers available in the Windows environment. Students may use any of these tools available. Students may also find that assembler directives used by these programs may differ. Assembly and C Programming helps students greatly in System Software implementation and giving understanding of the machine.

List of Experiments (Indicative)

1	Design and simulate ripple carry adders	2 lab hours
2	Design and simulate carry look ahead adders	2 lab hours
3	Design and simulate Wallace tree adders	2 lab hours
4	Synthesis of various flip-flops.	2 lab hours
5	Design and simulate various registers and counters	2 lab hours
6	Design and simulate combinational multipliers	3 lab hours
7	Design and simulate Booth's Multiplication	3 lab hours
8	Design and simulate arithmetic logic unit	3 lab hours
9	Design memory units and understand how it operates during read and write operation.	4 lab hours
10	Designing an associative cache for given parameters.	3 lab hours
11	Design a CPU to show the basic top-level functionality, organization and architecture of a computer.	4 lab hours

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical 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	Understand the concepts of microprocessors, their principles and practices.	**PO2**
CO2	Write efficient programs in assembly language of the 8086 family of microprocessors.	**PO3**
CO3	Organize a modern computer system and be able to relate it to real examples.	**PO4**
CO4	Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.	**PO9**
CO5	Implement embedded applications using Emulator.	**PO5**

		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	Employability	Ethics and Behaviour	Knowledge
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

ETCS 260A	**Computer organization & architecture lab**		2	3	3	2				3				3		3

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

ETCS 252A	**Software Engineering Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	None				
Co-requisites	--				

Course Objectives

1. The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.
2. Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams

Course Outcomes

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

CO1. To learn and understand the Concepts of Software Engineering
CO2. To Learn and understand Software Development Life Cycle
CO3. To apply the project management and analysis principles to software project development.
CO4. To apply the design & testing principles to software project development.
CO5. Ability to execute tests, design test cases, use test tools, etc.
CO6. To Study about Software maintenance tools

Catalog Description

Based on theory subject **ETCS 202A**, the following experiments are to be performed. It enables students to understand the Software Engineering concept and use them practically to develop quality software.

List of Experiments (Indicative)

1	To identify the role of the software in today's world across a few significant domains related to day-to-day life Create SRS document of admission management for your university	**2 lab hours**
2	To identify the problem related to software crisis for a given scenario	**2 lab hours**
3	To identify the suitable software development model for the given scenario.	**2 lab hours**
4	To identify the various requirement development activities viz. elicitation, analysis, specification and verification for the given scenario	**4 lab hours**
5	To identify the various elicitation techniques and their usage for the Banking case study.	**4 lab hours**
6	Identify the elements in Software Requirements Specification for a given document.	**2 lab hours**
7	Draw E-R Diagram for Hockey League.	**2 lab hours**
8	Draw a context diagram and a level-1 diagram that represent the selling system at the store**.**	**2 lab hours**
9	Find out all software metrics for a Quadratic Equation program written in 'C'.	**2 lab hours**
10	Identify the design principle that is being violated in relation to the given scenario.	**2 lab hours**
11	To identify the usage of stubs or drivers in the context of an integration testing scenario.	**2 lab hours**
12	Identify the different types of performance testing.	**2 lab hours**
13	Identify the usage of regression testing.	**2 lab hours**
14	Write various white box test cases to test the internal behaviour of above program.	**2 lab hours**

15	Write various Black box test cases to test the functionalities of above program.	**2 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	To learn and understand the Concepts of Software Engineering	**PO1**
CO2	To Learn and understand Software Development Life Cycle	**PO1**
CO3	To apply the project management and analysis principles to software project development.	**PO3, PO11**
CO4	To apply the design & testing principles to software project development.	**PO3**
CO5	Ability to execute tests, design test cases, use test tools, etc.	**PO4**
CO6	To Study about Software maintenance tools	**PO2, PO5**

		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	Employability	Ethics and Behavior	Knowledge
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 252A	Software Engineering Lab	3	3	3	3	3						2		3	2	3

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

ETCS464A	**Major Project**	L	T	P	C
Version 1.0		-	-	-	6
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.
C02. 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 I/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	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.	**PO3**
CO4	Communicate effectively and learn to be a team player.	**PO10**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course	Course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PS	PS	PS	PS	PS

Code	Title	1	2	3	4	5	6	7	8	9				O1	O2	O3	O4	O5
ETCS464A	Major Project			3		2					3							

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

ETCS422A	**Cloud Computing**	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real-life scenarios.
3. To enable students exploring some important cloud computing driven commercial systems and applications.
4. To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

Course Outcomes

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

CO1. Implement a public cloud instance using a public cloud service provider.

CO2. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.

CO3. Apply the fundamental concepts in data centres to understand the trade-offs in power, efficiency and cost.

CO4. Apply trust-based security model to different layers.

CO5. Develop a risk-management strategy for moving to the Cloud.

CO6. Describe big data and use cases from selected business domains.

CO7. Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.

CO8. Analyze various cloud programming models and apply them to solve problems on the cloud.

Catalog Description

The course presents a top-down view of cloud computing, from applications and administration to programming and infrastructure. Its focus is on parallel programming techniques for cloud computing and large-scale distributed systems which form the cloud infrastructure. The topics include overview of cloud computing, cloud systems, parallel processing in the cloud, distributed storage systems, virtualization, security in the cloud, and multicore operating systems. Students will study state-of-the-art solutions for cloud computing developed by Google, Amazon, Microsoft, Yahoo, VMWare, etc. Students will also apply what they learn in one programming assignment and one project executed over Amazon Web Services.

Course Content

Unit I: **12 lecture hours**

Introduction: Cloud computing fundamentals, the role of networks in Cloud computing, Essential characteristics of Cloud computing, Cloud deployment model, Cloud service models, Multi-tenancy, Cloud cube model, Cloud economics and benefits, Cloud types and service scalability over the cloud, challenges in cloud NIST guidelines, Cloud economics and benefits, Cloud computing platforms - IaaS: Amazon EC2, PaaS: Google App Engine, Microsoft Azure, SaaS. Open Source platforms: OpenStack.

Unit II: **10 lecture hours**

Virtualization, Server, Storage and Networking : Virtualization concepts, types, Server virtualization, Storage virtualization, Storage services, Network virtualization, service virtualization,

Virtualization management, Virtualization technologies and architectures, Internals of virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, Hyper V, VMware hypervisors and their features.

Unit III: 10 lecture hours

Data in Cloud Computing: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. MapReduce and extensions: Parallel computing, the map-Reduce model, Parallel efficiency of MapReduce, Relational operations using Map-Reduce, Enterprise batch processing using MapReduce.

Cloud Security: Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Cloud computing security architecture: General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro - architectures; Identity Management and Access control, Autonomic security, Security challenges: Virtualization security management - virtual threats, VM Security Recommendations, VM - Specific Security techniques, Secure Execution Environments and Communications in cloud.

Unit IV: 8 lecture hours

Issues in Cloud Computing: Implementing real time application over cloud platform, Issues in Inter - cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, resource optimization, resource dynamic reconfiguration, Monitoring in Cloud

Text Books

1. Cloud Computing, Dr. Kumar Saurabh, Wiley Publication

Reference Books/Materials

1. Cloud computing – Automated virtualized data center, Venkata Josyula, CISCO Press

2. Cloud and virtual data storage networking, Greg Schulr CRC Press

3. Handbook of Cloud Computing, BorkoFurht, Springer

Modes of Evaluation: Quiz I/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	Implement a public cloud instance using a public cloud service provider.	**PO5**
CO2	Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.	**PO1**
CO3	Apply the fundamental concepts in data centres to understand the trade-offs in power, efficiency and cost.	**PO4**
CO4	Apply trust-based security model to different layers.	**PO5**
CO5	Develop a risk-management strategy for moving to the Cloud.	**PO2**
CO6	Describe big data and use cases from selected business domains.	**PO3**
CO7	Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.	**PO3**
CO8	Analyze various cloud programming models and apply them to solve problems on the cloud.	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis

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	PSO5
ETCS422A	Cloud Computing	2	3	3	2	3				3				3		3		

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCA 362A	**Cloud Computing Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning				
Co-requisites	--				

Course Objectives

1. Define & implement Virtualization using different types of Hypervisors

2. Describe steps to perform on demand application delivery

3. Examine the installation and configuration of Open stack cloud

4. Analyze and understand the functioning of different components involved in Amazon web services cloud platform.

5. Describe the functioning of Platform as a Service

6. Design & Synthesize Storage as a service using own Cloud

Course Outcomes

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

CO1. Implement a public cloud instance using a public cloud service provider.

CO2. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.

CO3. Apply the fundamental concepts in data centres to understand the trade-offs in power, efficiency and cost.

CO4. Apply trust-based security model to different layers.

CO5. Develop a risk-management strategy for moving to the Cloud.

CO6. Describe big data and use cases from selected business domains.

CO7. Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.

CO8. Analyze various cloud programming models and apply them to solve problems on the cloud.

Catalog Description

This course is designed to introduce the concepts of Cloud Computing as a new computing paradigm. The students will have an opportunity to explore the Cloud Computing various terminology, concepts, principles and applications. This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). A variety of real case studies and existing in market cloud- based tools will be identified and studied in order to provide students with a close overview to Cloud Computing applications.

Course Content

1	Development of applications on Google app engine.	**4 lab hours**
2	Case study of private Cloud setup through OpenStack	**4 lab hours**
3	Case study of private Cloud setup through CloudStack	**4 lab hours**

4	Case study of XEN/VMware/KVM hypervisor	**4 lab hours**
5	Case study of Amazon ec2.	**4 lab hours**

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

Examination Scheme:

Components	Quiz I	Attendance	Mid Term Exam	Presentation/ Projects/ 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	Implement a public cloud instance using a public cloud service provider.	**PO5**
CO2	Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.	**PO1**
CO3	Apply the fundamental concepts in data centres to understand the trade-offs in power, efficiency and cost.	**PO4**
CO4	Apply trust-based security model to different layers.	**PO5**
CO5	Develop a risk-management strategy for moving to the Cloud.	**PO2**

CO6	Describe big data and use cases from selected business domains.	**PO3**
CO7	Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.	**PO3**
CO8	Analyze various cloud programming models and apply them to solve problems on the cloud.	**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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis

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	PSO5
ETCA362A	Cloud Computing Lab	2	3	3	2	3				3				3		3		

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS 424A	**Data Warehouse and Data Mining**	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Basic Database concepts, Query tools				
Co-requisites	--				

Course Objectives

1. Be familiar with mathematical foundations of data mining tools.

2. Understand and implement classical models and algorithms in data warehouses and data mining

3. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

4. Master data mining techniques in various applications like social, scientific and environmental context.

5. Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Outcomes

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

CO1. Understand the functionality of the various data mining and data warehousing component

CO2. Appreciate the strengths and limitations of various data mining and data warehousing models

CO3. Explain the analyzing techniques of various data

CO4. Describe different methodologies used in data mining and data ware housing

CO5. Compare different approaches of data ware housing and data mining with various technologies

Catalog Description

This course will introduce the concepts of data ware house and data mining, which gives a complete description about the principles, used, architectures, applications, design and implementation of data mining and data ware housing concepts.

Course Content

Unit I: 10 lecture hours

Introduction: Evolution Of Data Warehousing (Historical Context), The Data Warehouse - a Brief Overview, Characteristics, Operational Database Systems and Data Warehouse(OLTP & OLAP), Data Marts, Metadata.

Principles of Data Warehousing(Architecture and Design Techniques): System Processes, Data Warehousing Components, Architecture for a Warehouse, Three-tier Data Warehouse Architecture, Steps for the design and construction of Data Warehouses, Conceptual Data Architecture, Logical Architectures, Design Techniques.

Unit II: 12 lecture hours

Multidimensional Data Models: Types of Data and Their Uses, From Tables and Spreadsheets to Data Cubes, Identifying Facts and Dimensions, Fact Tables, Designing Fact Tables, Designing Dimension Table, Data Warehouse Schemas- STAR Schema, Snowflake Schema, OLAP, OLAP

Operations**,** Hypercube**,** ROLAP, MOLAP, From Data warehousing to Data Mining, Data warehouse Usage

Unit III: **12 lecture hours**

Data Mining: Motivation, Importance, Knowledge Discovery Process (KDD), KDD and Data Mining, Data Mining vs. Query Tools, Kind of Data, Data preprocessing, Functionalities, Interesting Patterns, Classification of data mining systems, Major issues.

Unit IV: **12 lecture hours**

Classification and Prediction: Classification & Prediction, Issues Regarding Classification & Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back Propagation, Classification Parameters.

Cluster Analysis: Types of Data in Cluster Analysis, Partitioning Method, Hierarchical Method, Density Based Method, Grid Based Method, Model Based Clustering Method, Outlier Analysis.

Mining Association Rules: Association Rule Mining, Market Basket Analysis, Types of Association Rules, Methods for Mining Association

Text Books

Kamber and Han, "Data Mining Concepts and Techniques", Hartcourt India P. Ltd

Reference Books/Materials

1. W. H. Inmon, "Building the operational data store", 2nd Ed., John Wiley.
2. Paul Raj Poonia, "Fundamentals of Data Warehousing", John Wiley & Sons.
3. Sam Anahony, "Data Warehousing in the real world: A practical guide for building decision support systems", John Wiley.

Modes of Evaluation: Quiz I/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	Understand the functionality of the various data mining and data warehousing component	**PO1**
CO2	Appreciate the strengths and limitations of various data mining and data warehousing models	**PO1**
CO3	Explain the analyzing techniques of various data	**PO2**
CO4	Describe different methodologies used in data mining and data ware housing	**PO2**
CO5	Compare different approaches of data ware housing and data mining with various technologies	**PO4, PO5**

		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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5

ETCS 424A	Data wareh ouse and data minin g	3	3		3	3								3	2		2	
																1		2

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS463A	**Data Warehousing and Data Mining Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basic Database concepts, Query tools				
Co-requisites	--				

Course Objectives

1. Be familiar with mathematical foundations of data mining tools.

2. Understand and implement classical models and algorithms in data warehouses and data mining

3. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

4. Master data mining techniques in various applications like social, scientific and environmental context.

5. Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Outcomes

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

CO1. Able to get the acquaintance to WEKA tool

CO2. Competent to preprocess the data for mining

CO3. Proficient in generating association rules

CO4. Able to build various classification models

CO5. Able to realize clusters from the available data

Catalog Description

The main objective of this lab is to impart the knowledge on how to implement classical models and algorithms in data warehousing and data mining and to characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering. At the end, the course provides a comparison of different conceptions of data mining.

List of Experiments (Indicative)

1	Demonstration of data pre-processing on datasets	**2 lab hours**
2	To list all the categorical (or nominal) attributes and the real valued attributes	**4 lab hours**
3	Create a data classification model using decision tree	**4 lab hours**
4	Create a data classification model using Naive Bayes	**2 lab hours**
5	Create a data classification model using rule based classifies	**2 lab hours**
6	Create a data classification model using statistical classifiers.	**4 lab hours**
7	Create a data classification model using neural networks.	**4 lab hours**
8	Create a data classification model	**4 lab hours**

9	Demonstrate the working of k-means algorithm for clustering the data.	**4 lab hours**
10	Create a clustering model using hierarchical clustering algorithm.	**2 lab hours**

Modes of Evaluation: Quiz I/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	Able to get **the** acquaintance to WEKA tool	**PO5**
CO2	Competent to preprocess the data for mining	**PO2**
CO3	Proficient in generating association rules	**PO4**
CO4	Able to build various classification models	**PO3**
CO5	Able to realize clusters from the available data	**PO4**

		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	Skills	Best Practices	Professional Responsibilities	Ethics
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO
ETCS 463A	Data warehouse and data mining Lab		2	3	3	3								3	2	3	1

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS421A	Internet of Things	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Sensors, System Integration				
Co-requisites	Cloud and Network Security				

Course Objectives

The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-time IoT based projects

Course Outcomes

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

CO1. Understand IoT and its hardware and software components

CO2. Interface I/O devices, sensors and communication mobiles

CO3. Remotely monitor data and control devices
CO4. Develop real life IoT based projects

Catalog Description

The Internet of Things (IoT) is everywhere. It provides advanced data collection, connectivity, and analysis of information collected by computers everywhere—taking the concepts of Machine-to-Machine communication farther than ever before. This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions.

Course Content

Unit I: **8 lecture hours**

Introduction to IoT: Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs. Machine to Machine, Difference between IoT and M2M, Software Define Network

Unit II: **9 lecture hours**

Network and Communication Aspects: Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

Unit III: **10 lecture hours**

Challenges in IoT: Design challenges, Development challenges, Security challenges, other challenges. Home automation, Industry applications, Surveillance applications, Other IoT applications

Unit IV: **12 lecture hours**

Developing IoT's: Input/output Programming: Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

Text Books

1. Vijay Madisetti, ArshdeepBahga, "Internet of Things: A Hands-On Approach"

2. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

Modes of Evaluation: Quiz I/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	Understand IoT and its hardware and software components	PO2
CO2	Interface I/O devices, sensors and communication mobile.	PO1
CO3	Remotely monitor data and control devices	PO4
CO4	Develop real life IoT based projects	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	Skills	Best Practices	Professional Responsibilities	Ethics	Analysis

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	PSO5
ETCS421A	Internet of Things	2	2	3	3									3		2		3

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS457A	**Internet of Things Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Sensors, System Integration				
Co-requisites	Cloud and Network Security				

Course Objectives

The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-time IoT based projects

Course Outcomes

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

CO1. Understand IoT and its hardware and software components
CO2. Interface I/O, sensors and communication mobiles
CO3. Remotely monitor data and control devices
CO4. Develop real life IoT based projects

Catalog Description

This course complements ETCS 480A. This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions.

List of Experiments (Indicative)

1	Start Raspberry Pi and try various Linux commands in command terminal window	**2 lab hours**
2	Read your name and print Hello message with name.	**2 lab hours**
3	Read two numbers and print their sum, difference, product and division.	
4	Word and character count of a given string	
5	Area of a given shape (rectangle, triangle and circle) reading shape and appropriate values from standard input	**2 lab hours**
6	Print a name 'n' times, where name and n are read from standard input, using for and while loops.	
7	Handle Divided by Zero Exception.	
8	Print current time for 10 times with an interval of 10 seconds.	**2 lab hours**
9	Read a file line by line and print the word count of each line.	
10	To interface LED/Buzzer with Arduino/Raspberry PiandwriteaprogramtoturnONLEDfor1 secafterevery2 seconds.	**2 lab hours**
11	Switch on a relay at a given time using cron, where the relay's contact terminals are connected to a load.	**2 lab hours**
12	To install MySQL database on Raspberry Pi and perform basic SQL queries.	**2 lab hours**
13	Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.	**2 lab hours**
14	WriteaprogramonArduino/RaspberryPitosubscribetoMQTTbrokerfortemperaturedata	**2 lab**

	andprint it.	**hours**
15	WriteaprogramtocreateTCPserveronArduino/RaspberryPiandrespondwithhumidity data to TCP client when requested.	**3 lab hours**

Modes of Evaluation: Quiz I/Oral practical oral exam/presentation/projects/Practical 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	Understand IoT and its hardware and software components	**PO2**
CO2	Interface I/O devices, sensors and communication mobile.	**PO1**
CO3	Remotely monitor data and control devices	**PO4**
CO4	Develop real life IoT based projects	**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	Skills	Best Practices	Profession Responsibilities	Ethics	Analysis

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	PSO5
ETCS457A	Internet of Things	2	2	3	3									3		2		3

1=weakly mapped

2= moderately mapped

3=strongly mapped