K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING AND TECHNOLOGY

Bachelor of Science (Honours) Data Science
B.Sc. (H) Data Science

Programme Code: 84

2022-25

Approved in the 29th Meeting of Academic Council Held on 09 August 2022

Academic Council * Member Secretary * K.R. Mangalam University

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

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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. Data Science programs have exploded in academics as university administrators have rushed to meet the demand K.R. Mangalam University is in the process of transforming to National Educational Policy 2020. In consultation with Deans, Faculty Members, Industry Experts, and University Alumni, the Academic council constituted school-wise committees to draft the curriculum. The curriculum of B.Sc. (H) Data Science primarily lays emphasis on designing a programme 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 programme is spread over three years in six semesters. The total number of credits is 160. 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. Discipline 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.

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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 student apply the 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 Modeling / Probability and Statistics / Artificial Intelligence / Databases / Predictive Modeling / Statistical Data Analysis/ Neural Networks.

Career Options:- Opportunities exist in IT industry, freelancers, education and forensics.

Program Educational Objectives (PEO)

PEO 1: To develop graduates who have strong foundation of knowledge and skills in the field of computer science and engineering.

PEO 2: To develop graduates who are employable in industries/public sector/research organizations or work as an entrepreneur.

PEO 3: To foster graduates who can provide solutions to challenging problems in their profession by applying computer engineering theory and practices.

PEO 4: To encourage graduates who can provide leadership and are effective in multidisciplinary environment.

PEO 5: To develop ability to demonstrate team work with the ability of leadership, analytical reasoning for solving time critical problems and strong human values for responsible professional.

PEO 6: To impart knowledge and skills to analyze, design, test and implement diverse range of technology.

Program Outcomes (PO)

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

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

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

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

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

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

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

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

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

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

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

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

Program Specific Outcomes (PSO)

PSO 1 Application of Concepts: Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using principles of data science and data mining software's.

PSO 2 Ethics: Recognize and analyses ethical issues in business related to intellectual property, data security, integrity, and privacy.

PSO 3 Analysis: Utilize the data science theories for societal and environmental concerns.

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 is given in the following pages. These are arranged as semester-wise. For each course, the first line contains; Course Code and Credits (C) of the course.

This is followed by the course objectives, course outcome and the syllabus (Unit I to IV), Text book and reference books.

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

	Semester I	**Semester II**	**Semester III**	**Semester IV**	**Semester V**	**Semester VI**	**Total**
Course	8	8	10	11	11	8	56
Credit	27	23	28	31	23	28	160

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

SEMESTER I

SNO		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	CC	ETCS316A	Web Technologies	3	1	-	4
2	CC	ETPH103A	Mechanics	4		-	4
3	CC	ETEC215A	Embedded Robotics and IOT	4	-	-	4
4	CC	ETCS104A	Introduction to Computer Science and Programming in Python	3	1	-	4
5	SE	ETMC121A	Management Thoughts and Applications	3	0	0	3
6	SE	ETCS150A	Introduction to Computer Science and Programming in Python Lab	-	-	2	1
7	SE	ETCA164A	Web Technologies Lab	-	-	2	1
8	SE	ETPH153A	Mechanics Lab	0	0	4	2
9	SE		Open Elective	4	-	-	4
TOTAL				**21**	**2**	**8**	**27**

SEMESTER II

SNO		COURSE CODE	COURSE TITLE	L	T	P	C
1	CC	ETMA124A	Ordinary Differential Equations	4	-	-	4
2	CC	UCES125A	Environmental Studies	3	-	-	3
3	CC	ETCS501A	Languages of Data Modeling	3	1	-	4
4			Open Elective	4	-	-	4
5		ETCS112A	Object Oriented Programming	3	1	-	4
6		ETCS551A	Languages of Data Modeling Lab	-	-	2	1
7		ETCS166A	Object Oriented Programming Lab	-	-	2	1
		ETMA174A	Ordinary Differential Equations Lab			4	2
			TOTAL	**17**	**2**	**8**	**23**

SEMESTER III

SNO		COURSE CODE	COURSE TITLE	L	T	P	C
1	CC	ETCS211A	Operating Systems	3	1	-	4
2	CC	ETCS217A	Data Structures	3	1	-	4
3	CC	ETCS304A	Computer Networks	3	1	-	4
4	CC	ETMA215A	Probability and Statistics	4	-	-	4
5	CC	ETCS231A	Discrete Mathematics	3	1	-	4
6	SE	UCDM301A	Disaster Management	3	-	-	3
7	SE	ETCS255A	Operating Systems Lab	-	-	2	1
8	SE	ETCS365A	Computer Networks Lab	-	-	2	1
9	SE	ETCS 257A	Data Structures Lab	-	-	2	1
10	SE	ETCS228A	Employability and Analytical Skills-I	2	-	-	2
TOTAL				**22**	**4**	**6**	**28**

SEMESTER IV

SNO		COURSE CODE	COURSE TITLE	L	T	P	C
1	CC	ETCS202A	Software Engineering	3	1	-	4
2	CC	ETCS401A	Artificial Intelligence	3	1	-	4
3	CC	ETCS307A	Database Management Systems	3	1	-	4
4	CC	ETMA214A	Linear Algebra	5	1	-	6

5	CC	ETCS 220A	Analysis and Design of Algorithms	3	1	-	4
6	SE	ETCS252A	Software Engineering Lab	-	-	2	1
7	SE	ETCS451A	Artificial 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
10	SE	ETCS325A	Employability and Analytical Skills-II	2	-	-	2
11	SE	ETMC602A	Essentials of Organizational Behaviour	3	-	-	3
TOTAL				**22**	**5**	**8**	**31**

SEMESTER V

SNO		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
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	SE	ETCS350A	Programming in MATLAB Lab	-	-	2	1
7	SE		DSE -1	3	-	-	3
8	SE		DSE -1 Lab	-	-	2	1
9	SE		DSE - 2	3	-	-	3
10	SE		DSE - Lab	-	-	2	1
11	SE	ETCS330A	Employability and Analytical Skills-III	2	-	-	2
TOTAL				16	2	10	**23**
DSE - 1							
(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
DSE - 2							
(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

SNO		COURSE CODE	COURSE TITLE	L	T	P	C
1	CC	ETCS520A	Internet Technologies	3	1		4
2	CC	ETCS519A	Blockchains	3	1	-	4
3	CC	ETCS222A	Computer Organization & Architecture	3	1	-	4
4	CC	ETCS423A	Neural Network	4	-	-	4
5	SE	ETCS561A	Blockchains Lab	-	-	2	1
6	SE		DSE -3	4	-	-	4
7	SE		DSE -3 Lab	-	-	2	1
8	SE	ETCS464A	Major Project	-	-	12	6
TOTAL				17	3	16	**28**
TOTAL CREDITS				**163**			

DSE -3							
(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

		DSE -4					
	SE	ETCS464A	Major Project	-	-	12	6

Semester I

ETCS316A	Web Technologies	L	T	P	C
Version 1.0		3	1	0	4
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/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	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	Application of Concepts	Ethics	Analysis
Course Code	Course Title	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS316A	WEB TECHNOLOGIES	2	2	2	3	3	-	-	-	-	-	-	-	3	-	-

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

ETPH103A	Mechanics	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Basic Physics and Mathematics				
Co-requisites					

Course Objectives

1. To acquire the knowledge of fundamentals of motion of objects, work, energy and collisions
2. To understand the concepts of rotational dynamics, elasticity and fluid motion.
3. To gain insight to the theory of gravitation and oscillations.
4. To have an insight about non-inertial systems and Special Theory of Relativity.

Course Outcomes

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

CO1. Better understand the laws of physics governing the motion of physical objects and relationship between force, work and energy.

CO2. Comprehend the concept of rotational motion of objects, elastic properties of the materials and motion of fluids.

CO3. Have an understanding of motion under gravitational force of attraction and simple harmonic motion.

CO4. Gain deeper understanding of Special Theory of Relativity, Lorentz Transformation, Mass energy transformations.

Catalog Description

This course is intended to introduce the basic concepts of physics related to motion of objects. It discusses the logic behind many events that we observe around us in day to day life. It emphasizes on the relationship between force, matter and motion under different circumstances. This course is a bridge between the basic and advance concepts of physics.

Course Content

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable-mass system:

motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. (6 Lectures)

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. (4 Lectures)

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. (3 Lectures)

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. (12 Lectures)

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.(3 Lectures)

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. (2 Lectures)

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. (3 Lectures)

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite incircular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of globalpositioning system (GPS). (6 Lectures)

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Dampedoscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. (7 Lectures)

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.

Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. (4 Lectures)

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. (10 Lectures)

Text books:

1. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000

Reference book(s) [RB]:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

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	Better understand the laws of physics governing the motion of physical objects and relationship between force, work and	PO1, PO2, PO3 & PO6

	energy.	
CO2	Comprehend the concept of rotational motion of objects, elastic properties of the materials and motion of fluids.	**PO1, PO2, PO3 & PO6**
CO3	Have an understanding of motion under gravitational force of attraction and simple harmonic motion.	**PO1, PO2, PO3 & PO6**
CO4	Gain deeper understanding of Special Theory of Relativity, Lorentz Transformation, Mass energy transformations.	**PO1, PO2, PO3 & 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	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETPH 107A	Mechanics	2	2	2	-	-	2	-	-	-	-	-	-	3	-	2

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

ETEC215A	Embedded Robotics and IOT	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

- To understand the basic of embedded system.
- To analyze the complex circuits and build new designs of analog to digital conversion.
- To be able to perform analysis of embedded C based circuits with robotics applications
- To gain basic insight of semiconductors-based switching and amplifying circuits, also with brief overview of working of logic gates.

Course Outcomes

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

CO1 Understand and apply Knowledge of Embedded Circuits in making real time projects to solve engineering difficulties.
CO2 Determine an understanding of logic gates and C language with electronic devices.
CO3 Demonstrate the ability to identify digital circuits. Utilization of the knowledge gained to solve problems.
CO4 Create an understanding of IOT & robotics devices application to existing setup.

Course Content

UNIT I **14 HRS**

Introduction to Embedded Systems: Introduction to Basic Electronics Components, Introduction to Microprocessor and Microcontroller, Difference between Microcontroller and Microprocessor, Introduction to Embedded System, Introduction to Arduino, Types of Microcontrollers: 8051, PIC, AVR & ARM, parametric comparisons among all, Reading Datasheet & schematics, Advantages of Atmega328,

UNIT II **10 HRS**

Robotics: Introduction to robotics: Automation, Anatomy of Robots, Manipulators, Robot control, History of robots, Types of Main bodies, Tasks Planning for robots, Robot's mechanisms, Manipulators Mechanisms-I, Actuators for Robots-Part I, Stepper motor, Performance characteristic, Sensors and Controllers in robots, Incremental encoders and position, velocity sensors, external state sensors.

UNIT III **8 HRS**

Internet of Things: IOT Introduction and its Architecture (Why, What and How), Hardware in IOT, Future in IOT, Introduction to ESP8266 Wi-Fi Module, IOT Basics: IOT definition, applications in different domains, trends in IOT market. IOT Architecture, Protocols Introduction (MQTT, AMQP, CoAP).

UNIT IV **8 HRS**

Sensors For Robotic Applications: Sensor Categories, Binary Sensor, Analog versus Digital Sensors, Shaft Encoder; A/D Converter, Position Sensitive Device; Compass, Gyroscope, Accelerometer, Inclinometer. Recap of Embedded C: Datatypes, Array, Conditional Statements, Functions / Call-back function Structures, Pointers, Storage classes, Embedded Controllers, Interfaces, Operating System - Industrial Robots.

TEXT BOOKS:

1. Peter Marwedel, book: Embedded System Design 1st Edition, Kindle Edition
2. "Rise of the Robots: Technology and the Threat of a Jobless Future", by Author: Martin Ford
3. "Robotics: Everything You Need to Know About Robotics from Beginner to Expert", by Author: Peter Mckinnon

REFERENCE BOOKS:

- "Making Simple Robots: Exploring Cutting-Edge Robotics with Everyday Stuff", by Author: Kathy Ceceri
- "Real-Time C++: Efficient Object-Oriented and Template Microcontroller Programming", 14 May 2018 by Author Christopher Kormanyos.

Program Articulation Matrix: Mapping of Course Outcome (COs) with Program Outcomes (POs) and Programme Specific Outcomes (PSOs)

Examination Scheme:

Evaluation Scheme:				
	Evaluation Component	**Duration**	**Weightage (%)**	**Date**
1	**Continuous Assessment (Quiz/Assignment/ Presentation/ Extempore)	-	20	
2	Mid Term Examination (Written Examination)	90Minutes	20	
3	Attendance		10	
4	End Term Examination (Written Examination)	180 Minutes	50	
Total			**100**	

Course Code	**Course Outcome**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
ETEC215A ER&I	CO1	1	-	-	-	-	-	-	-	-	-	1	-	1	-
	CO2	2	-	-	-	-	-	-	-	-	-	-	-	1	-
	CO3	1	-	-	-	1	-	-	2	-	-	-	-	-	-
	CO4	-	2	3	3	-	-	-	-	-	-	-	1	-	-
	CO5	-	-	-	-	-	1	2	-	-	-	-	2	-	-
	CO6	-	-	-	-	1	-	-	-	-	2	3	-	-	-

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

ETCS 104A	Introduction to Computer Science and Programming in Python	L	T	P	C
Version 1.0		3	1	0	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:

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/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

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

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

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Develop 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	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 104A	Introduction to Computer Science and Programming in Python	3	3	2	3	-	-	-	-	-	-	-	-	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: **10 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/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	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	Application of Concepts	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETMC 121A	MANAGEMENT THOUGHTS AND APPLICATIONS	-	-	2	1	-	-	-	-	-	2	1	-	3	-	3

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

ETCS 150A	Introduction to Computer Science and Programming in Python 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.

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,

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:

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/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

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

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

Mapping between COs and Pos		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Develop 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	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 150A	Introduction to Computer Science and Programming in Python Lab	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-

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: · Use user defined function to get array of values and sort them in	**10 lab hours**

	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	Application of Concepts	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCA 164A	WEB TECHNOLOGIES LAB	2	2	-	3	3	-	-	-	-	-	-	-	3	-	-

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

ETPH153A	Mechanics Lab	L	T	P	C
Version 1.0		0	0	4	2
Pre-requisites/Exposure	-				
Co-requisites	-				

Course Objectives

1. Demonstration cum laboratory sessions on the concepts of mechanics such as moment of inertia, determination of 'g' and elastic constants of materials.
2. Sessions on the review of scientific laboratory report writing, and on experimental data analysis.
3. Expand and exercise the students' physical intuition and thinking process through the experiments.
4. Interpretation of experimental data.

Course Outcomes

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

CO1. Acquire fundamental knowledge of laboratory instruments and their uses.
CO2. Better insight aboutdata collection techniques.
CO3. Better understanding of data interpretation and error analysis..
CO4. Acquire knowledge about the techniques related data analysis and curve fitting.

Catalog Description

This course involves the experimental verification of concepts of mechanics. The course is design to give knowledge how to use basic instruments in laboratory and laboratory experiment protocols. The main focus is on data collection techniques and the data interpretation. For this purpose a series of experiments have been set. The difficulty level of experiments is set easy to moderate level due to introductory physics.

List of Experiments (Indicative)

1	Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.	**2 lab hours**
2	To study the random error in observations.	**2 lab hours**
3	To determine the height of a building using a Sextant.	**2 lab hours**

4	To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.	**2 lab hours**
5	To determine the Moment of Inertia of a Flywheel.	**2 lab hours**
6	To determine g and velocity for a freely falling body using Digital Timing Technique	**2 lab hours**
7	To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).	**2 lab hours**
8	To determine the Young's Modulus of a Wire by Optical Lever Method.	**2 lab hours**
9	To determine the Modulus of Rigidity of a Wire by Maxwell's needle.	**2 lab hours**
10	To determine the elastic Constants of a wire by Searle's method.	**2 lab hours**
11	To determine the value of g using Bar Pendulum.	**2 lab hours**
12	To determine the value of g using Kater's Pendulum.	**2 lab hours**

References for Laboratory Work:

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt.Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

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

Examination Scheme:

Components	Quiz	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	Acquire fundamental knowledge of laboratory instruments and their uses.	**PO2**
CO2	Better insight aboutdata collection techniques.	**PO3**
CO3	Better understanding of data interpretation and error analysis.	**PO4**
CO4	Acquire knowledge about the techniques related data analysis and curve fitting.	**PO2 & 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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETPH 153A	Mechanics Lab	2	3	2	2	-	-	-	-	-	-	-	2	3	-	3

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

Semester II

ETMA124A	Ordinary Differential Equations	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Differentiation, Integration				
Co-requisites	--				

Course Objectives

1. Identify, analyse and subsequently solve physical situations whose behaviour can be described by ordinary differential equations
2. Enhance and develop the ability of using the language of mathematics in analyzing the real-world problems of sciences and engineering.
3. Demonstrate the strength of mathematics in modelling and simulating real world problems of science and engineering.

Course Outcomes

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

CO1 Understand the genesis of ordinary differential equations.

CO2 Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.

CO3 Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is nomethod available to solve such equations.

CO4 Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.

CO5 Analyse mathematical models using first order differential equations to solve application problems such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields.

CO6 Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day-to-day problems arising in physical, chemical and biological disciplines.

Catalog Description

In this introductory course on Ordinary Differential Equations, we first provide basic terminologies on the theory of differential equations and then proceed to methods of solving various types of ordinary differential equations. We handle first and second order differential equations and then higher order linear differential equations. The course demonstrates the usefulness of ordinary differential equations for modelling physical, biological, financial or economic problems. The ability to predict the way in which these systems evolve or behave is determined by modelling these systems and find solutions of the equations explicitly or approximately. The course includes complementary mathematical approaches for their solution, including analytical methods, graphical analysis and numerical techniques. A significant part of the course is emphasis on solving linear systems with computer software as a mathematical tool.

Course Content

UNIT-I

First Order Differential Equations: Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions. Picard's method of successive approximations and the statement of Picard's theorem for the existence and uniqueness of the solutions of the first order differential equations.

UNIT-II

Second Order Linear Differential Equations: Statement of existence and uniqueness theorem for linear differential equations, General theory of linear differential equations of second order with variable coefficients, Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, Transformations of the equation by changing the dependent/independent variable, Method of variation of parameters and method of undetermined coefficients, Reduction of order, Coupled linear differential equations with constant coefficients.

UNIT-III

Higher Order Linear Differential Equations: Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler-Cauchy equation, Method of variation of parameters and method of undetermined coefficients, Inverse operator method.

UNIT-IV

Series Solutions of Differential Equations: Power series method, Legendre's equation, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomials, Frobenius method, Bessel's equation, Bessel functions and their properties, Recurrence relations.

Applications: Orthogonal trajectories, Acceleration-velocity model, Minimum velocity of escape from Earth's gravitational field, Growth and decay models, Malthusian and logistic population models, Radioactive decay, Drug assimilation into the blood of a single cold pill; Free and forced mechanical oscillations of a spring suspended vertically carrying a mass at its lowest tip, Phenomena of resonance, LCR circuits, Lotka-Volterra population model.

Reference Books/Materials

1. Belinda Barnes & Glenn Robert Fulford (2015). Mathematical Modelling with Case Studies**:** A Differential Equation Approach Using Maple and MATLAB (2nd edition). Chapman & Hall/CRC Press, Taylor & Francis.
2. H. I. Freedman (1980). Deterministic Mathematical Models in Population Ecology. Marcel Dekker Inc.
3. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.
4. Daniel A. Murray (2003). Introductory Course in Differential Equations, Orient.
5. B. Rai, D. P. Choudhury & H. I. Freedman (2013). A Course in Ordinary Differential Equations (2nd edition). Narosa.
6. Shepley L. Ross (2007). Differential Equations (3rd edition), Wiley India.
7. George F. Simmons (2017). Differential Equations with Applications and Historical Notes (3rd edition). CRC Press. Taylor & Francis.

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 genesis of ordinary differential equations.	PO3
CO2	Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.	PO2

CO3	Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is no method available to solve such equations.	**PO4**
CO4	Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.	**PO5**
CO5	Analyze mathematical models using first order differential equations to solve application problems such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields.	**PO1**
CO6	Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day-to-day problems arising in physical, chemical and biological disciplines.	**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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETMA 124A	Ordinary Differential Equations	3	3	3	2	2	2	-	-	-	-	-	-	2	-	3

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/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	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	Application of Concepts	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
UCES 125A	Environmental Studies	-	-	-	-	-	2	3	3	-	3	-	-	2	1	-

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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

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/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	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	**PO9, PSO 1**

	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.	

		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 112A	Object oriented programming	-	2	3	3	3	-	-	-	3	-	-	-	3	-	-

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	**PO5**

	scheduling.	
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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 operate 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.

Course Content

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	**2 lab hours**

	argument is omitted, the number will be squared. Write a main ( ) function that gets values from the user to test this function.	
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	**2 lab hours**

	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 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 values NUMERATOR & 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 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.	**2 lab hours**
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/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand 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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS 166A	Object oriented programming Lab	-	2	3	-	3	-	-	-	3	-	-	-	3	-	-

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

ETMA174A	Ordinary Differential Equations Lab	L	T	P	C
Version 2.0		0	0	4	2
Pre-requisites/Exposure					
Co-requisites	MATLAB Software				

Course Objectives

The purpose of these labs is to help students talk and write in meaningful ways about mathematics. Specifically, to describe quantities and changes in quantities clearly in terms of context, to make rigorous arguments about how such quantities are related, and to make connections between these features in the contexts and on graphs.

Course Outcomes

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

CO1. Test program output for accuracy using hand calculations and plotting the different type of the differential equation graphs

CO2. Analyses the applicability solve of second order differential equation and find the double and triple integration of function

CO3. Find the evaluate the area of closed curve and arc length.

CO4. The ability to draw two- and three-dimensional graph.

CO5. Write efficient, well-documented MATLAB code and present numerical results in an informative way of different real-life problems.

Catalog Description

The aim of this course is to learn theory of ordinary differential equations and solution methods. Use knowledge of Ordinary Differential Equations (ODEs), modelling, the general structure of solutions, and analytic and numerical methods for solution. Nature of ODEs.. After completion of the course, the students will be able to solve the ODEs independently. They can solve PDEs in higher dimension. Convert ordinary differential equations to canonical form.

Course Content

List of practical

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model)

9. Basic Epidemic model of influenza
10. Basic Battle model

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & setup by the concerned person as per the scope of the syllabus.

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 genesis of ordinary differential equations.	**PO3**
CO2	Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.	**PO2**
CO3	Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is no method available to solve such equations.	**PO4**
CO4	Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.	**PO5**
CO5	Analyze mathematical models using first order differential equations to solve application problems such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields.	**PO1**
CO6	Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day-to-day problems arising in physical, chemical and biological disciplines.	**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	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETMA 174A	Ordinary Differential Equations Lab	3	3	3	2	2	2	-	-	-	-	-	-	2	-	3

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

Semester III

ETCS211A	Operating Systems	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	--				
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/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	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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS 211A	Operating Systems	2	-	3	3	3	-	-	-	-	-	-	-	2	-	-

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.
C02. 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/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 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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS 217A	Data Structures	2	2	-	3	3	-	-	-	-	-	-	-	3	-	2

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

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.
CO2. 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.

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 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	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 304A	COMPUTER NETWORKS	-	2	-	3	3	-	-	-	-	-	2	3	3	-	3

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO4	PSO5
ETMA 215A	Probability and Statistics	3	2	2	3	3	-	-	-	-	-	2	-	2	-	3

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

ETCS231A	Discrete Mathematics	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	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 231A	Discrete Mathematics	3	3	2	-	-	-	-	-	-	-	-	-	2	-	-

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

UCDM301	Disaster Managment	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.),MassDisastersandMultinational Liability: 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/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.	**PS01**
CO2	The course examines disaster profile of our country and illustrates the role played by various governmental and non-governmental organizations & its effective management.	**P03**
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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
UCDM 301A	Disaster Management	-	-	2	-	-	3	-	-	-	-	-	2	2	-	-

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	**2 lab hours**

	user processes. Use FCFS scheduling for the processes in each queue.	
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/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	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	**PO1**

	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.	**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	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 255A	Operating Systems Lab	2	-	3	3	3	-	-	-	-	-	-	-	-	1	-

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/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the structure and organization of 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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS 365A	Computer Networks Lab	-	3	3	-	2	-	-	3	-	-	-	-	3	3	-

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 complexity.

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/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 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	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 257A	Data Structures Lab	2	2	-	3	3	-	-	-	-	-	-	-	3	-	2

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

ETCS228A	Employability and Analytical Skills-I	L	T	P	C
Version 1.0		2	0	0	2
Pre-requisites/Exposure	--				
Co-requisites	MS Excel				

COURSE OBJECTIVES

- Professional development of the students.
- To develop a platform with Intelligent combination of training, technology and interactive learning.
- Converting fresh graduates into priced assets who are ready to face any challenge head-on.
- Crafting candidates to be winners and train them to handle their failures as well
- To train students and make them job ready
- To understand HR perspective and Industry hiring patterns
- To understand and create Cross Industry and Industry specific Training Modules

COURSE OUTCOMES (COs)

- Analytical and Calculative skills
- Technical Knowledge
- Logic building
- Communication skills
- Grooming
- Presentation skills
- Group discussion & Interview handling skills

Modes of Evaluation: Quiz/Assignment/ Presentation/ Extempore/ Written Examination
Examination Scheme:

Evaluation Scheme:				
	Evaluation Component	**Duration**	**Weightage (%)**	**Date, Time & Venue**
1	Quiz/Assignment/ Presentation/ Extempore	120 Minutes	20	
2	Written Examination	120 Minutes	20	
3	Attendance		10	
4	End Term Examination	120 Minutes	50	
Total			**100**	

SYLLABUS

UNIT - I

- Communication
- Introduction to Communication
- Types of communication
- Verbal & Nonverbal Communication
- Barriers to Communication
- Body language
- Listening Skills
- Activity
- Language

Quant

- Types of Numbers, HCF & LCM
- Divisibility, Unit Digit.
- Remainder Theorem
- Equations, Factorials.

UNIT-II

- Objective: Vocabulary Building & general speaking
- Basic Grammar/Communicative Grammar
- Parts of speech
- Nouns
- Pronouns: Noun Pronoun Agreement, Types with special emphasis over relative pronouns
- Verbs: Introduction Principal verbs and auxiliary verbs, subject-verb agreement
- Adjectives: degrees of comparison
- Adverb: Types and its usage in sentences
- Conjunctions: Coordinating and Co-relative conjunctions
- Prepositions
- Articles: Definite and Indefinite articles
- Usage of Tenses
- Subject verb agreement
- Sentence Structure: Simple Complex and Compound sentences
- Clauses

Quant

- Progression, Probability
- Permutation & Combination, Average, Percentage, Ratio & Proportion, Partnership
- Profit & Loss

UNIT III **(Lectures-)**

- Word formation
- Theory and exercise
- Synonyms and antonyms
- One-word substitutes
- Idioms
- Phrasal verbs
- Pair of words
- Homonyms, hyponyms, hypernyms
- Linking words: sequencing of sentences (to form a coherent paragraph
- Paragraph writing
- Supplying a suitable beginning/ending/middle sentence to make the paragraph coherent
- Idiomatic language (with emphasis on business communication),
- Punctuation depending on the meaning of the sentence, run on errors, sentence fragments, coma splices

Quant

- Problems on Ages.
- Mixture & Allegation
- Simple Interest & Compound Interest.

UNIT IV **(Lectures-)**

- General Essay writing, Writing Issues and Arguments (with emphasis on creativity and analysis of a topic)
- Story writing
- Business letter writing: Guidance in framing a 'Statement of purpose',
- Letters of Recommendation
- Email writing, email and business letter writing etiquette,
- Letters of complaints/responses to complaint

Quant

- Time & Work.
- Time, Speed and Distance
- Data Interpretation.

Mapping of Course Outcome (Cos) with Program Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Code	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
ETCS228 A	CO1	3	3	-	-	-	-	-	-	-	3
	CO2	3	3	-	-	-	-	-	-	-	3
	CO3	3	2	-	-	-	-	-	-	-	3
	CO4	3	2	-	-	-	-	-	-	-	3

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

Semester IV

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:

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	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 202A	Software Engineering	3	3	3	3	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; depth first, 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	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 401A	ARTIFICIAL 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 timestamp based 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/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	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	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 307A	Database Management Systems	1	2	3	3	3	-	-	-	3	-	-	-	3	-	-

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

1. Provide the brief idea to students of vector spaces, Basis and dimensions.
2. To understand the consequences of linear transformation and matrix representation of a linear transformation.
3. Find the Eigen values and Eigen vectors of LT. Diagonalization, Cayley Hamilton theorem.
4. Find the inner product spaces and Orthonormal basis.
5. 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

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.
CO2. Appreciate and identify linear transformations of finite dimensional vector spaces and compose their matrices in specific bases.
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.
CO4. Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.
CO5. Determine the concepts of Halbert space and inner product space.
CO6. Apply the mathematical modeling 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
ETMA 214A	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 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	**4 lab hours**

	scenario	
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	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 252A	Software Engineering Lab	3	3	3	3	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 Prolog/python.	**2 lab hours**
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.	**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 451A	ARTIFICIAL INTELLIGENCE LAB	2	3		3	3								3		

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

ETCS355A	Database Management 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	Analysis and Design of 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 Understand various sorting techniques.

CO 3 Analyze working of various operations on graphs.

CO 4 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	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
ETCS 262A	Analysis and design of algorithms Lab	-	2	3	-	3	-	-	-	3	-	-	-	3	-	-

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

ETCS325A	Employability and Analytical Skills-II	L	T	P	C
Version 1.0		2	0	0	2
Pre-requisites/Exposure	-				
Co-requisites	-				

COURSE OBJECTIVES

- Professional development of the students.
- To develop a platform with Intelligent combination of training, technology and interactive learning.
- Converting fresh graduates into priced assets who are ready to face any challenge head-on.
- Crafting candidates to be winners and train them to handle their failures as well
- To train students and make them job ready
- To understand HR perspective and Industry hiring patterns
- To understand and create Cross Industry and Industry specific Training Modules

COURSE OUTCOMES (COs)

- Analytical and Calculative skills
- Technical Knowledge
- Logic building
- Communication skills
- Grooming
- Presentation skills
- Group discussion & Interview handling skills

Modes of Evaluation: Quiz/Assignment/ Presentation/ Extempore/ Written Examination
Examination Scheme:

Evaluation Scheme:

	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue
1	Quiz/Assignment/ Presentation/ Extempore	120 Minutes	20	
2	Written Examination	120 Minutes	20	
3	Attendance		10	
4	End Term Examination	120 Minutes	50	
Total			**100**	

SYLLABUS

UNIT I **(Lectures-)**

- General speaking -Just a minute session,
- Reading news clippings in the class,
- Extempore speech, expressing opinions,
- Making requests/suggestions/complaints, telephone etiquette.
- Professional Speaking
- Elocutions
- Debate

Quant

- Mensuration.

Reasoning

- Number Series, Alpha-Numeric Series.

UNIT II

- Describing incidents and developing positive nonverbal communication. Analogies, YES-NO statements (sticking to a particular line of reasoning)
- Group discussion,
- Intricacies of a group discussion, topics for GD (with special focus on controversial topics),
- Structure of participation in a group discussion,
- Words often mis-used, words often mis-spelt,
- Multiple meanings of the same word (differentiating between meanings with the help of the given context),
- Business idioms and expressions foreign phrases, Enhanced difficulty level in spotting errors will be taken up with reference to competitive test based exercises.

Reasoning

- Seating Arrangement, Puzzle.
- Blood Relation, Coding & Decoding.

- **UNIT III** **(Lectures-)**
  - Group discussion Advance
  - Role Plays
  - Video Showcasing
  - Just a minute rounds
  - Extempore
  - Presentations – Team and Individual
  - Team Lead activities
  - Debates

- Free speech sessions

Reasoning

- Seating Arrangement, Puzzle.
- Data Sufficiency.
- Ranking Test, Venn-diagram, Statement and Conclusion, Statement and Inferences, Statement and Course of Action, Statement and Assumptions, Syllogism.

- **UNIT IV** **(Lectures-)**
  - Professional grooming
  - Inter personal skills,
  - brushing up on general awareness,
  - latest trends in their respective branches,
  - resume preparation,
  - Different types of interviews (with emphasis on personal interview), preparation for an interview,
  - areas of questioning,
  - answering questions on general traits like strengths/weaknesses/ hobbies/extracurricular activities, Importance of non-verbal communication while participating in interviews, tips to reduce nervousness during personal interviews,

Mapping of Course Outcome (Cos) with Program Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Code	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
ETCS325 A	CO1	3	3	-	-	-	-	-	-	-	3
	CO2	3	3	-	-	-	-	-	-	-	3
	CO3	3	2	-	-	-	-	-	-	-	3
	CO4	3	2	-	-	-	-	-	-	-	3

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

ETMC602A	Essentials of Organizational Behaviour	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	-				
Co-requisites	-				

Overview:

Human behaviour at work strives in the universal market, and to run the business effectively for a long term, it is critical for the organizations to shape their business with the current trends. For this, organizational behaviour is an important factor to operate the business. This course sheds light on understanding the employees in a better way to maximize the profits which are only possible by satisfying customer's needs which are the ultimate target of an organization. It also considers factors that hamper or foster job satisfaction. This course focuses on how managers become effective leaders by addressing the human side of enterprise. This helps examine teams, individuals, and networks in the context of job satisfaction, organization culture, leadership and conflict resolution, understanding employees better, establishing productive relationships with peers and seniors over whom the manager has no formal authority, managing the performance of individual subordinates, introduces a model for strategic career management.

The course will help students examine the contemporary principles, techniques and research findings in management and organizational behaviour that are driving high performance and continuous improvement in business today. To understand management and organizational behaviour, concepts associated with continuous improvement in individual and group processes will be discussed. The focus in this course structure is laid on Organizational Behaviours, Diversity in Organization, Attitudes and Job Satisfaction, Personality and Values, Perceptions and Individual Decision Making, Motivation Concepts, Foundations of Group Behaviour, Communication, Leadership, Power and Politics, and Conflict and Negotiation.

The course will be taught with a combination of lectures and experiential learning techniques so that students will learn the specifics of a particular subject matter and about their own strengths and weaknesses as a learner (i.e. learning how to learn from experience). Each topic will be presented as an educational intervention to facilitate each stage of the experience- based learning process. Personal Application assignments and simulations are designed to relate personal experiences. Observational methods and team project are added to facilitate the understanding of these experiences. Theories and models are introduced to form generalizations and mental models. And finally, the intervention is structured with the purpose that will encourage students to experiment with and test what they have learned in class as well as in other areas of their lives.

Objective and Expected Outcome

The main objective of this course is to understand the human interactions in an organization find what is driving it and influence it for getting better results in attaining business goals. The organizations in which people work have an effect on their thoughts, feelings, and actions. These thoughts, feelings, and actions, in turn, affect the organization itself.

This study aids to achieve the goals as it controls and develops human activity at work. The managers are responsible for the productivity. They need to make an impact on the employee behaviour, develop their skills, motivate them to work in a team collectively for better productivity and thus, ultimately achieve their targets.

This course will enable students to list and define basic organizational behaviour principles, and analyse how these influence behaviour in the workplace.

This will help analyse individual human behaviour in the workplace as influenced by personality, values, perceptions, and motivations. They would be able to outline the elements of group behaviour including group dynamics, communication, leadership, power & politics and conflict & negotiation and understand their own management style as it relates to influencing and managing behaviour in the organization systems. This course will enhance critical thinking and analysis skills through the use of management case studies, personal application papers and small group exercises.

Course Content:

UNIT I

Foundation and background of OB: contemporary challenges -workforce diversity, cross-cultural dynamics, changing nature of managerial work, ethical issues at work

UNIT II

Individual behaviour and processes: individual differences – values and attitudes; Perception- concept, process; Personality- concept, determinants; Learning and Reinforcement, Stress – causes, consequences and management

UNIT III

Interpersonal and team processes: Group, group development, developing teams – self-directed work teams, virtual teams; Empowerment - concept, significance, Conflict – concept, sources, types, management of conflict, Power and organizational politics

UNIT IV

Organizational processes and structure: organizational learning; organizational culture; organizational change and development

TEXT BOOK

1. Robbins, S.P., Organisational Behaviour , Prentice Hall of India, New Delhi

REFERENCE BOOKS:

1. Pareek, Udai, Understanding Organisational Behaviour, Oxford University Press, New Delhi
2. Robbins, S.P., Organisational Behaviour , Prentice Hall of India, New Delhi
3. Hellgiegel, D & J.W. Slocum, Organisational Behaviour, Thomson Learning
4. McSchane, Organisation Behaviour, TMH, New Delhi
5. Luthans, Fred, Organisational Behaviour, McGraw Hill, New York
6. New Storm and Keith Davis, Organisation Behaviour , TMH, New Delhi
7. Nelson, Debra L and James C Quick, Organisational Behaviour, Thomson Learning

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 practical application 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 502A	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 503A	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	**PO3**

	mathematical and statistical tools with modern technologies.	

		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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS 552A	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
ETCS 553A	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 especially 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 creates a useful function to be used later in another mathematical subject.

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/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Learn 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	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 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 $(D^2 + 5 D + 6)y = e^x$	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/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	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	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 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/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	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, 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	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 409A	ADVANCED COMPUTER NETWORKS	-	2	3	3	3	-	-	-	3	-	-	-	3	-	2

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 Toplology creation and REST API introduction. b. Influencing flows via cURL commands. c. Create a network and run a simple performance test. 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.	**4 lab hours**
8	The experiments 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 UdpServer 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	**8 lab hours**

	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 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/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	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 Communication and networks, layered architecture and their applications.	**PO4**
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	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 452A	ADVANCED COMPUTER NETWORKS LAB	2	2	2	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/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	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**

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

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	**2 lab hours**

	uplink & downlink frequency.	
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/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	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**

CO4	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**

		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 453A	Mobile and Wireless Communication Lab	2	3	3	-	2	-	-	2	3	-	-	-	3	-	-

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 http://www.deeplearningbook.org
8. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann Publisher

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

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	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	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 411A	Machine Learning	2	3	3	3	3								3		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. Datasets can 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/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Understand the 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	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 455A	Machine Learning Lab	-	3	3	-	2	-	-	2	-	-	-	-	3	-	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/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand soft computing 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**
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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS 517A	Soft Computing	2	2	2	3	3	2	-	-	-	-	-	-	3	-	-

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 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

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

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 backpropagation network in MATLAB.	

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

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand 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, PO9**
CO4	Develop application on different soft computing techniques like Fuzzy, GA and Neural network	**PO4, 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 559A	Soft Computing Lab	-	2	3	3	3	-	-	-	3	-	-	-	3	-	-

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

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 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	Application of Concept	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 519A	Big Data Analytics and Visualization	-	3	3	2	3	-	-	-	-	-	-	3	3	-	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/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	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	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	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 563A	Big Data Analytics and Visualization Lab	2	3	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 lead into scanning and attacking their own networks, no real network is harmed.

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

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 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**

		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 515A	Ethical hacking	-	2	3	3	3	-	-	-	3	-	-	-	3	2	-

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 analyze 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.

List of Experiments (Indicative)

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/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	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**
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	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 557A	Ethical Hacking Lab	-	2	3	-	3	-	-	-	3	-	-	-	3	2	-

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

ETCS330A	Employability and Analytical Skills-III	L	T	P	C
Version 1.0		2	0	0	2
Pre-requisites/Exposure	-				
Co-requisites	-				

COURSE OBJECTIVES

- Professional development of the students.
- To develop a platform with Intelligent combination of training, technology and interactive learning.
- Converting fresh graduates into priced assets who are ready to face any challenge head-on.
- Crafting candidates to be winners and train them to handle their failures as well
- To train students and make them job ready
- To understand HR perspective and Industry hiring patterns
- To understand and create Cross Industry and Industry specific Training Modules

COURSE OUTCOMES (COs)

- Analytical and Calculative skills
- Technical Knowledge
- Logic building
- Communication skills
- Grooming
- Presentation skills
- Group discussion & Interview handling skills

Modes of Evaluation: Quiz/Assignment/ Presentation/ Extempore/ Written Examination
Examination Scheme:

Evaluation Scheme:

	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue
1	Quiz/Assignment/ Presentation/ Extempore	120 Minutes	20	
2	Written Examination	120 Minutes	20	
3	Attendance		10	
4	End Term Examination	120 Minutes	50	
Total			**100**	

SYLLABUS

UNIT I **(Lectures-)**

- Different types of interviews (with emphasis on personal interview), preparation for an interview,
- areas of questioning,
- Answering questions on general traits like strengths/weaknesses/ hobbies/extracurricular activities,
- importance of non-verbal communication while participating in interviews, tips to reduce nervousness during personal interviews,
- handling stress,
- Suggestions for responding to tough/unknown questions, preparation on self and personality development

Quant & Reasoning

- Test series Practice
- Mass Hiring Companies Test Papers
- Doubt clearing sessions
- Mock tests
- One to One Feedback sessions

UNIT II

- Profile Building On LinkedIn
- Resume Building
- Video CV building.
- Professional Grooming
- E mail Writing

Quant & Reasoning

- Test series Practice
- Mass Hiring Companies Test Papers
- Doubt clearing sessions
- Mock tests
- One to One Feedback sessions

UNIT III **(Lectures-)**

- Interview Role Plays
- Individual Intro Video making
- Team Building sessions
- Self-analysis
- Telephone etiquettes

Quant & Reasoning

- Test series Practice
- Mass Hiring Companies Test Papers
- Doubt clearing sessions
- Mock tests
- One to One Feedback sessions

UNIT IV **(Lectures -)**

- Industry readiness (Resume writing, grooming, GDPI etc.)
- Grooming
- Mock sessions
- FAQs discussions
- Multiple Test series
- Brush-up on GDPI and Industry readiness

Quant & Reasoning

- Test series Practice
- Mass Hiring Companies Test Papers
- Doubt clearing sessions
- Mock tests
- One to One Feedback sessions

Mapping of Course Outcome (Cos) with Program Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Code	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
ETCS330A	CO1	3	3	-	-	-	-	-	-	-	3
	CO2	3	3	-	-	-	-	-	-	-	3
	CO3	3	2	-	-	-	-	-	-	-	3
	CO4	3	2	-	-	-	-	-	-	-	3

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

Semester VI

ETCS520A	Internet Technologies	L	T	P	C
Version 1.0		3	1	-	4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

This Subject is useful for Making own Web page and how to host own web site on internet. Also Students will learn what the protocols are involving in internet technology.

Course Outcomes

CO1. To understand the terms related to the Internet and how the Internet is changing the world.
CO2. To understand how computers are connected to the Internet and demonstrate the ability to use the World Wide Web.
CO3. Demonstrate an understanding of and the ability to use electronic mail and other internet based services
CO4. Understand the design principles of Web pages and how they are created
CO5. To develop an ability to create basic Web pages with HTML.

Catalog Description

On completion of this course, the students will be able tomake own web site and host their own web site on internet. Also students would have enough knowledge about what are the technologies used in internet.

Course Content

Unit I: **10 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: **8 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.
2. 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	To understand the terms related to the Internet and how the Internet is changing the world.	**PO1**
CO2	To understand how computers are connected to the Internet and demonstrate the ability to use the World Wide Web.	**PO2, PO3**
CO3	Demonstrate an understanding of and the ability to use electronic mail and other internet based services.	**PO4**
CO4	Understand the design principles of Web pages and how they are created.	**PO1, PO3, PO12**
CO5	To develop an ability to create basic Web pages with HTML.	**PO1, PO9, 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	Application of Concepts	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS520	Internet Technologies	3	2	3	3	-	-	-	-	2	-	-	3	3	-	2

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

ETCA519A	Blockchain	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Cryptography				
Co-requisites	Basic Mathematics				

Course Objectives

1. Help in understanding Creation of block and working of blockchain technology to innovate and improve business process.

Course Outcomes

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

CO1. Understand blockchain technology.
C02. Develop blockchain based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks.
CO3. Build and deploy block chain application for on premise and cloud-based architecture.
CO4. Integrate ideas from various domains and implement them using block chain technologyin different perspectives.

Catalog Description

Through this subject, student will be able to understand the coarse grained aspects of Blockchain Technology. Student will understand the applications of Blockchain and its working in networks. The internals of framework and working will be discussed throughout the course duration.

Course Content

Unit I: 8 lecture hours

Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Blockchain.

Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

Unit II: **12 lecture hours**

Bitcoin and Blockchain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation andblock relay.

Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, HashcashPoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Unit III: **10 lecture hours**

Permissioned Blockchain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

Enterprise application of Blockchain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain

Unit IV: **10 lecture hours**

Hyperledger Fabric: Architecture, Identities and Policies, Membership and Access Control,Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda

Text Books

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015
2. Josh Thompsons, “Block Chain: The Block Chain for Beginners- Guide to Blockchain Technology and Leveraging Block Chain Programming”
3. Daniel Drescher, “BlockChain Basics”, Apress; 1st edition, 2017
4. AnshulKaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.
5. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralizationand Smart Contracts Explained”, Packt Publishing

6. RiteshModi, “Solidity Programming Essentials: A Beginner’s Guide to Build SmartContracts for Ethereum and Block Chain”, Packt Publishing

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 block chain technology.	**PO1**
CO2	Develop blockchain based solutions and write smart contract using Hyperledger Fabricand Ethereum frameworks	**PO2, PO3**
CO3	Build and deploy block chain application for on premise and cloud-based architecture	**PO5**
CO4	Integrate ideas from various domains and implement them using blockchain technologyin different perspectives.	**PO5, PO6, 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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCA 519A	Block chain	3	3	3	-	2	2	-	-	-	-	-	2	3	-	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 423	Neural Network	2	3	-	3	3	-	-	-	-	-	-	-	3	3	2

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

ETCS561A	BlockchainsLab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Cryptography				
Co-requisites	Basics of Mathematics				

Course Objectives

The Lab taps into the transformative potential of block chain and related technologies to achieve the goals set out for Sustainable Development.

Course Outcomes

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

CO1.To understand the practical implementation of Blockchain technology.
CO2. To be able to explain the different components involved within Blockchain implementation.
CO3. To know when and why you may want to use Blockchain within your environment.
CO4. To be able to implement IoT asset tracking app using Block chain.
CO5. To be able to Secure art using block chain digital certificates.

Catalog Description

This course complements ETCS519A. It enables students to utilize potential of blockchain into anoptimal solution(s). The list of experiments helps to understand details of component, implementation and application domain of blockchain.

List of Experiments (Indicative)

1	Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on Cloud to run.	**2 lab hours**
2	Create and deploy a block chain network using Hyperledger Fabric SDK for JavaSet up and initialize the channel, install and instantiate chaincode, and perform invoke and query on your block chain network.	**2 lab hours**
3	Interact with a block chain network. Execute transactions and requests against a block chain network by creating an app to test the network and its rules.	**2 lab hours**
4	Deploy an asset-transfer app using block chain. Learn app development within a Hyperledger Fabric network.	**2 lab hours**

5	Use block chain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.	**2 lab hours**
6	Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Block chain Starter Plan. Use Hyperledger Fabric to invoke chaincode while storing results and data in the starter plan.	**2 lab hours**
7	Develop an IoT asset tracking app using Block chain. Use an IoT asset tracking device to improve a supply chain by using Block chain, IoT devices, and Node-RED.	**2 lab hours**
8	Secure art using block chain digital certificates. Node.js-based auction application can help democratize the art market.	**2 lab hours**
9	Mini projects such as : i) Block chain for telecom roaming, fraud, and overage management. See how communication service providers use block chain to enhance their value chains. ii) Use IoT dashboards toanalyze data sent from a Blockchain network. Build an IoT app and IoT dashboards with Watson IoT Platform and Node-RED to analyzeIoT data sent from a Block chain network. iii) Create an Android app with Block chain integration. Build a Block chain enabled health and fitness app with Android and Kubernetes	**10 lab hours**

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

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To understand the practical implementation of Block chain technology.	**PO1**

CO2	To be able to explain the different components involved within Block chain implementation.	**PO3**
CO3	To know when and why you may want to use Block chain within your environment.	**PO2, PO4**
CO4	To be able to implement IoT asset tracking app using Block chain.	**PO3, PO4, PO5**
CO5	To be able to Secure art using block chain digital certificates.	**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	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 660P	Blockchains Lab	2	2	3	3	3	-	-	-	1	-	-	-	3	-	2

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

ETCS464A	Major Project	L	T	P	C
Version 1.0		-	-	12	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.
CO2. Use the relevant tools necessary for engineering practice.
CO3. Define overall needs and constraints to solve a problem and develop/ design a prescribed engineering sub-system.
CO4. Communicate effectively and learn to be a team player.

Catalog Description

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

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

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

Course Content

The assignment to normally include:

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

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Use applied scientific knowledge to identify and implement relevant principles of mathematics and computer science.	**PO3**
CO2	Use the relevant tools necessary for engineering practice.	**PO5**
CO3	Define overall needs and constraints to solve a problem and develop/ design a prescribed engineering sub-system.	**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	Application of Concepts	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS464A	Major Project	-	-	3	-	2	-	-	-	-	3	-	-	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 centers 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: 12 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: 8 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/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	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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS 422A	Cloud Computing	2	3	3	2	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/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	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	Application of Concepts	Ethics	Analysis
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCA 362A	Cloud Computing Lab	2	3	3	2	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/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 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	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 424A	Data warehouse and data mining	3	3	-	3	3	-	-	-	-	-	-	-	3	2	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/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	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	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	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETCS 463 A	Data warehouse and data mining Lab	-	2	3	3	3	-	-	-	-	-	-	-	3	2	2

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/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 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	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 421A	Internet of Things	2	3	3	3	-	-	-	-	-	-	-	-	3	-	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	TointerfaceLED/BuzzerwithArduino/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	ToinstallMySQLdatabaseonRaspberryPiandperformbasicSQLqueries.	**2 lab hours**
13	WriteaprogramonArduino/RaspberryPitopublishtemperaturedatatoMQTT broker.	**2 lab hours**
14	WriteaprogramonArduino/RaspberryPitosubscribetoMQTTbrokerfortemperaturedataandprint it.	**2 lab hours**
15	WriteaprogramtocreateTCPserveronArduino/RaspberryPiandrespondwithhumidity datatoTCPclientwhenrequested..	**3 lab hours**

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

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand 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	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 457A	Internet of Things Lab	2	3	3	3	-	-	-	-	-	-	-	-	3	-	3

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