K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING AND TECHNOLOGY

Bachelor of Technology (Computer Science Engineering Specialization in Artificial Intelligence and Machine Learning)

B.Tech (CSE -AI/ML)
Programme Code: 73

2021-25

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

Academic Council
Member Secretary
K.R. Mangalam University

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

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PREFACE

The Academic Council in consultation with Deans, Faculty Members, Industry Experts and University Alumni constituted school- wise committees to draft the model curriculum of UG engineering courses. During the meetings held for developing curriculum for undergraduate engineering courses, a concern was shared that the overall credits are too high. It is important to lower the credits to 160 across all departments to lower the burden of syllabi and credits.

The respective Head of Committees, Faculty members along with Industry Experts and Alumni discussed the existing system prevalent in various universities, industry requirements and market trends, employability, problem solving approach, need for life-long learning, and after due deliberations, the scheme and syllabus of the B.Tech (CSE) and B.Tech (CSEwith specialization in AI & ML) has been formalized. Salient features of this model curriculum are enumerated below:

1. Curriculum has been designed in such a way that it encourages innovation and research as total numbers of credits have been reduced and many new courses have been incorporated in consultation with industry experts.
2. The revised curriculum has been designed where the students can understand the industry requirements and have hands-on experience. The students will develop a problem solving approach and will meet the challenges of future.
3. Emerging areas in B.Tech (CSE) has been included in sixth and seventh semester.
4. Emphasis on hands-on training has been promoted by including two industrial training of 4 weeks and 6 weeks respectively, mini project and project in sixth and seventh semester, and six month Industrial Internship in eight semester.
5. The School will ensure the revision of the curriculum to help students to achieve better employability; start-ups and other avenues for higher studies.

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 programmes 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.Tech Computer Science and Engineering with specialization in AI & ML (in collaboration with Samatrix and IBM)

K.R. Mangalam University, IBM and Samatrix has jointly designed a curriculum on new course B. Tech in CSE with specialization in Artificial Intelligence and Machine Learning to equip students with the next generation of technologies like building intelligent machines, software, or applications with a cutting-edge combination of Machine Learning, Deep leaning, Natural Language Processing, Sensor technologies, Artificial Neural Network, IOT, Big Data analytics and Visualization technologies.

IBM and Samatrix will provide training, knowledge expertise and resources on new technologies leveraging its expertise in the field of computing. The students will be provided learning opportunities in real world work situations that will keep them abreast of the latest skills and knowledge. The programme aims to prepare the students to analyze problems and generate solutions in the areas of AI & ML. 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 in Science with mathematics as one of the subjects and with an overall aggregate of 50% or more.

Course Outline: Clean coding with Python / R programming for data science and data analytics/Operating Systems/ Computer networks /Data visualization and storytelling/ Cloud Computing / Artificial Intelligence.

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)- B.Tech.Computer Science & Engineering and B.Tech Computer Science and Engineering with specialization in AI & ML (in collaboration with Samatrix and IBM)

PSO 1. **Applications of Concepts:** Ability to apply fundamentals of mathematics, science and engineering knowledge to understand, analyze and develop computer programs in the areas related to algorithms, multimedia, big data analytics, networks including cloud and edge computing, cyber security, machine learning, and IoTs for efficient design of computer-based systems of varying complexity.

PSO 2. Innovation and Industry Friendly: Ability to apply appropriate techniques and modern engineering hardware and software tools for the design and integration of computer system and related technologies, understand contemporary issues in industry and research and thereby innovate original ideas and solutions, culminating into a modern, easy to use tool, by a larger section of the society with longevity and to engage in lifelong learning for the advancement of technology and its adaptation in multi-disciplinary environments.

PSO 3. **Ethics and Communication Skills**: Implementation of professional engineering solutions for the betterment of society keeping the environmental context in mind, be aware of professional ethics and be able to communicate effectively.

Program Duration

The maximum completion period of the B.Tech. (CSE) with specialization in AI & ML (in collaboration with Samatrix and IBM) programme offered by the University shall be four 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.Tech. (CSE) with specialization in AI & ML (in collaboration with Samatrix and IBM) program 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.

Four Years B.Tech Computer Science & Engineering in AI & ML with Samatrix and IBM Program at a Glance

	Semester I	**Semester II**	**Semester III**	**Semester IV**	**Semester V**	**Semester VI**	**Semester VII**	**Semester VIII**	**Total**
Course	10	8	10	9	10	9	7	1	64
Credit	24	22.5	22	24	20	18	19	12	161.5

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

SEMESTER I

SNo	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**EMP/ENT/SE/ OP**
1	BS	ETMA105A	Applied Mathematics-I	3	1	0	4	SE
2	BS	ETPH109A	Engineering Physics	3	1	0	4	SE
3	MC	UCES125A	Environmental Studies	3	0	0	3	SE
4	PCC	ETCS106A	Clean Coding with Python	3	0	0	3	EMP
5	PCC	ETCS105A	Overview of AI, Data Science, Ethics and Foundation of Data Analysis	2	0	0	2	EMP
6	ESC	ETME101A	Basics of Mechanical Engineering	3	1	0	4	OP
7	ESC	ETME151A	Basics of Mechanical Engineering Lab	0	0	2	1	OP

8	BS	ETPH151A	Engineering Physics Lab	0	0	2	1	SE
9	PCC	ETCS155A	Overview of AI, Data Science, Ethics and Foundation of Data Analysis Lab	0	0	2	1	EMP
10	PCC	ETCS157A	Clean Coding with Python Lab	0	0	2	1	EMP
TOTAL				**17**	**3**	**8**	**24**	

SEMESTER II

EVEN SEMESTER								
SNo	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**EMP/ENT/SE/OP**
1	BS	ETMA104A	Applied Mathematics-II	3	1	0	4	SE
2	HSMC	UCCS155A	Communication Skills	4	0	0	4	SE
3	BS	ETCH119A	Engineering Chemistry	3	1	0	4	SE
4	ESC	ETME155A	Engineering Graphics Lab	0	0	3	1.5	SE
5	BS	ETCH159A	Engineering Chemistry Lab	0	0	2	1	SE
6	PCC	ETCS107A	Data Analysis using Python, Numpy, Pandas, Matplotlib, and Seaborn	2	0	0	2	EMP
8	PCC	ETCS154A	Data Analysis using Python, Numpy, Pandas, Matplotlib, and Seaborn Lab	0	0	2	1	EMP
9	ESC	ETEC101A	Basics of Electrical and Electronics Engineering	3	1	0	4	OP
10	ESC	ETEC151A	Basics of Electrical and Electronics Engineering Lab	0	0	2	1	OP
TOTAL				**15**	**3**	**10**	**22.5**	

SEMESTER III

1	GE	ETMA215A	PROBABILITY AND STATISTICS	4	-	-	4	SE
2	PCC	ETCS203A	Probabilistic Modelling and Reasoning with Python	2	-	-	2	SE
3	PCC	ETCS231A	Discrete Mathematics	3	1	-	4	SE/OP
4	PCC	ETCS217A	Data Structures	3	1	-	4	SE/EMP
5	PCC	ETCS208A	R Programming for Data Science and Data Analytics	2	-	-	2	EMP
6	PCC	ETCS257A	Data Structures Lab	-	-	2	1	SE/EMP
7	PCC	ETCS259A	Probabilistic Modelling and Reasoning with Python Lab	-	-	2	1	SE
8	PCC	ETCS261A	R Programming for Data Science and Data Analytics Lab	-	-	2	1	EMP
9	MC	UCDM301A	Disaster Management	3	-	-	3	MC
TOTAL				**17**	**2**	**6**	**22**	

SEMESTER IV

1	PCC	ETCS222A	Computer Organization & Architecture	3	1	-	4	SE
2	PCC	ETCS220A	Analysis and Design of Algorithms	3	1	-	4	SE/EMP
3	PCC	ETCS307A	Database Management Systems	3	1	-	4	EMP/ENT/OP
4	PCC	ETCS205A	Machine Learning and Pattern Recognition	3	-	-	3	EMP/ENT
5	HSMC	ETMC 226A	Fundamentals of Management	3	-	-	3	ENT
6	PCC	ETCS254A	Machine Learning Practical with Python, Scikit-learn, Matplotlib, TensorFlow	-	-	4	2	EMP/ENT
7	PCC	ETCS 355A	Database Management Systems Lab	-	-	2	1	EMP/ENT/OP
8	PCC	ETCS262A	Analysis and Design of Algorithms Lab	-	-	2	1	SE/EMP

10	HSMC		MOOC	1	-	-	2	SE
TOTAL				**19**	**3**	**8**	**24**	

SEMESTER V

1	PCC	ETCS308A	Big Data Analytics	3	-	-	3	EMP/ENT
2	PCC	ETCS 214A	Theory of Computation	3	1	-	4	SE
3	PCC	ETCS211A	Operating Systems	3	1	-	4	SE
4	PCC	ETCS304A	Computer Networks	3	1	-	4	EMP/OP
5	PCC	ETCS365A	Computer Networks Lab	-	-	2	1	EMP/OP
6	PCC	ETCS364A	Big Data Analytics Lab	-	-	2	1	EMP/ENT
7	PCC	ETCS367A	iOS Development Lab	-	-	2	1	EMP/ENT
8	PCC	ETCS255A	Operating System Lab	-	-	2	1	SE
9	PROJ	ETCS381A	Practical Training I	-	-	-	1	EMP
TOTAL				**15**	**3**	**8**	**20**	

SEMESTER VI

1	PCC	ETCS412A	Compiler Design	3	1	-	4	SE/PCC
2	PCC	ETCS327A	Neural Networks and Deep Learning	3	-	-	3	EMP/ENT/PCC
3	PCC	ETCS354A	Deep Learning Practical with Python, TensorFlow and Keras	-	-	4	2	EMP/ENT/PCC

4	PCC	ETCS313A	Data Science - Tools and Techniques	2	-	-	2	EMP/ENT/PCC
5	PCC	ETCS311A	Natural Language Processing	2	-	-	2	EMP/ENT/PCC
6	PCC	ETCS356A	Data Science - Tools and Techniques Lab	-	-	2	1	EMP/ENT/PCC
7	PCC	ETCS352A	Natural Language Processing Lab	-	-	2	1	EMP/ENT/PCC
8		**Elective**						
(i)	PEC	ETCS420A	Graph Theory	3	-	-	3	SE/PEC
(ii)	PEC	ETCS320A	Distributed Computing Systems	3	-	-	3	EMP/PEC
(iii)	PEC	ETCS310A	Advanced Computer Architecture	3	-	-	3	EMP/PEC
TOTAL				**16**	**1**	**10**	**18**	

SEMESTER VII

1	PCC	ETCS428A	Computer Vision	2	-	-	2	EMP
2	PROJ	ETCS464A	Major Project	-	-	-	6	EMP/ENT
3	PCC	ETCS453A	Computer Vision Lab	-	-	2	1	EMP
4	PROJ	ETCS481A	Practical Training II	-	-	-	2	EMP/ENT
5	PCC	ETCS332A	Data Visualization and Story Telling	2	-	-	2	EMP/ENT
6	PCC	ETCS461A	Data Visualization and Story Telling Lab	-	-	2	1	EMP/ENT
7		**Elective (with Lab)**						
(i)	PEC	ETCS422A	Cloud Computing	4	-	-	4	EMP/ENT
	PEC	ETCA362A	Cloud Computing Lab	-	-	2	1	EMP/ENT
(ii)	PEC	ETCS418A	Internet of Things	4	-	-	4	EMP/ENT
	PEC	ETCS457A	Internet of Things Lab	-	-	2	1	EMP/ENT
(iii)	PEC	ETCS424A	Data Warehousing and Data Mining	4	-	-	4	EMP/ENT

	PEC	ETCS463A	Data Warehousing and Data Mining Lab	-	-	2	1	EMP/ENT
TOTAL				**8**	-	**6**	**19**	

SEMESTER VIII

1	PROJ	ETCS490A	Industrial Internship	-	-	-	12	EMP/ENT/PROJ
TOTAL				-	-	-	**12**	
Total Credits [C]				**161.5**				

EMP	Employability
SE	Skill Enhancement
ENT	Entrepreneurship
OP	Open Elective

HSMC	Humanities, Social Science and Management Course
BS	Basic Science
ESC	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc
MC	Mandatory Courses

SEMESTER I

ETMA105A	Applied Mathematics-I	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

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

Course Outcomes

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

CO7. Understand and able to apply the basic concept of complex variable.

CO8. Recognize and able to apply the concepts of continuity and differentiability for complex functions and solve the analytic function and its properties.

CO9. Applied the differential calculus method for curve tracing and radios of curvatures.

CO10. Use the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to Diagonalizable matrices when this is possible.

CO11. Explain the qualitative long-term behavior of the solutions to an ODE or system of ODE's.

CO12. Demonstrate knowledge and understanding ordinary differential equations and how they relate to different modeling situations.

Catalog Description

Applied mathematics-I is the mathematical study of basic concepts, principles, and application, relate or

unify various disciplines. The core of the program the following principles and their mathematical formulations: complex number and variables, ordinary differential equations, differential calculus and matrices. The concepts of applied mathematics-I 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 algebraare to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **10 lecture hours**

Complex Numbers and Infinite Series: De Moivre's theorem, Roots of complex numbers, Euler's theorem, Logarithmic Functions, Circular and Hyperbolic Functions, Convergence and Divergence of Infinite series, Necessary condition for convergence, Positive term infinite series test, Alternating series, Lebnitz test, Absolute and Conditional Convergence.

Unit II: **10 lecture hours**

Application of Differential Calculus: Successive differentiation, Leibnitz theorem (without proof), Taylor's and Maclaurin's theorem and expansion of functions, Asymptotes (Cartesian and polar), Curve Tracing, Curvature, Radius of Curvature.

Unit III: **10lecture hours**

Matrices and its application: Elementary transformation, Inverse of matrix by elementary operations, Rank, Linear and orthogonal transformations, Hermitian and skew - Hermitian forms, Solutions of simultaneous linear equations, Eigen values, Eigen vectors and its properties, Caley - Hamilton theorem (without proof), Diagonalisation of a matrix.

Unit IV: **10 lecture hours**

Ordinary Differential Equations: Exact differential equations of first order and first degree, Linear

differential equations of higher order with constant coefficients, Variation of parameters, Solution of simultaneous linear differential equations, Solution of homogeneous differential equations - Cauchy and Legendre forms.

Text Books

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

Reference Books/Materials

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

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and able to apply the basic concept of complex variable.	**PO1**
CO2	Recognize and able to apply the concepts of continuity and differentiability for complex functions and solve the analytic function and its properties.	**PO8**

CO3	Applied the differential calculus method for curve tracing and radios of curvatures.	**PO2**
CO4	Use the characteristic polynomial to compute the eigen values and eigenvectors of a square matrix and use them to Diagonalizable matrices when this is possible.	**PO4**
CO5	Explain the qualitative long-term behavior of the solutions to an ODE or system of ODE's.	**PO3**
CO6	Demonstrate knowledge and understanding ordinary differential equations and how they relate to different modeling situations.	**PO1**

ETMA 105A	Course Code	
Applied Mathematics - I	Course Title	
3	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
1	PO8	Ethics

	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETPH109A	Engineering Physics	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Waves & Optics				
Co-requisites					

Course Objectives

1. Learning different types of harmonic oscillators.
2. Understanding phenomenon of non dispersive and transverse waves in strings.
3. Analyzing propagation of light, geometric and wave optics.
4. Understanding of various laser systems.

Course Outcomes

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

CO1. Understand difference between different types of harmonic oscillators and can find quality factor.
CO2. Solve non-dispersive transverse and longitudinal waves equations. CO3. Analyze propagation of light, geometric and wave optics.
CO4. Design different laser source systems.

Catalog Description

This course imparts the basic concepts of waves and optics. This course enables learners to solve non- dispersive transverse and longitudinal waves equations. This course helps learners to analyze propagation of light, geometric and wave optics. The course introduces the basic concepts about lasers and helps learners to design different laser source systems.

Course Content

UNIT-I **10 Lecture Hours**

Simple harmonic motion, damped and forced simple harmonic oscillator

Mechanical and electrical simple harmonic oscillators damped harmonic oscillator: heavy, critical

and light damping, energy decay in a damped harmonic oscillator, quality factor.

UNIT-II **10 Lecture Hours**

Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection, and transmission of waves at a boundary. Longitudinal waves and the wave equation for them, acoustics waves and speed of sound, wave groups and group velocity.

UNIT-III **10 Lecture Hours**

The propagation of light and geometric optics

Laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection.

Wave optics

Huygens 'Principle, superposition of waves and interference of light by wave front splitting and amplitude splitting: Young's double slit experiment, Newton's rings. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision: Diffraction gratings and their resolving power.

UNIT-IV **10 Lecture Hours**

Lasers

Amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid- state lasers (Ruby, Neodymium), dye lasers. Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Suggested Reference Books

1. Ian G. Main, Oscillations and waves in physics
2. H.J. Pain, The physics of vibrations and waves
3. E. Hecht, Optics
4. A. Ghatak, Optics
5. O. Svelto, Principles of Lasers

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 difference between different types of harmonic oscillators and can find quality factor.	PO1
CO2	Solve non-dispersive transverse and longitudinal waves equations.	PO4
CO3	Analyze propagation of light, geometric and wave optics	PO5
CO4	Design different laser source systems.	PO2

ETPH109A	Course Code	
Engineering Physics	Course Title	
2	PO1	Engineering Knowledge
2	PO2	Problem analysis

	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
2	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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**

UCES125A	Course Code	
Environmental Studies	Course Title	
	PO1	Engineering Knowledge
	PO2	Problem analysis
	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
2	PO6	The engineer and society
3	PO7	Environment and sustainability
3	PO8	Ethics
	PO9	Individual or team work
3	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
	PSO1	Application of Concepts
1	PSO2	Innovation and Industry Friendly
2	PSO3	Ethics and Communication Skills

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

ETCS106A	Clean Coding with Python	L	T	P	C
Version 1.0	--	3	0	0	3
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To understand why Python is a useful scripting language for developers.
2. To learn how to design and program Python applications.
3. To learn how to use lists, tuples, and dictionaries in Python programs.
4. To learn how to identify Python object types.
5. To learn how to use indexing and slicing to access data in Python programs.
6. To define the structure and components of a Python program.
7. To learn how to write loops and decision statements in Python.

Course Outcomes

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

CO1. Learn how to write functions and pass arguments in Python. CO2. Learn how to build and package Python modules for reusability. CO3. Learn how to read and write files in Python.
CO4. Learn how to design object-oriented programs with Python classes. CO5. Learn data handling and use cases diagrams.
CO6. Learn how to use class inheritance in Python for reusability.

CO7. Learn how to use exception handling in Python applications for error.

Course Overview: Python is a language with a simple syntax, and a powerful set of libraries. It is an interpreted language, with a rich programming environment, including a robust debugger and profiler. While it is easy for beginners to learn, it is widely used in many scientific areas for data exploration. This course is an introduction to the Python programming language for students without prior programming experience. We cover data types, control flow, object-oriented programming, and graphical user interface- driven applications. The examples and problems used in this course are drawn from diverse areas such as text processing, simple graphics creation and image manipulation, HTML and web programming, and genomics.

Course Content

Unit I: **8 lecture hours**

Introduction to Clean Code: What is Bad Code? Example 1: Avoid, Example 2: for each code, What is Clean Code? , Purpose of Clean Code, Thought of experienced programmers,Intention Revealing Names, Example 1: Poor Variable Names, Example 2: Poor Method Names, Example 3: Variable Name, Make Meaningful Distinctions, Example 1: Usage of Different Words, Example 2: Distinct Names, Use Pronounceable Names, Example 1: Vocal Names, Example 2: Short Form Names, Example 3: Non- Pronounceable Names, Example 4: Compare, Avoid Encodings and Mental Mappings, Difference between smart and professional programmer, Class and Method Names, Function Size Matters, Blocks and Indenting, Do only one thing within a function, One level of abstraction per function, Use Descriptive Name, Example 1: Verbal Names, Function Arguments, Advantages of Having Less Arguments, Command Query Separation, Prefer Exceptions to Returning Error Codes, Extract Try/Catch Blocks, Error Handling Is One Thing, Good Comments, Good Names Can Obviate Comments, Types of Good Comments, Legal Comment, Informative Comment, Explanation of Intent Comment, Clarification Comment, Warning of Consequences Comment, TODO Comments, Amplification Comment, Bad Comments , Mumbling Comments, Redundant Comments, Misleading Comments, Mandated Comments, Journal Comments, Noise Comments, Scary Noise, Commented-Out Code, Too Much Information, Test Your Knowledge, The Purpose of Formatting, Vertical Formatting, Horizontal Formatting, Team Rules, Exercise 1: Comments and Formatting, Test Your Knowledge, Data Abstraction, Example 1: Concrete Point, Example 2: Abstract Point, Data/Object Antisymmetry, Law of Demeter, Data Transfer Objects.

Unit II: **12 lecture hours**

Introduction to Python: What is Python?, Advantages and disadvantages, Downloading and installing, Which version of Python, Running Python Scripts, Using the interpreter interactively, Using variables, String types: normal, raw and Unicode String operators and expressions, Math operators and expressions, Writing to the screen, Reading from the keyboard, Indenting is significant, The if and elif statements, While Loops, Using List, Dictionaries, Using the for statement, Opening, reading and writing a text file, Using Pandas, the python data analysis library and data frames, Grouping, aggregating and applying, merging and joining, Dealing with syntax errors, Exceptions, Handling exceptions with try/exception.

Unit III: **12 lecture hours**

Data Handling and Use Cases: re Pattern Matching, Parsing Data, Introduction to Regression, Types of Regression, Use Cases, Exploratory data analysis, Correlation Matrix, Visualization using Matplotlib, Implementing linear regression.

Unit IV: **8 lecture hours**

Object Oriented Concepts: Class, Object, Functions, Inheritance, Types of Inheritance, Encapsulation, Polymorphism, Method Overloading and Method Overriding, Data Abstraction, Abstract Classes.

Text Books

1. IBM Material

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 how to write functions and pass arguments in Python.	**PO1**
CO2	Learn how to build and package Python modules for reusability.	**PO4**
CO3	Learn how to read and write files in Python.	**PO5**
CO4	Learn how to design object-oriented programs with Python classes.	**PO2**

CO5	Learn data handling and use cases diagrams.	**PO3**
CO7	Learn how to use exception handling in Python applications for error.	**PO2**
CO6	Learn how to use class inheritance in Python for reusability.	**PO3**

ETCS306A	Course Code	
Clean Coding with Python	Course Title	
2	PO1	Engineering Knowledge
3	PO2	Problem analysis
	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance

	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS105A	Overview of AI, Data Science, Ethics and Foundation of Data Analysis	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the concepts of current main conceptual frameworks at use in AI

Course Outcomes

On completion of this course, the students will be able to learn:-
CO1. Uses of AI, Ethics present and future.
CO2. Introduction to Machine Learning.

CO3. Application of AI by domain, Role of AI in society.

Catalog Description

The course begins with the theoretical understanding of AIML and usage, Ethics present and future.

Course Content

Unit I: **06 lecture hours**

Introduction to Data Science: Defining Data Science and Big Data, Benefits and Uses of Data Science and Big Data, Facets of Data, Structured Data, Unstructured Data, Natural Language, Machine generated Data, Graph based or Network Data, Audio, Image, Video, Streaming data, Data Science Process, Big data ecosystem and data science, distributed file systems, Distributed programming framework, data integration framework, machine learning framework, No SQL Databases, scheduling tools, benchmarking tools, system deployments.

Unit II: **06 lecture hours**

Data Science Processes: Six steps of data science processes, define research goals, data retrieval, cleansing data, correct errors as early as possible, integrating – combine data from different s ources, transforming data, exploratory data analysis, Data modelling, model and variable selection, model execution, model diagnostic and model comparison, presentation and automation

Unit III: **06 lecture hours**

Introduction to Machine Learning: What is Machine Learning, Learning from Data, History of Machine Learning, Big Data for Machine Learning, Leveraging Machine Learning, Descriptive vs Predictive Analytics, Machine Learning and Statistics, Artificial Intelligence and Machine Learning, Types of Machine Learning – Supervised, Unsupervised, Semi-supervised, Reinforcement Learning, Types of Machine Learning Algorithms, Classification vs Regression Problem, Bayesian, Clustering, Decision Tree, Dimensionality Reduction, Neural Network and Deep Learning, Training machine learning systems.

Unit IV: **06 lecture hours**

Introduction to AI: What is AI, Turing test, cognitive modelling approach, law of thoughts, the relational agent approach, the underlying assumptions about intelligence, techniques required to solve AI problems, level of details required to model human intelligence, successfully building an intelligent problem, history of AI.

Unit V: **06 lecture hours**

Introduction to Data Analytics: Working with Formula and Functions, Introduction to Power BI & Charts, Logical functions using Excel, Analyzing Data with Excel.

Text Books

1.Stuart J Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach" 3rd edition. Pearson.

Reference Books/Materials

1. Kevin Knight, Elaine Rich, B. Nair, "Artificial Intelligence" 3rd edition. McGraw Hill.
O'Reilly Media.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Uses of AI, Ethics present and future.	**PO2**
CO2	Introduction to Machine Learning.	**PO1**
CO3	Application of AI by domain, Role of AI in society.	**PO6**

ETCS 105A	Course Code	
Overvie w of AI, Data Science, Ethics and Foundat ion of Data Analysi s	Course Title	
3	PO1	Engineering Knowledge
3	PO2	Problem analysis

	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage
3	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
2	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETEC 101A	Basics Of Electrical & Electronics Engineering	L	T	P	C
		4	0	0	4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To understand the circuit behavior on the DC and AC supply.
2. To analyses the complex circuits using various theorems to resolve it to a simple circuit.
3. To be able to perform analysis of single-phase ac circuits consisting of combinations (series and parallel) elements
4. To analyses the circuit response with addition of circuit elements i.e inductor and capacitors.
5. 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 AC and DC Circuits in making real time projects to solve engineering difficulties.
C02	Determine an understanding of logic gates.
CO3	Demonstrate the ability to identify series, parallel complex circuits. Utilization of the preliminary knowledge gained to obtain real existing power related problems.
CO4	Create an understanding of semiconductor devices application to existing devices.
CO5	Learn the basics of electronics devices used in practical application.
CO6	Able to determine waveform basics by obtaining it on analyzer devices.

Catalog Description

The aim of the course is to familiarize students with complex AC and DC circuits. For better recognition and learning point of view to identify the response of circuits with addition of capacitor and inductor elements in AC and DC circuits as real time. This course consists of learning with experimental studies involved of semiconductor switches and utilization as

amplifier circuits. Basic topics included are AC and DC circuits, Series and Parallel Connections, CRO introduction and utilization, AC circuits with capacitor and inductor responses, Digital logic gates, Semiconductor introduction as BJT, MOSFET etc. along with their application to solving practical engineering problems.

Course Content

Unit I **10 Hour**

Circuit Analysis: Ohm's Law, KCL, KVL Mesh and Nodal Analysis, Circuit parameters, energy storage aspects, Superposition, Thevenin's, Norton's, Reciprocity, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta Transformation. Application of theorem to the Analysis of D.C. circuits.

Unit II **11 Hour**

A.C. Circuits: R-L, R-C, R-L-C circuits (series and parallel), Time Constant, Phasor representation, Response of R-L, R-C and R-L-C circuit to sinusoidal input Resonance-series and parallel R-L-C Circuits, Q-factor, Bandwidth.

Cathode Ray Oscilloscope: Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its component

Unit II **10 Hour**

Semiconductor Physics: Basic concepts, Intrinsic and extrinsic semiconductors, diffusion and drift currents.
P-N junction diode: Ideal diode, P-N junction under open-circuit and closed-circuit, Diode Current Equation, Diode Resistance, Transition and Diffusion Capacitance, Effect of Temperature, Carrier Life Time, Continuity Equation.
Special Diodes: Zener Diode, Photodiode, Light Emitting Diodes, applications of Diodes.

Unit II **9 Hour**

Digital Electronics: Boolean algebra, Truth tables of logic gates (AND, OR, NOT), NAND, NOR as universal gates
Bipolar junction transistor: Introduction to transistors: construction, transistor operations, BJT characteristics, load line, operating point, leakage currents.

Application of BJT: CB, CE configurations, Introduction to FETs and MOSFETs.

TEXT BOOKS:

1. D.P. Kothari & I J Nagrath, Basic Electrical Engineering, Tata McGraw Hill , New Delhi.
2. B L Thareja – A text book of Electrical Technology
3. Boylestad&Nashelsky, "Electronic Devices & Circuits", Pearson Education, 10th Edition.
4. V. K. Mehta & Rohit Mehta, "Principles of Electronics", S. Chand Publishers, 27th Edition.

REFERENCE BOOKS:

1. Electrical Engineering Fundamentals, V.Del Toro
2. Problems in Electrical Engineering – Parker Smith.S.
3. Sedra A S and Smith K C, "Microelectronic Circuits" 4th Ed., New York, Oxford University Press, New York.
4. Tocci R J and Widmer N S, "Digital Systems – Principles and Applications", 8th Ed., Pearson Education India, New Delhi.
5. A.K. Sawhney, "A course in Electrical & Electronics Measurements & Instrumentation", DhanpatRai& 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	Understand and apply Knowledge of AC and DC Circuits in making real time projects to solve engineering difficulties.	**PO1**
CO2 2	Determine an understanding of logic gates.	**PO2**
CO3	Demonstrate the ability to identify series, parallel complex circuits. Utilization of the preliminary knowledge gained to obtain real existing power related problems.	**PO2**
CO4	Create an understanding of semiconductor devices application to existing apparatuses	**PO12**

ETEC 101A	Course Code	
BASICS OF ELECTR ICAL & ELECTR ONICS ENGINE ERING	Course Title	
3	PO1	Engineering Knowledge
	PO2	Problem analysis

3		
	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
3	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETEC 151A	Basics Of Electrical & Electronics Engineering Lab	L	T	P	C
		0	0	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To understand the DC and AC circuit behavior by application of network theorems.
2. To elaborate complex signals over oscilloscope devices with reading.
3. To be able to perform analysis of forward and reverse V-I characteristics of diode circuits.
4. To analyses the BJT in build circuits as per practical application point of view.
5. To gain basic insight of truth table based logic gate decisions and to provide application based output using seven segment display.

Course Outcomes

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

CO1	Get an exposure to common electrical components and their ratings.
C02	Determines proper electrical connections as per wires of appropriate ratings.
CO3	Understand the usage of common electrical measuring instruments.
CO4	Ability to discover applications related to seven segment display type of devices

Catalog Description

The aim of the course is to acquaint the students with basics of AC and DC circuits. Identification of tools and devices to provide demonstration capabilities involved after learning AC in waveform format. Proofing of Complex AC waveform with practical circuit calculations. Basic topics included are AC and DC circuits, Cathode Ray Oscilloscope, Function Generator, LC, RL circuits, Superposition Theorems, Zener diode, Truth table verification with seven segment displays. All along with their application in real time situations.

Course Content

1. To get familiar with the working knowledge of the following instruments:

a) Cathode ray oscilloscope (CRO)

b) Multimeter (Analog and Digital)

c) Function generator

d) Power supply

2. To measure phase difference between two waveforms using CRO. To measure an unknown frequency from Lissajous figures using CRO
3. To Verify the Thevenin' s and Norton's theorem
4. To Verify the Superposition theorem
5. To measure voltage, current and power in an A.C. circuit by LCR impedance method
6. To study the frequency response curve in series and parallel R-L-C circuit
7. a)Plot the forward and reverse V-I characteristics of P-N junction diode

b) Calculation of cut-in voltage c) Study of Zener diode in breakdown region

8. To plot and study the input and output characteristics of BJT in common-emitter configuration.
9. Verification of truth tables of logic gates (OR,AND, NOT, NAND, NOR).
10. To get familiar with the working and use of seven-segment display.

Reference Books For Lab Studies:

1. Electrical Engineering Fundamentals, V.Del Toro
2. Problems in Electrical Engineering – Parker Smith.S.
3. Sedra A S and Smith K C, "Microelectronic Circuits" 4th Ed., New York, Oxford University Press, New York.
4. Tocci R J and Widmer N S, "Digital Systems – Principles and Applications", 8th Ed., Pearson Education India, New Delhi.
5. A.K. Sawhney, "A course in Electrical & Electronics Measurements & Instrumentation", Dhanpat Rai & 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	Get an exposure to common electrical components and their ratings.	PO1
CO2	Determines proper electrical connections as per wires of appropriate ratings.	PO2
CO3	Understand the usage of common electrical measuring instruments.	PO2
CO4	Ability to discover applications related to seven segment display type of devices	PO12

ETEC 151A	Course Code	CO
BASICS OF ELECTR ICAL & ELECTR ENGINE ERING LAB	Course Title	
3	PO1	Engineering Knowledge
2	PO2	Problem analysis
	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
3	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETPH151A	Engineering Physics Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Physics				
Co-requisites	--				

Course Objectives

1. The abstraction from fields using the examples of the gravitational fields, with some applications
2. To learn how interference, diffraction and polarization of light take place.
3. Consolidate the understanding of fundamental concepts in mechanics more rigorously as needed for further studies in physics, engineering and technology.
4. Expand and exercise the students' physical intuition and thinking process through the understanding of the theory and application of this knowledge to the solution of practical problems

Course Outcomes

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

CO1. Acquire fundamental knowledge of mechanics and able to apply on physical systems. CO2. Better insight aboutwave nature of light.
CO3. Better understanding of data interpretation which enhances problem solving approach.

CO4. Develop the ability to correlates the daily life phenomenon to physics using mathematical tools

Catalog Description

This course imparts the basic concepts of waves and optics. This course enables learners to solve non- dispersive transverse and longitudinal waves equations. This course helps learners to analyze propagation of light, geometric and wave optics. The course introduces the basic concepts about lasers and helps learners to design different laser source systems.

Course Content

LIST OF EXPERIMENTS

1) To determine the value of acceleration due to gravity using Bar pendulum.
2) To determine the value of acceleration due to gravity using Kater's pendulum.

3) To determine the wavelength of sodium light using Newton`s ring apparatus.
4) To determine the wavelength of prominent lines of mercury by plane diffraction grating.
5) To determine the refractive index of the material of the prism for the given colours (wavelengths) of mercury light with the help of spectrometer.
6) To determine the specific rotation of cane sugar solution with the help of half shade polarimeter.
7) To determine the wavelength of He-Ne LASER using transmission diffraction grating.

Text Books

- C. L.Arora, B.Sc Practical Physics (S Chand and Co. Ltd., New Delhi).
- Harnam Singh, Hemne P S, B.Sc. Practical Physics (S. Chand & Co).
- InduPrakash, Ramakrishna, A Text Book of Practical Physics (KitabMahal, New Delhi).

Reference Books/Materials

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Acquire fundamental knowledge of mechanics and able to apply on physical systems	PO1& PO2
CO2	Better insight aboutwave nature of light.	PO4
CO3	Better understanding of data interpretation which enhances problem solving approach.	PO5
CO4	Develop the ability to correlates the daily life phenomenon to physics using mathematical tools	PO6

ETPH151A	Course Code	
Engineering Physics Lab	Course Title	
2	PO1	Engineering Knowledge
3	PO2	Problem analysis
	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
2 3	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS155A	Overview of AI, Data Science, Ethics and Foundation of Data Analysis Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the concepts of current main conceptual frameworks at use in AI

Course Outcomes

On completion of this course, the students will be able to
implement:- CO1. No SQL Database queries.
CO2. Basic machine learning algorithms such as regression, classification
etc. CO3. Unsupervised algorithms.

Catalog Description

This course complements ETCS105A. It enables them to write algorithms for solving basic machine learning algorithms. The list of experiments helps organizing the data in variety of ways using python and to solve the given problem efficiently.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS105A.

Text Books

1.Stuart J Russell & Peter Norvig, “Artificial Intelligence: A Modern Approach” 3rd edition. Pearson.

Reference Books/Materials

1. Kevin Knight, Elaine Rich, B. Nair, “Artificial Intelligence” 3rd edition. McGraw Hill. O’Reilly Media.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	No SQL Database queries.	**PO2**
CO2	Basic machine learning algorithms such as regression, classification etc.	**PO3**
CO3	Unsupervised algorithms.	**PO5**

ETCS 155A	Course Code	
Overvie w of AI, Data Science, Ethics and Foundat ion of Data Analysi s Lab	Course Title	
	PO1	Engineering Knowledge
	PO2	Problem analysis

3		
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
ω	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS157A	Clean Coding with Python Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. Be fluent in the use of procedural statements — assignments, conditional statements, loops, function calls — and sequences.
2. Be able to design, code, and test small Python programs.
3. Understand the concepts of object-oriented programming as used in Python: classes, subclasses, inheritance, and overriding.
4. Understand the basics of Object Oriented Design.
5. Implement the data structures and use the built-in libraries for efficient codes.

Course Outcomes

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

CO1. Develop solutions to simple computational problems using Python programs.

C02. 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

Clean coding with python emphasize on principles of software development, style, and testing. Topics include procedures and functions, iteration, recursion, arrays and vectors, strings, an operational model of procedure and function calls, algorithms, exceptions, object-oriented programming, and GUIs (graphical user interfaces). Weekly labs provide guided practice on the computer, with staff present to help. Assignments use graphics and GUIs to help develop fluency and understanding.

Course Content

LIST OF EXPERIMENTS

1. Develop programs to understand the control structures of python

2. Develop programs to implement list

3. Develop programs to implement Dictionary

4. Develop programs to implement tuples

5. Develop programs to implement function with stress on scoping

6. Develop programs to implement classes and objects

7. Develop programs to implement exception handling.

8. Develop programs to implement linear search and binary search.

9. Develop programs to implement insertion sort

10. Develop programs to implement bubble sort.

11. Develop programs to implement quick sort.

12. Develop programs to implement heap sort.

Text Books

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

Reference Books/Materials

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 solutions to simple computational problems using Python programs	**PO3**
CO2	Solve problems using conditionals and loops in Python.Develop Python programs by defining functions and calling them	**PO4**
CO3	Use Python lists, tuples and dictionaries for representing compound data	**PO2**
CO4	Develop Python programs using files	**PO3**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	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	Innovation and Industry Friendly	Ethics and Communication Skills

ETCS157A	Clean Coding with Python Lab		3	2	3								2		3

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETMA104A	Applied Mathematics-II	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Provide the brief idea to students of Laplace transformation.
2. To understand Curl, divergence and gradient with their applications and have the idea of directional derivatives and derive the equations of tangent planes and normal lines.
3. Apply the Green, Stoke and Gauss Theorem to find the area and volume of the object.
4. Recognize and implement the concept of differential equations and learn various methods to solve ordinary differential equations
5. Apply the method of characteristics to solve first order partial differential equations.

Course Outcomes

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

CO1. Understand and able to apply the basic concept of Laplace transform.

CO2. Recognize and able to apply the concepts of vector function, vector field, scalar field, gradient, divergence and curl.

CO3. Demonstrate the Green, Stoke and Gauss Theorem to find the area and volume of the object in real world.

CO4. Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.

CO5. Determine and find Extend the concept of series solutions to solve differential equations and learn orthogonality about the functions.

CO6. Demonstrate knowledge and understanding partial differential equations and how they relate to different modeling situations.

Catalog Description

Applied mathematics-II is the mathematical study of general scientific concepts, principles, and phenomena that, because of their widespread occurrence and application, relate or unify various disciplines. The core of the program the following principles and their mathematical formulations: Linear transformation, partial differential equations, ordinary differential equations

and vector calculus. The concepts of applied mathematics-II 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: **09 lecture hours**

Laplace Transformation: Existence condition, Laplace transform of standard functions, Properties, Inverse Laplace transform of functions, Convolution theorem, solving linear differential equations using Laplace transform. Heaviside unit step function, Impulse function, Periodic function and their transforms.

Unit II: **10 lecture hours**

Vector Calculus: Scalar and vector point functions, Gradient, Divergence, Curl with their physical significance, Directional derivatives, Properties, Line integrals, Surface integrals and Volume integrals, Gauss theorem, Green's theorem and Stoke's theorem (without proof).

Unit III: **10 lecture hours**

Ordinary Differential Equations: Exact differential equations of first order and first degree, Linear differential equations of higher order with constant coefficients, Variation of parameters, Solution of simultaneous linear differential equations, Solution of homogeneous differential equations - Cauchy and Legendre forms.

Unit IV: **10 lecture hours**

Partial Differential Equations and its applications: Formation of partial differential equations, Lagrange's linear equation, Charpit's method of non-linear partial differential equations, Method of separation of variables, Solution of wave and heat conduction equations, Initial and boundary value problems.

Text Books

1. Kresyzig, "Advanced Engineering Mathematics", John Wiley and Sons.

2. Jain and Iyengar, "Advanced Engineering Mathematics", Narosa Publication

Reference Books/Materials

10. B.S. Grewal, " Higher Engineering Mathematics", Khanna Publishers.

11. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Company.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and able to apply the basic concept of Laplace transform.	**PO1**
CO2	Recognize and able to apply the concepts of vector function, vector field, scalar field, gradient, divergence and curl.	**PO8**
CO3	Demonstrate the Green, Stoke and Gauss Theorem to find the area and volume of the object in real world.	**PO2**
CO4	Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.	**PO4**
CO5	Determine and find Extend the concept of series solutions to solve differential equations and learn orthogonality about thefunctions.	**PO3**
CO6	Demonstrate knowledge and understanding partial differential equations and how they relate to different modeling situations.	**PO1**

ETMA104A	Course Code	
Applied Mathematics- II	Course Title	
2	PO1	Engineering Knowledge
3	PO2	Problem analysis
2	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
2	PO8	Ethics
	PO9	Individual or team work

	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

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

Course Objectives

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

Course Outcomes

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

CO1. Understand the basics of Grammar to improve written and oral communication skills CO2. Understand the correct form of English with proficiency
CO3. Improve student's personality and enhance their self-confidence CO4. Improve professional communication
CO5. Enhance academic writing skills

Catalog Description

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

Course Content

UNIT I10 lecture hours

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

UNIT II **10 lecture hours**

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

UNIT III **10 lecture hours**

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

UNIT IV **10 lecture hours**

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

UNIT V **10 lecture hours**

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

Text book [TB]:

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

Reference Books/Materials

11. Mitra, Barun K. Personality Development and Soft Skills. Oxford University Press, 2012.
12. Tickoo, M.L., A. E.Subramanian and P.R.Subramaniam. Intermediate Grammar, Usage and Composition. Orient Blackswan, 1976.
13. Bhaskar, W.W.S., AND Prabhu, NS., " English Through Reading", Publisher: MacMillan,1978
14. Business Correspondence and Report Writing" -Sharma, R.C. and Mohan K. Publisher: Tata McGraw Hill1994

15. Communications in Tourism & Hospitality- Lynn Van Der Wagen, Publisher: HospitalityPress
16. Business Communication-K.K.Sinha
17. Essentials of Business Communication By Marey Ellen Guffey, Publisher: ThompsonPress
18. How to win Friends and Influence People By Dale Carnegie, Publisher: Pocket Books
19. Basic Business Communication By Lesikar&Flatley, Publisher Tata McGraw Hills
20. Body Language By Allan Pease, Publisher SheldonPress

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

UCCS155A	Course Code	
Communication Skills	Course Title	
	PO1	Engineering Knowledge
	PO2	Problem analysis
	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
3	PO10	Communication
	PO11	Project management and finance
3	PO12	Life-long Learning
	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
3	PSO3	Ethics and Communication Skills

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

ETCH119A	Engineering Chemistry	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	12^{th} Standard Chemistry				
Co-requisites	--				

Course Objectives:

- To acquire knowledge of engineering materials and about fuels.
- To develop the interest among the students regarding chemistry and their applications in engineering.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.
- To acquire knowledge about desalination of brackish water and treatment of municipal water.
- To gain the knowledge of conducting polymers, bio-degradable polymers and fiber reinforced plastics.

Course Outcomes:

CO1: Develop the understanding of Technology involved in improving quality of water for its industrial use.
CO2: Identify instrumental techniques for analysis and analyze the quality parameters of chemical fuels. CO3: Develop the understanding of Chemical structure of polymers and its effect on their various properties when used as engineering materials.
CO4: Impart the knowledge of fuels and biofuels with its properties and applications.

CO5: Illustrate the principles involved in thermodynamics and kinetic theory of gases which are used in daily life.
CO6: They can predict potential applications of chemistry and practical utility in order to become good engineers and entrepreneurs.

Catalog Description

This course gives an introduction to chemistry of water and an overview of different methods used for purification of water using various inorganic and organic compounds with detection of major and minor ions present in water. Various techniques used for preparation of fuels, biofuels and techniques used for analysis are reviewed. The purpose of this course is to develop a strong foundation in the principles and methods to understand the kinetic theory of gases, thermodynamics, phase rule, polymer and biopolymers. There will be an excursion at the end of the semester.

Course Content

Unit I: **10 lecture hours**

Water Technology: Introduction and characteristics of water; Hardness and its determination (EDTA method only); Alkalinity and its determination; Boiler feed water; Boiler problems - scale, sludge, priming & foaming, their causes & prevention; Caustic embrittlement & corrosion -Causes & prevention; Removal of silica & dissolved gases; Water softening processes : Lime - soda process, Ion exchange method, carbonate & phosphate conditioning, colloidal conditioning & calgon treatment; Water for domestic use.

Unit II: **10 lecture hours**

Fuels: Classification; Calorific value of fuel and its determination; Bomb calorimeter; Boy's Gas calorimeter; Solid fuels- Proximate and ultimate analysis, High & Low temperature carbonization, manufacture of coke (Otto-Hoffmann oven); Liquid Fuels - Petroleum-Chemical composition, fractional distillation, Thermal & catalytic cracking, Octane & Cetane No. and its significance; Power alcohol, Analysis of flue gases (Orsat's apparatus).

Unit III: **10 lecture hours**

Gaseous state and thermo chemistry: Gas laws and kinetic theory of gases; Distribution of molecular velocities; Mean free path; Real gases-non ideal behavior; Causes of deviation from ideal behavior; Vander Waal's equation; liquefaction of gases.

Hess's Law; Heat of Reaction; Heat of dilution; Heat of Hydration; Heat of neutralization and Heat of Combustion; Effect of temperature on heat of reaction at constant pressure (Kirchhoff s equation); Flame Temperature

Unit IV: **10 lecture hours**

The phase rule and polymers: Definition of various terms, Gibb's Phase rule, Application of phase rule to one component system- The water system and carbon dioxide system, Two component system:Lead-silver,Na2SO4-water.
Polymers and its classification; Mechanism of addition and condensation polymers; Coordination polymerization; Synthesis, properties and uses of urea formaldehyde, phenol formaldehyde, poly vinyl acetate and polythene; Conducting and bio-polymers.**)**

Text Books

1. Chemistry in Engineering & Technology (Vol I & II) (Latest ed.), By J.C. Kuriacose& J. Rajaram
2. Principles of Physical Chemistry, (Latest ed.), Puri B.R., Sharma L.R. and Pathania, M.S.
3. Text book of Engg. Chemistry, S. Chand & Co., (Latest ed.), S.S. Dara

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 the understanding of Technology involved in improving qualityof water for its industrial use.	PO2
CO2	Identify instrumental techniques for analysis and analyze the qualityparameters of chemical fuels.	PO1

CO3	Develop the understanding of Chemical structure of polymers and itseffect on their various properties when used as engineering materials.	**PO6**
CO4	Impart the knowledge of fuels and biofuels with its propertiesand applications.	**PO7**
CO5	Illustrate the principles involved in thermodynamicsand kinetic theory of gases which are used in daily life.	**PO3**
CO6	They can predictpotential applications of chemistry and practical utility in order to become goodengineers and entrepreneurs	**PO1**

Cour se	Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCH11	Engineeri	3	3	2			3	2						3	3	

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

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

ETME155A	Engineering Graphics Lab	L	T	P	C
Version 1.0		0	0	3	1.5
Pre-requisites/Exposure	Basic concepts of drawing				
Co-requisites	--				

Course Objectives

The Basic aim of this subject is to: -

1. Learn to sketch and take field dimensions.
2. Learn to take data and transform it into graphic drawings.
3. Learn basic Auto Cad skills and learn basic engineering drawing formats.
4. Prepare the student for future Engineering positions for designing.

Course Outcomes

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

CO1. To know and understand the conventions and the method of engineering drawing. CO2. Interpret engineering drawings using fundamental technical mathematics.

CO3. Construct basic and intermediate geometry, to improve their visualization skills so that they can apply this skill in developing new products.

CO4. To improve their technical communication skill in the form of communicative drawings and to comprehend the theory of projection.

Catalog Description

This course covers the fundamentals of engineering graphics including the drawing oforthographic, isometric, and auxiliary projections.Other topics include scaling, sectioning,dimensioning, and drawing documentation. This course uses the latest release of computer-aideddesign (CAD) software commonly used in industry to introduce students to CAD interface,
structure, and commands.

List of Experiments (Indicative)

1	To understand Drawing Instruments and their uses, Dimensioning, line conventions and free hand practicing.	**3 lab hours**

2	To learn basics of AUTO CAD, layout of the software, standard tool bar/menus and description of most used tool bars, navigational tools.	**3 lab hours**
3	To understand the co -ordinate system and reference planes, HP, VP, RPP & LPP, creation of 2D/3D environment, selection of drawing size and scale, commands and creation of lines, co-ordinate points, axes, poly lines, square, rectangle, polygons, sp lines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.	**3 lab hours**
4	To understand Orthographic Projections, Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants.	**3 lab hours**
5	To understand Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes.	**3 lab hours**
6	To understand the projections of plane surfaces such as triangle, square, rectangle, rhombus, pentagon, hexagon, and circle.	**3 lab hours**
7	To understandProjections of Solids such as right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders, and cones in different positions.	**3 lab hours**
8	To understand about the Sections and Development of Lateral Surfaces of Solids.	**3 lab hours**
9	To Study Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders, and cones having base on Horizontal Plane.	**3 lab hours**
10	To study and draw Isometric projection of simple plane figures such as tetrahedron, hexahedron(cube).	**3 lab hours**
11	To draw the isometric projection of right regular prisms, pyramids, cylinders, cones, spheres, cut spheres.	**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	To know and understand the conventions and the method of engineering drawing.	**PO1**
CO2	Interpret engineering drawings using fundamental technical mathematics.	**PO2**
CO3	Construct basic and intermediate geometry, to improve their visualization skills so that they	**PO3**
CO4	To improve their technical communication skill in the form of communicative drawings and to	**PO5**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	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	Innovation and Industry Friendly	Ethical and Communication Skills
ETME	Engineerin	3	2	3		3								3		

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCH159A	Engineering Chemistry Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Chemistry				
Co-requisites	--				

Course Objectives

- To acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field.
- To understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence.
- To enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.

Course Outcomes

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

CO1: Analyze & generate experimental skills.

CO2: Enhance the thinking capabilities in the modern trends in Engineering & Technology.

CO3: Learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification.

CO4: Utilize the fundamental laboratory techniques for analyses hardness/ alkalinity of water.

CO5: Employ the basic techniques used in chemistry laboratory for analyses such as volumetric titrations, conductometric, and stalagmometer.

CO6: Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

Catalog Description

This course covers the simple synthesis method of resin using polymers. The course gives introduction and hand on experience of analysis of alkalinity/ dissolved oxygen/ hardness of water in an analytical way. An overview of volumetric titration and conductometric titration has been introduced.

List of Experiments (Indicative)

1	Determine the percentage composition of sodium hydroxide in the given mixture of sodium hydroxide and sodium chloride.	**2 lab hours**
2	Determine the amount of Oxalic acid and Sulphuric acid in one liter of solution, given standard sodium hydroxide and Potassium Permanganate.	**2 lab hours**
3	Determine the amount of copper in the copper ore solution, provided hypo solution.	**2 lab hours**
4	Argent metric titration one each by Vohlard's method and by Mohr's method.	**2 lab hours**
5	Complexometric titrations.	**2 lab hours**
6	Determine the heat of neutralization of strong acid with strong base.	**2 lab hours**
7	Determine the surface tension of a liquid using drop weight method.	**2 lab hours**
8	Determine viscosity of a given liquid (density to be determined).	**2 lab hours**
9	Determine the reaction rate constant for the Ist order reaction.	**2 lab hours**
10	Determine the cell constant of a conductivity cell.	**2 lab hours**
11	Find out strength of given solution of HClconductometric ally.	**2 lab hours**
12	Preparation of urea formaldehyde and phenol formaldehyde resins.	**2 lab hours**
13	Determination of dissolved oxygen in the given sample of water.	**2 lab hours**
14	Determination of alkalinity in the given sample of water.	**3 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	Analyze & generate experimental skills.	**PO12**
CO2	Enhance the thinking capabilities in the modern trends in Engineering & Technology.	**PO1**
CO3	Learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification.	**PO3**
CO4	Utilize the fundamental laboratory techniques for analyses hardness/ alkalinity of water.	**PO2**
CO5	Employ the basic techniques used in chemistry laboratory for analyses such as volumetric titrations, conductometric, and stalagmometer.	**PO5**
CO6	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.	**PO9**

ETCH159A	Course Code	
Engineering Chemistry Lab	Course Title	
		Engineering Knowledge

3	PO1	
3	PO2	Problem analysis
2	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
2	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
3	PO8	Ethics
3	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
3	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
3	PSO3	Ethics and Communication Skills

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

ETCS107A	Data Analysis using Python, Numpy, Pandas, Matplotlib, and Seaborn	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the concepts of Python Programming Language with Libraries.

Course Outcomes

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

CO1. Theoretical and practical understanding of data analysis with Python package like NumPy and Pandas.

CO2. The knowledge of visualization tool (matplotlib and seaborn) so that one will be able to visualize and make correct decision based on the data.

CO3. To practice with real life data to feel confident of the topic and be able to ready to work on data analysis project or interview.

Catalog Description

Data Analysis with Python is for everyone who would like to create meaningful insight out of the data with the power of Numpy, Pandas, Matplotlib & Seaborn. The course has the right recipe to equip student with the right set of skill to ingest, clean, merge, manipulate, transform and finally visualize the data to create the meaning out of the data at hand.

Course Content

Unit I: 06 lecture hours

Python programming Basic: Python interpreter, IPython Basics, Tab completion, Introspection, %run command, magic commands, matplotlib integration, python programming, language semantics, scalar types. Control flow.

Unit II: 06 lecture hours

Data Structure, functions, files: tuple, list, built-in sequence function, dict, set, functions, namescape, scope, local function, returning multiple values, functions are objects, lambda functions, error and exception handling, file and operation systems.

Unit III: **06 lecture hours**

NumPy: Array and vectorized computation: Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array.

Unit IV: **06 lecture hours**

Pandas: Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, soring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format.

Unit V: **06 lecture hours**

Visualization with Matplotlib: Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration.

Plotting with pandas and seaborn: line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data.

Text Books

1.Fabio Nelli, Python Data Analytics 2nd Edition, Apress.

Reference Books/Materials

1. Python for Data Analysis: A Complete Beginner Guide for Python basics, Numpy, Pandas, Seaborn, Bokeh and Matplotlib for Data Analysis, AI Publishing LLC.

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	Theoretical and practical understanding of data analysis with Python package like NumPy and Pandas.	**PO2**
CO2	The knowledge of visualization tool (matplotlib and seaborn) so that one will be able to visualize and make correct decision based on the data.	**PO5**
CO3	To practice with real life data to feel confident of the topic and be able to ready to work on data analysis project or interview.	**PO3**

ETCS 107A	Course Code	
Data Analysi s using Python, Numpy, Pandas, Matplot lib, and Seaborn	Course Title	

	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
ω	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETME157A	Workshop Practice	L	T	P	C
Version 1.0		0	0	3	1.5
Pre-requisites/Exposure	Basic of mechanical engineering				
Co-requisites	--				

Course Objectives

The objective of this course is to develop:

1. Understanding different manufacturing techniques and their relative advantages / disadvantages with respect to different applications
2. The selection of a suitable technique for meeting a specific fabrication need
3. Acquire a minimum practical skill with respect to the different manufacturing methods and develop the confidence to design & fabricate small components for their project work and also to participate in various national and international technical competitions.

Course Outcomes

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

CO1.Introduction to different manufacturing methods in different fields of engineering CO2. Practical exposure to different fabrication techniques
CO3. Creation of simple components using different materials

CO4.Exposure to some of the advanced and latest manufacturing techniques being employed in the industry.

Catalog Description

This course is intended to expose engineering students to different types of manufacturing/ fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weight age, some lectures and video clips available on different methods of manufacturing are also included.

List of Experiments (Indicative)

1	To introduce various shops and common tools used with their safety precautions	**3 lab hours**

2	To make T-joint in carpentry shop	**3 lab hours**
3	To make Bridal-joint in carpentry shop	**3 lab hours**
4	To make Double V-Butt joint in welding shop	**3 lab hours**
5	To make Lap joint in welding shop	**3 lab hours**
6	To make saw - cut filling V-cut taper at the corners, circular cut in fitting shop.	**3 lab hours**
7	To fit square in square, triangle in square using fitting hand tools.	**3 lab hours**
8	To Study various types of welding and perform Arc welding and Oxy-Acetylene Welding.	**3 lab hours**
9	To Study about the micrometer and vernier caliper.	**3 lab hours**
10	To Study about the various machine tools.	**3 lab hours**
11	To make jobs by using various machine tools.	**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	Introduction to different manufacturing methods in different fields of engineering	**PO1**
CO2	Practical exposure to different fabrication techniques	**PO4**

CO3	Creation of simple components using different materials	**PO5**
CO4	Exposure to some of the advanced and latest manufacturing techniques being employed in the industry.	**PO2**

ETME 157A	Course Code	
Workshop Practice	Course Title	
3	PO1	Engineering Knowledge
	PO2	Problem analysis
3	PO3	Design/development of solutions
2	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability

	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethical and Communication Skills

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

ETCS154A	Data Analysis using Python, Numpy, Pandas, Matplotlib, and Seaborn Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the concepts of Python Programming Language with Libraries.

Course Outcomes

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

CO1. Practical understanding of data analysis with Python package like NumPy and Pandas.

CO2. Implementation of visualization tool (matplotlib and seaborn) so that one will be able to visualize and make correct decision based on the data.

CO3. To practice with real life data to feel confident of the topic and be able to ready to work on data analysis project or interview.

Catalog Description

This course complements ETCS107A. It enables them to write algorithms/programs for implementing python libraries such as NumPy, Pandas, Seaborn etc. The list of experiments helps organizing the data in variety of ways using python and to solve the given problem efficiently.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS107A.

Text Books

1.Fabio Nelli, Python Data Analytics 2nd Edition, Apress.

Reference Books/Materials

1. Python for Data Analysis: A Complete Beginner Guide for Python basics, Numpy, Pandas, Seaborn, Bokeh and Matplotlib for Data Analysis, AI Publishing LLC.

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	Practical understanding of data analysis with Python package like NumPy and Pandas.	PO2
CO2	Implementation of visualization tool (matplotlib and seaborn) so that one will be able to visualize and make correct decision based on the data.	PO5
CO3	To practice with real life data to feel confident of the topic and be able to ready to work on data analysis project or interview.	PO3

ETCS 154A	Course Code	
Data Analysi s using Python, Numpy, Pandas, Matplot lib, and Seaborn Lab	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning

3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

1.1 Syllabi of Courses specific to B.Tech Computer Science and Engineering in AI & ML with Samatrix and IBM

ETMA 201A	APPLIED MATHEMATICS - III	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basic of Mathematics				
Co-requisites	--				

Course Objectives

1. Obtain the Fourier series and Fourier transform for a given function
2. Evaluate real integrals using residue theorem
3. Express analytic functions in terms of Taylor's series and Laurent series
4. Calculate complex line integrals and some infinite real integrals using Cauchy's integral theorem or residue calculus
5. Express any periodic function in term of sines and cosines
6. Analyze one dimensional wave and heat equation

Course Outcomes

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

CO1. Obtain the Fourier series and Fourier transform for a given
function CO2. Evaluate real integrals using residue theorem
CO3. Express analytic functions in terms of Taylor's series and Laurent series.

CO4. Calculate complex line integrals and some infinite real integrals using Cauchy's integral theorem or residue calculus;

- Express any periodic function in term of sines and cosines
- Analyze one dimensional wave and heat equation

Catalog Description

The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of engineering and technology. The first part of this module extends the theory of Fourier series and Fourier integral transform.

Course Content

Unit I: **8 lecture hours**

Fourier series and its applications: Euler's formulae, Dirichlet's conditions, Change of interval, Fourier expansion of even and odd functions, Fourier expansion of square wave, Rectangular wave; Saw- toothed wave; half & full rectified wave functions, Harmonic analysis.

Unit II: **12 lecture hours**

Fourier integrals and Transforms: Fourier integral theorem, Fourier sine integral, Fourier cosine integral, Fourier sine Transform, Fourier cosine transform, Fourier transform and its properties, Finite Fourier sine transform, Finite Fourier cosine transform, Fourier transforms of derivatives.

Unit III: **12 lecture hours**

Complex Numbers and Functions of Complex Variables: De Moivre's theorem, Roots of complex numbers, Euler's theorem, Logarithmic Functions, Circular and Hyperbolic Functions, Limit, Continuity and Derivatives of complex functions, Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions, application to flow problems

Unit IV: **8 lecture hours**

Complex Integration and Conformal mapping: Standard mappings (linear, square, inverse and bilinear), Complex line integral, Cauchy's integral theorem, Cauchy's integral formula, Zeroes and Singularities, Taylor series, Laurent's series, Calculation of residues, Residue theorem, Application of residue theorem to solve real integrals.

Text Books

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

Reference Books/Materials

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

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

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Obtain the Fourier series and Fourier transform for a given function	**PO1**
CO2	Evaluate real integrals using residue theorem	**PO2**
CO3	Express analytic functions in terms of Taylor's series and Laurent series.	**PO3**
CO4	Calculate complex line integrals and some infinite real integrals using Cauchy's integral theorem or residue calculus; Express any periodic function in term of sines and cosines Analyze one dimensional wave and heat equation	**PO4**

ETMA201A	Course Code	
Applied Mathematics- III	Course Title	
2	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work

	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS203A	Probabilistic Modelling and Reasoning with Python	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the basic concepts of Statistics, Probability and probability distribution and other statistical methods to solve various engineering problems.

Course Outcomes

On completion of this course, the students will be able to
learn:- CO1. Basics of Statistics and Probability distributions.
CO2. Sampling theory and Theory of
Estimation. CO3. Various tests of Hypothesis
and Significance.
CO4. Correlation and Regression and fitting of different types of curves.

Catalog Description

The course begins with the theoretical study of statistics and probability distributions which is widely used in ML, AI and all engineering applications. Topics include: basic combinatorics, random variables, probability distributions, Bayesian inference, hypothesis testing, and confidence intervals.

Course Content

Unit I: 08 lecture hours

Introduction to Statistics: Introduction to Statistics. Role of statistics in scientific methods, current applications of statistics.
Scientific data gathering: Sampling techniques, scientific studies, observational studies, data management.
Data description: Displaying data on a single variable (graphical methods, measure of central tendency, measure of spread), displaying relationship between two or more variables, measure of association between two or more variables.

Unit II: **07 lecture hours**

Probability Theory: Sample space and events, probability, axioms of probability, independent events, conditional probability, Bayes' theorem.
Random Variables: Discrete and continuous random variables. Probability distribution of discrete random variables, binomial distribution, Poisson distribution. Probability distribution of continuous random variables, The uniform distribution, normal (Gaussian) distribution, exponential distribution, gamma distribution, beta distribution, t-distribution, χ" distribution. Expectations, variance and covariance. Probability Inequalities. Bivariate distributions

Unit III: **08 lecture hours**

Point Estimations: Methods of finding estimators, method of moments, maximum likelihood estimators, bayes estimators. Methods of evaluating estimators mean squared error, best unbiased estimator, sufficiency and unbiasedness
Interval Estimations: Confidence interval of means and proportions, Distribution free confidence interval of percentiles.

Unit IV: **07 lecture hours**

Test of Statistical Hypothesis and p-values: Tests about one mean, tests of equality of two means, test about proportions, p-values, likelihood ratio test, Bayesian tests.
Bayesian Statistics: Bayesian inference of discrete random variable, Bayesian inference of binomial proportion, comparing Bayesian and frequentist inferences of proportion, comparing Bayesian and frequentist inferences of mean.
Univariate Statistics using Python: Mean, Mode. Median, Variance, Standard Deviation, Normal Distribution, t-distribution, interval estimation, Hypothesis Testing, Pearson correlation test, ANOVA F- test

Text Books

1.Achim Klenke, Probability Theory A Comprehensive Course Second Edition, Springer

Reference Books/Materials

1. •Christian Heumann, Michael Schomaker Shalabh (2016), Introduction to Statistics and DataAnalysis With Exercises, Solutions and Applications in R, Springer International 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	Basics of Statistics and Probability distributions.	PO1
CO2	Sampling theory and Theory of Estimation.	PO1
CO3	Various tests of Hypothesis and Significance.	PO2
CO4	Correlation and Regression and fitting of different types of curves.	PO3

ETCS 203A	Course Code	
Probabilistic Modelling and Reasoning with Python	Course Title	
3	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication

	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

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

Course Objectives

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

Course Outcomes

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

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

CO2. Develop the given problem as graph networks and solve with techniques of graph theory. CO3. Understanding the language of mathematical logic and expressing statements in terms of logic.

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

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

Catalog Description

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

Course Content

Unit I: 10 lecture hours

Set Theory: Introduction to set theory, Set operations, Algebra of sets, Duality, Finite and Infinite sets, Classes of sets, Power Sets, Multi sets, Cartesian Product, Representation of relations, Types

of relation, Equivalence relations and partitions , Partial ordering relations and lattices Function and its types, Composition of function and relations, Cardinality and inverse relations

Unit II: **10 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: **10 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, Semi group, 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**

ETCS219A	Course Code	
Foundation of Computer Systems	Course Title	
3	PO1	Engineering Knowledge
3	PO2	Problem analysis
2	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance

	PO12	Life-long Learning
2	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS217A	Course Code	
Data Structures	Course Title	
2	PO1	Engineering Knowledge
2	PO2	Problem analysis
	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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	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	Capacity to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.	**PSO3**
CO2	The course examines disaster profile of our country and illustrates the role played by various governmental and non- governmental organizations & its effective management.	**PO3**

CO3	It also acquaints learners with the existing legal framework for disaster management.	**PO12**
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**.**	**PO6**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
UCDM301A	Disaster Manageme			2			3						2			2

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS208A	R Programming for Data Science and Data Analytics	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

R is a programming language for statistical computing and graphics that you can use to clean, analyze, and graph your data. It is widely used by researchers from diverse disciplines to estimate and display results and by teachers of statistics and research methods.

Course Outcomes

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

CO1. Open Source, Platform Independent, Machine Learning Operations.
CO2. Exemplary support for data wrangling.
CO3. Quality plotting and graphing.
CO4. The array of packages, Statistics.

Catalog Description

The course begins with the study of R Programming.

Course Content

Unit I: 08 lecture hours

Getting Started with R and R Workspace: Introducing R, R as a programming Language, the need of R, Installing R, RStudio, RStudio's user interface, console, editor, environment pane, history pane, file pane, plots pane, package pane, help and viewer pane, R Workspace, R's working directory, R Project in R Studio, absolute and relative path, Inspecting an Environment, Inspect existing Symbols, View the structure of object, Removing symbols, Modifying Global Options, Modifying warning level, Library of Packages, Getting to know a package, Installing a Package from CRAN, Updating Package from CRAN, Installing package from online repository, Package Function, Masking and name conflicts.

Unit II: **07 lecture hours**

Basic Objects and Basic Expressions: Vectors, Numeric Vectors, Logical Vectors, Character Vectors, subset vectors, Named Vectors, extracting element, converting vector, Arithmetic operators, create Matrix, Naming row and columns, subsetting matrix, matrix operators, creating and subsetting an Array, Creating a List, extracting element from list, subsetting a list, setting value, creating a value of data frame, subsetting a data frame, setting values, factors, useful functions of a data frame, loading and writing data on disk, creating a function, calling a function, dynamic typing, generalizing a function. Assignment Operators, Conditional Expression, using if as expression and statement, using if with vectors, vectorized if: ifelse, using switch, using for loop, nested for loop, while loop.

Unit III: **08 lecture hours**

Working with Basic Objects and Strings: Working with object function, getting data dimensions, reshaping data structures, iterating over one dimension, logical operators, logical functions, dealing with missing values, logical coercion, math function, number rounding functions, trigonometric functions, hyperbolic functions, extreme functions, finding roots, derivatives and integration, Statistical function, sampling from a vector, Working with random distributions, computing summary statistics, covariance and correlation matrix, printing string, concatenating string, transforming text, Formatting text, formatting date and time, formatting date and time to string, finding string pattern, using group to extract data, reading data.

Unit IV: **07 lecture hours**

Working with Data – Visualize and Analyze Data: Reading and Writing Data, importing data using built-in-function, READR package, export a data frame to file, reading and writing Excel worksheets, reading and writing native data files, loading built-in data sets, create scatter plot, bar chart, pie chart, histogram and density plots, box plot, fitting linear model and regression tree.

Text Books

1.Garrett Grolemund, Hands-On Programming with R, O′Reilly.

Reference Books/Materials

1. Hadley Wickham & Garrett Grolemund, R for Data Science, O′Reilly.

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	Open Source, Platform Independent, Machine Learning Operations.	PO1
CO2	Exemplary support for data wrangling.	PO1
CO3	Quality plotting and graphing.	PO2
CO4	The array of packages, Statistics.	PO3

ETCS 208A	Course Code	
R Programming for Data Science and Data Analytics	Course Title	
3	PO1	Engineering Knowledge
3	PO2	Problem analysis

3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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 helps 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**

Course Code	Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	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	Innovation and Industry Friendly	Ethics and Communication Skills
ETCS25	Data Structure	2	2		3	3								3		

1=weakly mapped

2= moderately mapped

3=strongly mappe

ETCS259A	Probabilistic Modelling and Reasoning with Python Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the basic concepts of Statistics, Probability and probability distribution and other statistical methods to solve various engineering problems.

Course Outcomes

On completion of this course, the students will be able to learn:-
CO1. Applications of Sampling theory and Theory of
Estimation. CO2. Implementation of various tests of Hypothesis
and Significance.
CO3. Implementation of Correlation and Regression and fitting of different types of curves.

Catalog Description

This course complements ETCS203A. It enables them to write algorithms/programs for solving various tests of Hypothesis and Significance and Correlation and Regression and fitting of different types of curves. The list of experiments helps organizing the data in variety of ways using python and to solve the given problem efficiently.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS203A.

Text Books

1.Achim Klenke, Probability Theory A Comprehensive Course Second Edition, Springer

Reference Books/Materials

1. Christian Heumann, Michael Schomaker Shalabh (2016), Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R, Springer International 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	Applications of Sampling theory and Theory of Estimation	**PO3**
CO2	Implementation of various tests of Hypothesis and Significance.	**PO2**
CO3	Implementation of Correlation and Regression and fitting of different types of curves.	**PO5**

ETCS 259A	Course Code	
Probabi listic Modelli ng and Reasoni ng with Python Lab	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions

	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS261A	R Programming for Data Science and Data Analytics Lab	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

R is a programming language for statistical computing and graphics that you can use to clean, analyze, and graph your data. It is widely used by researchers from diverse disciplines to estimate and display results and by teachers of statistics and research methods.

Course Outcomes

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

CO1. Implement Open Source, Platform Independent, Machine Learning Operations. CO2. Exemplary support for data wrangling.
CO3. Implement Quality plotting and graphing.
CO4. Implement the array of packages,
Statistics.

Catalog Description

This course complements ETCS208A. It enables them to write algorithms/programs for Implementing Open Source, Platform Independent, Machine Learning Operations and Quality plotting and graphing. The list of experiments helps organizing the data in variety of ways using R and to solve the given problem efficiently.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS208A.

Text Books

1.Garrett Grolemund, Hands-On Programming with R, O′Reilly.

Reference Books/Materials

1. Hadley Wickham & Garrett Grolemund, R for Data Science, O′Reilly.

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 Open Source, Platform Independent, Machine Learning Operations.	**PO5**
CO2	Exemplary support for data wrangling.	**PO2**
CO3	Implement quality plotting and graphing.	**PO3**
CO4	Implement The array of packages, Statistics.	**PO3**

ETCS 261A	Course Code	
R Progra mming for Data Science and Data Analyti cs Lab	Course Title	
	PO1	Engineering Knowledge
3		Problem analysis

	PO2	
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCH 285A	Buisness Communication Skills- I	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To provide an overview of Prerequisites to Business Communication.
2. To put in use the basic mechanics of Grammar.
3. To provide an outline to effective Organizational Communication.
4. To underline the nuances of Business communication.
5. To impart the correct practices of the strategies of Effective Business writing.

Course Outcomes

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

CO1. To be familiar with the complete course outline/Course Objectives/Learning Outcomes/ Evaluation Pattern & Assignments
CO2. Understand the correct form of English with proficiency. CO3. To demonstrate his/her ability to write error free while making an optimum use of correct Business Vocabulary & Grammar.

CO4. To distinguish among various levels of organizational communication and communication barriers while developing an understanding of Communication as a process in an organization.

Catalog Description

In this course, the focus will be on improving LSRW skills, i.e. listening, speaking, reading and writing. Students will learn how to communicate effectively though prescribed syllabus as well as classroom assignments/activities specifically designed to encourage students to play an active role for enhancing their knowledge and developing learning strategies.

List of Experiments (Indicative)

1	**Self- introduction:** Informal introduction & formal introduction'; Formal Introduction of oneself in front of the	**2 lab hours**

	group.	
2	**Personal Branding:**Social media presence (Facebook, twitter and LinkedIn)**,**Networking**,** Digital Etiquettes	**2 lab hours**
3	**JAM:** Introduction to 'Just A Minute speech' and the 'Extempore speech'; Preparation of speech on given topic (different topic for each student); delivery of the speech; Feedback (on content, time management, body language etc. highlighting the positive aspects.)	**2 lab hours**
4	**Listening Comprehension:** Listen to online / downloaded oration by renowned Orators; write down the content in a precise form and give an oral presentation of that write up following all the etiquettes of public speaking.	**2 lab hours**
5	**Academic Language Skills,**Identify ways of emphasizing, signposting, organising, etc used in spoken (academic) English, Read and comprehend authentic English language publications, both print and electronic, such as newspapers, journals, brochures and catalogues, course materials and online blogs.	**2 lab hours**
6	**Turn Coat**: Speaking for and against on a topic by the same person with time specification; topics to assigned from the current events; feedback & suggestions for improvement.	**2 lab hours**
7	**Turn Coat**: Speaking for and against on a topic by the same person with time specification; topics to assigned from the current events; feedback & suggestions for improvement.	**2 lab hours**
8	**Conversation ability:** Characteristics of effective conversation; Listening to a few sample conversations; preparing conversation based on the given situation; enacting the situation through effective delivery of the script; feedback & suggestions for improvement	**2 lab hours**
9	**Role Play:** Characteristics of Role Play; assigning roles; developing the content to deliver; enacting the role with effective delivery; feedback & suggestions for improvement	**2 lab hours**
10	**Etiquettes and Manners:**Etiquette Basics: Emails and Spoken Words**,** Professional Appearance and Grooming**,**Office Etiquette: Workplace Behaviour	**2 lab hours**

11	**Public Speaking:** Characteristics of effective Public speaking; possible barriers; watching demo online; topic assignment, information gathering & recording; delivery in front of the class; feedback & suggestions for improvement. . (Different topic for each student)	**2 lab hours**
12	**Group Discussion:** Importance and characteristics; Dos & Don'ts in GD; Demo display; assign topic for the group, Preparation & performance; feedback & suggestions for improvement.	**2 lab hours**
13	**Debate**: Difference between Group Discussion & Debating; Watching demo of Debating; Topic for the group of 2 or 4; preparation and performance; feedback & suggestions for improvement	**2 lab hours**
14	**Interview:** Importance & purpose of Job Interview; Interview etiquettes; Watch demo interview; Appear for formal mock interview; feedback & suggestions for improvement.	**3 lab hours**
15	**Interview:** Importance & purpose of Job Interview; Interview etiquettes; Watch demo interview; Appear for formal mock interview; feedback & suggestions for improvement.	**2 lab hours**

Text book [TB]:

Soft Skills & Employability Skills by Sabina Pillai and Agna Fernandez published by Cambridge University Press 2018.

Reference Books

1. Professional Speaking Skills by ArunaKoneru, Oxford Publications, 2015 2. Soft Skills for everyone by Jeff Butterfield Cengage Learning 2011

E Books

- https://www.britishcouncil.in/english/courses-business 27
- http://www.bbc.co.uk/learningenglish/english/features/pronunciation

- http://www.bbc.co.uk/learningenglish/english/
- http://www.antimoon.com/how/pronunc-soundsipa.htm
- http://www.cambridgeenglish.org/learning-english/free-resources/write-and-improve/

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	To be familiar with the complete course outline/Course Objectives/Learning Outcomes/ Evaluation Pattern & Assignments	**P010, PSO3**
CO2	Understand the correct form of English with proficiency.	**P09, PSO3**
CO3	To demonstrate his/her ability to write error free while making an optimum use of correct Business Vocabulary & Grammar.	**P09, PSO3**
CO4	To distinguish among various levels of organizational communication and communication barriers while developing an understanding of Communication as a process in an organization.	**P010, PSO3**

ETEL285A	Course Code	
Buisness Communication Skills- I	Course Title	
	PO1	Engineering Knowledge
	PO2	Problem analysis
	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
3	PO9	Individual or team work
3	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
	PSO1	Application of Concepts
	PSO2	Project Management
3	PSO3	Ethical and Professional Issues

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-andadd, 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: 8lecture 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: 10lecture 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

ETCS 222A	Course Code	
Computer Organization and Architecture	Course Title	
	PO1	Engineering Knowledge
2	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex
2	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
3	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

1=weakl 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**

ETCS 220A	Course Code	
Analysi s and design of algorith ms	Course Title	
		Engineering Knowledge

2	PO1	
2	PO2	Problem analysis
	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	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	Innovation and Industry Friendly	Ethics and Communication Skills
ETCS307A	Database Management Systems		2	3	3	3				3				3		

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS205A	Machine Learning and Pattern Recognition	L	T	P	C
Version 1.0		3	-	-	3
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the basic concepts of machine learning, supervised learning, unsupervised learning, and reinforcement learning.

Course Outcomes

On completion of this course, the students will be able to learn:- CO1. Basic Algorithms of Machine Learning.
CO2. Supervised and Unsupervised Learning.

CO3. Linear Regression, Classification, Tree, PCA, SVD, SVM. CO4. Resampling Methods and Optimization Techniques.

Catalog Description

The course begins with the key concepts of Machine Learning. The student gets an opportunity to learn Machine learning algorithms, analyze the results, and techniques to optimize them.

Course Content

Unit I: 10 lecture hours

Introduction: Learning systems, real world applications of machine learning, why machine learning, variable types and terminology, function approximation.
Types of machine learning: Supervised learning, unsupervised learning, reinforcement learning.

Unit II: 10 lecture hours

Important concepts of machine learning: Parametric vs non-parametric models, the trade-off between prediction accuracy and model interpretability, the curse of dimensionality, measuring the quality of fit, bias-variance trade off, overfitting, model selection, no free lunch theorem.

Unit III: **10 lecture hours**

Linear Regression: Linear regression, estimating the coefficients, accessing the accuracy of coefficient estimates, accessing the accuracy of the model, multiple linear regression, qualitative predictors.

Unit IV: **07 lecture hours**

Classification: Logistic regression, estimating regression coefficients, making predictions, multiple logistic regressions, linear discriminant analysis, bayes' theorem of classification, LDA for p=1, LDA for p>1, quadratic discriminant analysis.

Text Books

1.Tom M. Mitchell, Machine Learning, First Edition, McGraw Hill Education.

Reference Books/Materials

1. Christopher M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer International 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	Basic Algorithms of Machine Learning.	PO2

CO2	Supervised and Unsupervised Learning.	**PO2**
CO3	Linear Regression, Classification, Tree, PCA, SVD, SVM.	**PO3**
CO4	Resampling Methods and Optimization Techniques.	**PO4**

Ethics and Communication Skills	PSO3	
Innovation and Industry Friendly	PSO2	
Application of Concepts	PSO1	3
Life-long Learning	PO12	
Project management and finance	PO11	
Communication	PO10	
Individual or team work	PO9	
Ethics	P O 8	
Environment and sustainability	PO7	
The engineer and society	PO 6	
Modern tool usage	P O 5	
Conduct investigations of complex problems	PO4	2
Design/development of solutions	PO3	3
Problem analysis	PO2	3
Engineering Knowledge	PO1	
	Course Title	Machin e Learnin g and Pattern Recogni tion
	Course Code	ETCS 205A

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETMC226A	Fundamentals of Management	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To be able to Provide understanding of management history and functions of planning,
2. organizing, leading, and controlling. The role of a manager is examined in promoting change, providing effective leadership, motivation, team building, communication, and decision making.
3. To learn & obtain skills to manage production, operations, and inventory control.
4. Develop the 4 P's of marketing: Product, promotion, distribution (place), and pricing.
5. To develop &learn about the accounting, finance, and financial markets within the business world.

Course Outcomes

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

CO1. Analyze & Attain management, leadership, and human resource management skills.

CO2. Provide the students with an understanding of the theories, models, problems, issues, and techniques related to the management of production and operations management

CO3.Develop an integrated marketing communications plan for a product, concept, good and/or service based on an identified market need or target.

CO4. Provide the students with a tool for assessing the financial position of an organization

Catalog Description

This course imparts the basic understanding of management history and functions of planning, organizing, leading, and controlling. The role of a manager is examined in promoting change, providing effective leadership, motivation, team building, communication, and decision making. This subject also provides the students with an understanding of the theories, models, problems, issues, and techniques related to the management of production and operations management , marketing & finance.

Course Content

Unit I: **8 lecture hours**

UNIT I

Meaning of management, Definitions of Management, Characteristics of management, Management vs. Administration. Management-Art, Science and Profession. Importance of Management. Development of Management thoughts. Principles of Management. The Management Functions, Inter-relationship of Managerial functions. Nature and Significance of staffing, Personnel management, Functions of personnel management, Manpower planning, Process of manpower planning, Recruitment, Selection; Promotion - Seniority Vs. Merit. Training - objectives and types of training.

Unit II: 12 lecture hours

Production Management: Definition, Objectives, Functions and Scope, Production Planning and Control; its significance, stages in production planning and control. Brief introduction to the concepts of material management, inventory control; its importance and various methods.

Unit III: 12 lecture hours

Marketing Management - Definition of marketing, marketing concept, objectives & Functions of marketing. Marketing Research - Meaning; Definition; objectives; Importance; Limitations; Process. Advertising - meaning of advertising, objectives, functions, criticism.

Unit IV: 8 lecture hours

Introduction of Financial Management, Objectives of Financial Management, Functions and Importance of Financial Management. Brief Introduction to the concept of capital structure and various sources of finance.

Text book [TB]: Robbins S. P. (2009). Fundamentals of Management (6th Edition). Delhi Pearson.

Reference book(s) Text book [TB]: Robbins S. P. (2009). Fundamentals of Management (6th Edition). Delhi Pearson.

Reference book(s) [RB]:

Gupta R. S., Sharma B. D., & Bhalla N. S. (2011). Principles and Practice of Management (11th Edition), Kalyani Publishers.

Prasad L.M. (2016). Principles & Practices of Management (1st Edition). Sultan Chand & Sons.

Gupta C. B. (2013). Management: Principles and Practice (3rd Edition). Sultan Chand and Sons.

Tripathi, P.C. & Reddy P. N. (5th Edition). Principles of Management (5th Edition). McGraw Hill Education.

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

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)

3

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Analyze & Attain management, leadership, and human resource management skills.	**PO1**
CO2	Provide the students with an understanding of the theories, models, problems, issues, and techniques related to the management of production and operations management	**PO4**
CO3	Develop an integrated marketing communications plan for a product, concept, good and/or service based on an identified market need or target.	**PO5**
CO4	Provide the students with a tool for assessing the financial position of an organization	**PO2**

ETMC226A	Course Code	

FUNDAM ENTALS OF MANAGEMENT	Course Title	
2	PO1	Theoretical Knowledge
2	PO2	Problem analysis
	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PS O1	Application of Concepts
	PS O2	Innovation and Industry Friendly
	PS O3	Ethics and Communication Skills

ETCS254A	Machine Learning Practical with Python, Scikit-learn, Matplotlib, TensorFlow	L	T	P	C
Version 1.0		-	-	4	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the basic concepts of machine learning, supervised learning, unsupervised learning, and reinforcement learning.

Course Outcomes

On completion of this course, the students will be able to
learn:- CO1. Basic Algorithms of Machine Learning.
CO2. Implementation of libraries such as Scilit-learn, matplotlib etc. on real life datasets. CO3. Implementation of libraries tensorflow on real life datasets.
CO4. Resampling Methods and Optimization Techniques.

Catalog Description

This course complements ETCS205A. It enables them to write algorithms/programs for Implementing Scilit-learn, matplotlib, tensorflow and Quality plotting and graphing. The list of experiments helps organizing the data in variety of ways using python and to solve the given problem efficiently.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS205A.

Text Books

1.Tom M. Mitchell, Machine Learning, First Edition, McGraw Hill Education.

Reference Books/Materials

1. Christopher M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer International 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	Basic Algorithms of Machine Learning.	**PO2**
CO2	Implementation of libraries such as Scilit-learn, matplotlib etc. on real life datasets.	**PO3**
CO3	Implementation of libraries tensor flow on real life datasets.	**PO3**
CO4	Resampling Methods and Optimization Techniques.	**PO4**

ETCS 254A	Course Code	
Machin e Learnin g Practica l with Python, Scikit-learn, Matplot lib, TensorF low	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions

2	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

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

Course Objectives

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

Course Outcomes

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

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

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

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

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

Catalog Description

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

Course Content

List of Experiments

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**

ETCS 355A	Course Code	
Databas e Manage ment Systems Lab	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage

2		
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS262A	Analysisand 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 To understand various sorting techniques.
CO 3 Analyze working of various operations on graphs.

CO 4 To understand concept of string matching in data structure

Course Content

List of Experiments

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

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

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

Examination Scheme:

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

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

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

CO1	Student able to implement program for graph representation.	**PO2**
CO2	To understand operations like insert and search record in the database.	**PO3**
CO3	Analyze working of various operations on AVL Tree.	**PO5**
CO 4	To understand concept of file organization in data structure	**PSO1, PO9**

Course Code	Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Innovation and Industry Friendly	Ethics and Communication Skills
ETCS262A	Analysis and		2	3		3				3				3		

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCH286A	Buisness Communication II	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To apply business communication theory to solve workplace communication issues.
2. To demonstrate the communication skills required in the workplace.
3. To understand complex ideas in written and spoken formats.
4. To express complex ideas accurately in written and spoken formats.

Course Outcomes

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

CO1. To demonstrate his/her ability to write error free while making an optimum use of correct Business Vocabulary & Grammar.
CO2. To distinguish among various levels of organizational communication and communication barriers while developing an understanding of Communication as a process in an organization.
CO3. To draft effective business correspondence with brevity and clarity.
CO4. To stimulate their Critical thinking by designing and developing clean and lucid writing skills.

Catalog Description

In this course, the focus will be on improving LSRW skills, i.e. listening, speaking, reading and writing. Students will learn how to communicate effectively though prescribed syllabus as well as classroom assignments/activities specifically designed to encourage students to play an active role for enhancing their knowledge and developing learning strategies.

List of Experiments (Indicative)

1	Interpersonal Communication and Building Vocabulary	**2 lab hours**
2	Interpersonal Communication and Building Vocabulary	**2 lab hours**

3	Activities on Reading Comprehension	**2 lab hours**
4	Activities on Reading Comprehension	**2 lab hours**

5	Activities on Writing Skills	**2 lab hours**
6	Activities on Writing Skills	**2 lab hours**
7	Activities on Presentation Skills	**2 lab hours**
8	Activities on Presentation Skills	**2 lab hours**
9	Activities on Group Discussion and Interview Skills	**2 lab hours**
10	Activities on Group Discussion and Interview Skills	**2 lab hours**
11	Conflict Management	**2 lab hours**
12	Conflict Management	**2 lab hours**
13	Leadership Skills	**2 lab hours**
14	Team Building	**3 lab hours**
15	Social Media Engagement	**2 lab hours**

Text book [TB]:

Soft Skills & Employability Skills by Sabina Pillai and Agna Fernandez published by Cambridge University Press 2018.

Reference Books

1. Professional Speaking Skills by ArunaKoneru, Oxford Publications, 2015 2. Soft Skills for everyone by Jeff Butterfield Cengage Learning 2011

E Books

- https://www.britishcouncil.in/english/courses-business 27
- http://www.bbc.co.uk/learningenglish/english/features/pronunciation
- http://www.bbc.co.uk/learningenglish/english/
- http://www.antimoon.com/how/pronunc-soundsipa.htm

- http://www.cambridgeenglish.org/learning-english/free-resources/write-and-improve/

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	To demonstrate his/her ability to write error free while making an optimum use of correct Business Vocabulary & Grammar.	P010, PSO3
CO2	To distinguish among various levels of organizational communication and communication barriers while developing an understanding of Communication as a process in an organization.	P09, PSO3
CO3	To draft effective business correspondence with brevity and clarity.	P09, PSO3
CO4	To stimulate their Critical thinking by designing and developing clean and lucid writing skills.	P010, PSO3

ETCH286A	Course Code	
Buisness Communication II	Course Title	
	PO1	Engineering Knowledge
	PO2	Problem analysis
	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
3	PO9	Individual or team work
3	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
3	PSO3	Ethics and Communication Skills

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

ETCS308A	Big Data Analytics	L	T	P	C
Version 1.0	--	3	0	0	3
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. Understand analytics, what is leading to big data.
2. Understand Scientific techniques of analytics.
3. Develop an understanding of the complete open-source Hadoop ecosystem and its near term future directions.
4. Understand the major challenges of data.
5. Understand how the growth of interconnected devices helps big data.
6. Understand the functions and features of HDP.
7. Understand IBM value-add components.
8. Understand Explain IBM Watson Studio.

Course Outcomes

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

CO1. Understand the brief description of the purpose of each of the value-add components. CO2. Understand Hortonworks Data Platform (HDP)
CO3. Understand Apache Ambari

CO4. Understand Hadoop and the Hadoop Distributed File System, MapReduce and Yarn, Apache Spark.
CO5. Understand Zoo Keeper, Slider, and
Knox CO6. Loading data with Sqooq

Course Overview:

The course explains Dataplane Service , Stream Computing, Data Science essentials, Drew Conway's Venn Diagram - and that of others, The Scientific Process applied to Data Science, The steps in running a Data Science project , Languages used for Data Science (Python, R, Scala, Julia, ...), Survey of Data Science Notebooks, Markdown language with notebooks, Resources for Data Science, including GitHub, Jupyter Notebook, Essential packages: NumPy, SciPy, Pandas, Scikit-learn, NLTK, BeautifulSoup, Data

visualizations: matplotlib, , PixieDust, Using Jupyter “Magic” commands, Using Big SQL to access HDFS data, Creating Big SQL schemas and tables, Querying Big SQL tables, Managing the Big SQL Server, Configuring Big SQL security, Data federation with Big SQL, IBM Watson Studio , Analyzing data with Watson Studio.

Course Content

Unit I: **10 lecture hours**

Introduction to Big Data and Analytics: Overview of Big Data 5 Vs of Big data, Realtime example of analytics with use cases ,Developing an understanding of the complete open-source Hadoop ecosystem and its nearterm future directions ,Comparing and evaluating the major Hadoop distributions and their ecosystem components, both their strengths and their limitations ,Gaining hands-on experience with key components of various big data ecosystem components and their roles in building a complete big data solution to common business problems, Learning the tools that will enable you to continue your big data education after the course, Describing the functions and features of HDP, Listing the IBM value-add components, Explaining what IBM Watson Studio is, Giving a brief description of the purpose of each of the value-add components, Exploring the lab environment, Launching Apache Ambari, Starting a variety of services using Apache GUI, Exploring some of the directory structure on the Linux system, Understanding the purpose of Apache Ambari in the HDP stack, Understanding the overall architecture of Ambari, and Ambari’s relation to other services and components of a Hadoop cluster, Listing the functions of the main components of Ambari, Explaining how to start and stop services from Ambari Web Console, Managing Hadoop clusters with Apache Ambari, Start the Apache Ambari web console and perform basic start/stop services, Explore other aspects of the Ambari web server, Understanding the basic need for a big data strategy in terms of parallel reading of large data files and internode network speed in a cluster, Describing the nature of the Hadoop Distributed File System (HDFS), Explaining the function of the NameNode and DataNodes in an Hadoop cluster, Explaining how files are stored and blocks ("splits") are replicated, Filing access and basic commands with HDFS, Describing the MapReduce model v1, Listing the limitations of Hadoop 1 and MapReduce 1, Reviewing the Java code required to handle the Mapper class, the Reducer class, and the program driver needed to access MapReduce , Describing the YARN model, Comparing Hadoop 2/YARN with Hadoop 1, Run MapResuce and YARN jobs, Creating and code a simple MapReduce job, Understanding the nature and purpose of Apache Spark in the Hadoop ecosystem, Listing and describing the architecture and components of the Spark unified stack , Describing the role of a Resilient Distributed Dataset (RDD), Understanding the principles of Spark programming, Listing and describing the Spark libraries, Launching and using Spark's Scala and Python shells, Working with Spark RDD with Scala, Listing the characteristics of representative data file formats, including flat/text files, CSV, XML, JSON, and YAML, Listing the characteristics of the four types of NoSQL datastores, Describing the

storage used by HBase in some detail, Describing and compare the open source programming languages, Pig and Hive, Listing the characteristics of programming languages typically used by Data Scientists: R and Python, Understanding the challenges posed by distributed applications and how ZooKeeper is designed to handle them, Explaining the role of ZooKeeper within the Apache Hadoop infrastructure and the realm of Big Data management, Exploring generic use cases and some real-world scenarios for ZooKeeper, Defining the ZooKeeper services that are used to manage distributed systems, Exploring and use the ZooKeeper CLI to interact with ZooKeeper services, Understanding how Apache Slider works in conjunction with YARN to deploy distributed applications and to monitor them, Explaining how Apache Knox provides peripheral security services to an Hadoop cluster, Listing some of the load scenarios that are applicable to Hadoop, Understanding how to load data at rest, Understanding how to load data in motion, Understanding how to load data from common sources such as a data warehouse, relational database, web server, or database logs, Explaining what Sqoop is and how it works, Describing how Sqoop can be used to import data from relational systems into Hadoop and export data from Hadoop into relational systems, Briefing introduction to what Flume is and how it works, Moving data into HDFS with Sqoop, Explaining the need for data governance and the role of data security in this governance, Listing the Five Pillars of security and how they are implemented with HDP, Discussing the history of security with Hadoop, Identifying the need for and the methods used to secure Personal & Sensitive Information, Describing the function of the Hortonworks DataPlane Service (DPS), Defining streaming data, Describing IBM as a pioneer in streaming data - with System S IBM Streams, Explaining streaming data - concepts & terminology, Comparing and contrasting batch data vs streaming data, Listing and explaining streaming components & Streaming Data Engines (SDEs)

Unit II: **10 lecture hours**

Understanding Data Science and Notebooks: Working with Spark RDD with Scala, Listing the characteristics of representative data file formats, including flat/text files, CSV, XML, JSON, and YAML, Listing the characteristics of the four types of NoSQL datastores, Describing the storage used by HBase in some detail, Describing and compare the open source programming languages, Pig and Hive, Listing the characteristics of programming languages typically used by •Data Scientists: R and Python, Understanding the challenges posed by distributed applications and how ZooKeeper is designed to handle them, Explaining the role of ZooKeeper within the Apache Hadoop infrastructure and the realm of Big Data management, Exploring generic use cases and some real-world scenarios for ZooKeeper, Defining the ZooKeeper services that are used to manage distributed systems, Exploring and use the ZooKeeper CLI to interact with ZooKeeper services, Understanding how Apache Slider works in conjunction with YARN to deploy distributed applications and to monitor them, Explaining how Apache Knox provides peripheral security services to an Hadoop cluster, Listing some of the load scenarios that are applicable to Hadoop, Understanding how to load data at rest, Understanding how to load data in motion, Understanding how to load data from common sources such as a data warehouse,

relational database, web server, or database logs, Explaining what Sqoop is and how it works, Describing how Sqoop can be used to import data from relational systems into Hadoop and export data from Hadoop into relational systems, Briefing introduction to what Flume is and how it works, Moving data into HDFS with Sqoop, Explaining the need for data governance and the role of data security in this governance, Listing the Five Pillars of security and how they are implemented with HDP, Discussing the history of security with Hadoop, Identifying the need for and the methods used to secure Personal & Sensitive Information, Describing the function of the Hortonworks DataPlane Service (DPS), Defining streaming data, Describing IBM as a pioneer in streaming data - with System, Streams, Explaining streaming data - concepts & terminology, Comparing and contrasting batch data vs streaming data, Listing and explaining streaming components & Streaming Data Engines (SDEs), Data visualizations: matplotlib, PixieDust, Using Jupyter "Magic" commands, Start Jupyter - it will open in a web browser, Importing the lab file (all Jupyter files have a.ipynb suffix) into your default workspace, This is now a copy of the provided lab file and you can do anything with it, If you mess it up, you can re-import again later, Exploring the component panels - some are markdown, some are code, some are results of running the code (output data, visualizations, …), Learning how to run single panels - and then the whole script oYou may need to adjust the provided script to locate the data files that accompany the Jupyter.ipynb file, Add some additional panels, as described in the lab script

Unit III: 10lecture hours

BigSQL and Watson Studio: Overview of Big SQL, Understanding how Big SQL fits in the Hadoop architecture, Start and stop Big SQL using Ambari and command line, Connecting to Big SQL using command line, Connecting to Big SQL using IBM Data Server Manager, Configuring images, Starting Hadoop components, Start up the Big SQL and DSM services, Connecting to Big SQL using JSqsh, Executing basic Big SQL statements, Exploring Big SQL through Ambari using DSM, Describing and creating Big SQL schemas and tables, Describing and listing the Big SQL data types, Working with various Big SQL DDLs ,Loading data into Big SQL tables using best practices, Creating and dropping simple Big SQL table, Creating sample tables, Moving data into HDFS, Loading data into Big SQL tables Creating and working with views, Creating external tables, Describing Big SQL supported file formats, Query Big SQL tables using various DMLs, Connecting to Big SQL, Query data with Big SQL, Working with the ARRAY type, Working with Big SQL functions, Storing data in an alternate file format (Parquet), Configuring the Big SQL Server, Configuring the Big SQL Scheduler, Listing the registries for compiler and runtime performance improvement •Backup and restore Big SQL, Updating the database resource percentage for the Big SQL database instance, Inspecting the Big SQL scheduler configuration file, Viewing the registries for the compiler and runtime performance improvement, Configuring authentication for Big SQL, Managing security with Apache Ranger, Enabling SSL encryption, Configuring authorization of Big SQL objects, Configuring impersonation in Big SQL, Understanding the concept of Big SQL federation, Listing the supported data sources, Set up and configure a federation server to use different data

sources, Configuring Fluid Query with Big SQL, What is Watson Studio?, Setting up a project, Working with collaborators, Managing data assets, Sign up for a Watson Studio account, Creating a new project, Managing a project, Adding collaborators, Loading data, Managing the object storage, Overview of Jupyter notebooks, Creating notebooks, Coding and running notebooks, Sharing and publishing notebooks, Creating a notebook , Using notebooks, Working with external data.

Text Books

1. IBM Material

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 brief description of the purpose of each of the value-add components.	**PO1**
CO2	Understand Hortonworks Data Platform (HDP)	**PO4**
CO3	Understand Apache Ambari	**PO5**
CO4	Understand Hadoop and the Hadoop Distributed File System, MapReduce and Yarn, Apache Spark.	**PO2**
CO5	Understand Zoo Keeper, Slider, and Knox	**PO3**
CO6	Loading data with Sqooq	**PO3**

Ethics and Communication Skills	PSO3	2
Innovation and Industry Friendly	PSO2	
Application of Concepts	PSO1	3
Life-long Learning	PO12	
Project management and finance	PO11	
Communication	PO10	
Individual or team work	PO9	
Ethics	PO8	
Environment and sustainability	PO7	
The engineer and society	PO6	
Modern tool usage	PO5	3
Conduct investigations of complex problems	PO4	3
Design/development of solutions	PO3	3
Problem analysis	PO2	3
Engineering Knowledge	PO1	3
	Course Title	Big Data Analytics
	Course Code	ETCS308A

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

ETCS214A	Theory of Computation	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Discrete Mathematics				
Co-requisites	--				

Course Objectives

1. Develop a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. Prove that a given language is regular and apply the closure properties of languages.
4. Design context free grammars to generate strings from a context free language and convert them into normal forms.
5. Prove equivalence of languages accepted by Pushdown Automata and languages generated by context free grammars.
6. Identify the hierarchy of formal languages, grammars and machines.
7. Distinguish between computability and non-computability and Decidability and undecidability.

Course Outcomes

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

CO1. Write a formal notation for strings, languages and machines. CO2. Design finite automata to accept a set of strings of a language.
CO3. Determine equivalence of languages accepted by Pushdown Automata and languages generated by context free grammars.
CO4. Distinguish between computability and non-computability and Decidability and undecidability.

Catalog Description

This course provides a formal connection between algorithmic problem solving and the theory of languages and automata and develop them into a mathematical view towards algorithmic design and in general computation itself. The course should in addition clarify the practical view towards the applications of these ideas in the engineering part of computer science.

Course Content

Unit I: **12 lecture hours**

Introduction to formal proof: Additional forms of proof, Inductive proofs, Finite Automata (FA), Deterministic Finite Automata (DFA), Non-deterministic Finite Automata (NFA), Finite Automata with Epsilon transitions.

Unit II: **8 lecture hours**

Regular Expression: FA and Regular Expressions, Proving languages not to be regular, Closure properties of regular languages, Equivalence and minimization of Automata.

Unit III: **12 lecture hours**

Context-Free Grammar (CFG): Parse Trees, Ambiguity in grammars and languages, Definition of the Pushdown automata, Languages of a Pushdown Automata, Equivalence of Pushdown automata and CFG, Deterministic Pushdown Automata. Normal forms for CFG, Pumping Lemma for CFL, Closure Properties of CFL, Turing Machines, Programming Techniques for TM.

Unit IV: **8 lecture hours**

A language that is not Recursively Enumerable (RE): An undecidable problem that is RE, Undecidable problems about Turing Machine, Post's Correspondence Problem.

Text Books

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", second Edition, Pearson Education.

Reference Books/Materials

1. H.R. Lewis and C.H. Papadimitriou, "Elements of the theory of Computation", Second Edition, Pearson Education.

2. Thomas A. Sudkamp," An Introduction to the Theory of Computer Science, Languages and Machines", Third Edition, Pearson Education.

3. Raymond Greenlaw an H.James Hoover, "Fundamentals of Theory of Computation, Principles and Practice", Morgan Kaufmann Publishers.

4. MichealSipser, "Introduction of the Theory and Computation", Thomson Brokecole.

5. J. Martin, "Introduction to Languages and the Theory of computation" Third Edition, Tata Mc Graw Hill.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Write a formal notation for strings, languages and machines	**PO1**
CO2	Design finite automata to accept a set of strings of a language	**PO3**
CO3	Determine equivalence of languages accepted by Pushdown Automata and languages generated by context free grammars	**PO2**
CO4	Distinguish between computability and non-computability and Decidability and un-decidability	**PO4**

ETCS214A	Course Code	
Theory of Computation	Course Title	
2	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

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

Course Objectives

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

Course Outcomes

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

CO1. Create processes and threads.

CO2. Develop algorithms for process scheduling for a given specification of CPU utilization, throughput, Turnaround Time, Waiting Time, Response Time.

CO3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.

CO4. Design and implement file management system.

CO5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

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; Multiprocessorscheduling: 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 (bitvector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Unit IV: **10 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	Create processes and threads	PO1
CO2	Develop algorithms for process scheduling for a given specification of CPU utilization, throughput, Turnaround Time, Waiting Time, Response Time.	PO2

CO3	For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.	**PO4**
CO4	Design and implement file management system.	**PO3**
CO5	For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.	**PO5**

ETCS211A	Course Code	
Operating Systems	Course Title	
2	PO1	Engineering Knowledge
2	PO2	Problem analysis
3	PO3	Design/development of solutions
2	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability

	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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.

Reference Books/Materials

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	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**

ETCS304A	Course Code	
Computer Networks	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
	PO3	Design/development of solutions

3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
3	PO11	Project management and finance
3	PO12	Life-long Learning
2	PSO1	Application of Concepts
2	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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**

ETCS365A	Course Code	
Computer Networks Lab	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis

3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
2	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
3	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
3	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS364A	Big Data Analysis Lab	L	T	P	C
Version 1.0	--	0	0	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. Big Data and Data Analytics
2. Hortonworks Data Platform (HDP)
3. Apache Ambari
4. Hadoop and the Hadoop Distributed File System
5. MapReduce and Yarn
6. Apache Spark

Course Outcomes

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

CO1. Learn Storing and Quering data

CO2. Learn about ZooKeeper, Slider, and Knox
CO3. Loaddata with Sqooq
CO4. Learn Dataplane Service

CO5. Understand Stream Computing
CO6. Understand Data Science
essentials
CO7. Understand Drew Conway's Venn Diagram - and that of
others CO8. Understand the Scientific Process applied to Data
Science

Catalog Description

This course will expose the students to the data analytics practices executed in the business world. We will explore such key areas as the analytical process, how data is created, stored, accessed, and how the organization works with data and creates the environment in which analytics can flourish.

This course will give the students a strong foundation in all the areas that support analytics and will help them to better position themselves for success within the organization. Students will develop skills and a perspective that will make them more productive.

List of Experiments (Indicative)

1	Implement the following file management tasks in Hadoop: Adding files and directories ● Retrieving files ● Deleting file	**2 lab hours**
2	Install and Run Hive then use Hive to create,load, alter, and drop databases, tables, joins	**2 lab hours**
3	Implement Hive Partitioning and bucketing with data set.	**2 lab hours**
4	Install and Run Pig then write Pig Latin scripts to sort, group, join and filter your data.	**2 lab hours**
5	Implement sqoop commands.	**2 lab hours**
6	Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm with data set.	**4 lab hours**
7	Working with Jupyter Notebooks. ● Creating notebooks ● Coding and running notebooks ● Sharing and publishing notebooks ● Creating a notebook ● Using notebooks	**4 lab hours**

8	Create Big SQL table and load dataset into table.	**4 lab hours**
9	Implement Hbase commands with data set.	**4 lab hours**
10	Managing the Big SQL Server ● Update the database resource percentage for the Big SQL database instance ● Inspect the Big SQL scheduler configuration file ● View the registries for compiler and runtime performance Improvement	**4 lab hours**
11	Analyzing data with Watson Studio • Run through a sample notebook in Watson Studio • Use PixieDust for data visualization	**4 Lab Hours**

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

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

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

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Learn Storing and Quering data	**PO2**

CO2	Learn about ZooKeeper, Slider, and Knox	**PO3**
CO3	Load data with Sqooq	**PO5**
CO4	Learn Dataplane Service	**PO4**
CO5	Understand Stream Computing	**PO1**
CO6	Understand Data Science essentials	**PO4**
CO7	Understand Drew Conway's Venn Diagram - and that of others	**PO4**
CO8	Understand the Scientific Process applied to Data Science	**PO6**

ETCS364A	Course Code	
Big Data Analysis Lab	Course Title	
2	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
2	PO5	Modern tool usage
	PO6	The engineer and society

	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
3	PSO3	Ethics and Communication Skills

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

ETCS367A	iOS Development Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of MAC OS				
Co-requisites	--				

Course Objectives

1. To be able to Understand the basics of Swift Programming language
2. To Learn and practice the iOS App that commonly used in iPhone
3. Understand and able to differentiate between the concept of iOS and OS X
4. Apply necessary information to program for automation.
5. Apprehend the basic of MAC System and how to publish iOS app on AppStore.

Course Outcomes

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

CO1. Create iPhone apps using Objective-C and Apple's new programming language, use industry tools and frameworks such as Cocoa, Xcode, UIKit, Git.

CO2. Understand and know how to use properly UIKit, asynchronous code, Core Image, NSURL Session and JSON Map Kit and Core Location, Auto Layout, Source Control, Core Data, Animation, and the app submission process.

CO3. Read and write programs based on Objective-C, also have a strong grasp of Objective-C objects

CO4. Organize their code professionally using objects and blocks, prototype several entry- level apps and try to publish on App store.

Catalog Description

The objective of the course is to provide skills to develop applications for OS X and iOS. It includes introduction to development framework Xcode. Objective-C is used as programming language to develop the applications. Objective-C is the superset of the C programming language and provides object-oriented capabilities and a dynamic runtime.

Objective-C inherits the syntax, primitive types, and flow control statements of C and adds syntax for defining classes and methods. The list of experiments helps in making static and dynamic iOS App on based on real time systems.

List of Experiments (Indicative)

1	Case Study of Objective-C language.	2 lab hours
2	Case study of Windows and MAC systems	2 lab hours
3	Case Study of XCode based on MAC Systems	2 lab hours
4	Design an App for UISwitch based on Objective-C language	2 lab hours
5	Design an App for UISlider based on Objective-C language	2 lab hours
6	Design an App for UIStepper based on Objective-C language	2 lab hours
7	Write a program for creating Story Boards	2 lab hours
8	Design an App for UIAnimation based on Objective-C language	3 lab hours
9	Create a Simple Calculator using Objective-C Language	3 lab hours
10	Write an Objective-C program that displays the Phrase “Hello World”	1 lab hours
11	Write an Objective-C program for displaying the value of variables	2 lab hours
12	Write an Objective-C program for displaying the sum and subtraction of two variables	2 lab hours
13	Write an Objective-C program for displaying the multiplication and division of the two variables	2 lab hours
14	Write an Objective-C program that demonstrate control structure of Objective-C language	3 lab hours
15	Create a Button using Objective-C	2 lab hours
16	Make an interactive project based on iOS App using Objective-C Language	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	Create iPhone apps using Objective-C and Apple's new programming language, use industry tools and frameworks such as Cocoa, Xcode, UIKit, Git.	**PO2**
CO2	Understand and know how to use properly UIKit, asynchronous code, CoreImage, NSURLSession and JSON MapKit and CoreLocation, AutoLayout, Source Control, Core Data, Animation, and the app submission process.	**PO3**
CO3	Read and write programs based on Objective-C, also have a strong grasp of Objective-C objects	**PO5**
CO4	Organize their code professionally using objects and blocks, prototype several entry- level apps and try to publish on Appstore.	**PO9**

ETCS363A	Course Code	
Fundamentals of iOS Development Lab	Course Title	
	PO1	Engineering Knowledge

2	PO2	Problem analysis
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
3	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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. Create processes and threads.

CO2. Develop algorithms for process scheduling for a given specification of CPU utilization, throughput, Turnaround Time, Waiting Time, Response Time.

CO3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.

CO4. Design and implement file management system.

CO5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

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)

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**

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

9	Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.	**4 lab hours**
10	Write a C program to simulate page replacement algorithms a) FIFO b) LRU c) LFU	**2 lab hours**

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Create processes and threads	**PO1**
CO2	Develop algorithms for process scheduling for a given specification of CPU utilization, throughput, Turnaround Time, Waiting Time, Response Time.	**PO2**
CO3	For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.	**PO4**
CO4	Design and implement file management system.	**PO3**
CO5	For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.	**PO5**

ETCS255A	Course Code	
Operating Systems Lab	Course Title	
2	PO1	Engineering Knowledge
2	PO2	Problem analysis
3	PO3	Design/development of solutions
2	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS381A	Practical Training – I	L	T	P	C
Version 1.0		0	0	0	1
Pre-requisites/Exposure	Completion of fourth semester				
Co-requisites	--				

Course Objectives

The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Course Outcomes

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

CO1. Have an exposure to industrial practices and to work in teams.

CO2. Understand the impact of engineering solutions in a global, economic, environmental and societal context.
CO3. Develop the ability to engage in research and to involve in life-long
learning. CO4. Communicate effectively and learn to be a team player.

Catalog Description

This course enables students to face the real time problems which are usually faced by working professional while working in the industry. While on this training program, students come to know about technical as well individual skills required by a professional for survival in the market .In fact, this course is about industrial implementation of the technologies. This course enable students to learn technologies on industrial level. The student will be working closely with the technical team. This course enhances student's ability to think out of the box and suggest new ways of implementing ideas in a better manner and should be able to brainstorm and come up with innovative ideas.

Course Content

Six weeks of work at industry site. Supervised by an expert at the industry.

Modes of Evaluation: Internship Report, Presentation and Project Review**:**

Components	Internship Report	Presentation/ Project Review
Weightage (%)	50	50

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Have an exposure to industrial practices and to work in teams.	**PO5**
CO2	Understand the impact of engineering solutions in a global, economic, environmental and societal context	**PO7**
CO3	Develop the ability to engage in research and to involve in life-long learning	**PO3**
CO4	Communicate effectively and learn to be a team player	**PO10**

Course		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Innovation and Industry Friendly	Ethics and Communication Skills
ETCS38	Practical			3		3		2			3					

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETEC 371A	Quantitative Aptitude Reasoning-I	L	T	P	C
Version 1.0		**-**	**-**	**2**	**1**
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives:

1. To develop critical thinking skills
2. To develop the ability to analyze ideas, question assumptions and assess arguments
3. To clarify and interpret concepts and propositions.

Course Outcomes:

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

CO1. Understand and analyze the costs and benefits associated with various Information Systems projects.
CO2 Conduct reasoning to solve organizational problem, make recommendations, and draw logical conclusions.
CO3 Understand the various reasoning concepts to apply in practical life.

Catalog Description

Quantitative Aptitude Reasoning-I is designed for students who have basic knowledge of simple mathematical calculations and Collegiate Learning skills.

Course Content

Unit I: 10 hours

Numbers, H.C.F. & L.C.M. of Numbers, Decimal Fractions Simplification, Square Roots & Cube Roots, Whole numbers problems, Permutations and Combination, Decimals problems, Problems on Trains, Fractions problems, Numbers and Ages, Percentage problems.

Unit II: 8 hours

Boats and Streams, Ratio & Proportion, Pipes and Cistern, Square roots, Surds and Indices, Averages, Interest, Heights and Distances, Profit and Loss, Discount, Partnership.

Unit III: **8 hours**

Business, Permutations and Combination, Mixture and Alligation, Time and distance Series, Time & Work, The Data Interpretation part covers Tabulation, Volume & Surface Areas, Races & Games of Skill, Calendar, Clocks.

Unit IV: **10 hours**

Stocks & Shares, Permutations & Combinations, Probability, True Discount, Banker's Discount, Heights & Distances, Odd Man Out & Series, Data Interpretation: Tabulation, Bar Graphs, Pie Charts, Line Graph.

Textbooks:

1. Quantitative Aptitude for Competitive Examination by R S Agrawal, S. Chand publications.

2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.

3. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill 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	Understand and analyze the costs and benefits associated with various Information Systems projects.	PO2
CO2	Conduct reasoning to solve organizational problem, make recommendations, and draw logical conclusions.	PO3
CO3	Understand the various reasoning concepts to apply in practical life.	PO4

ETEC 371A	Course Code	
Quantitative Aptitude Reasoning-I	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
2	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
4	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or teamwork
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS412A	Compiler Design	L	T	P	C
Version 1.0		3	1	-	4
Pre-requisites/Exposure	Theory of Computation				
Co-requisites	--				

Course Objectives

1. To understand and list the different stages in the process of compilation.
2. Identify different methods of lexical analysis
3. Design top-down and bottom-up parsers
4. Identify synthesized and inherited attributes
5. Develop syntax directed translation schemes
6. Develop algorithms to generate code for a target machine

Course Outcomes

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

CO1. For a given grammar specification develop the lexical analyser

CO2. For a given parser specification design top-down and bottom-up parsers CO3. Develop syntax directed translation schemes
CO4. Develop algorithms to generate code for a target machine

CO5. Distinguish between computability and non-computability and Decidability and undecidability.

Catalog Description

This course aims to provide a thorough understanding of the theory and practice of compiler implementation, learn finite state machines and lexical scanning, context free grammars, compiler parsing techniques, construction of abstract syntax trees, symbol tables, intermediate machine representations and actual code generation

Course Content

Unit I: 8 lecture hours

Introduction to Compiling: Compilers, Analysis of the source program, the phase of a compiler, Cousins of the compiler, the grouping of phases, Compiler-constructions tools.

A Simple One-Pass Compiler: Syntax definition, Syntax-directed translation, Parsing, A translator for simple expressions, Lexical analysis, Incorporating a symbol table, Abstract stack machines**.**

Unit II: **12 lecture hours**

Lexical Analysis: The role of the lexical analyzer, Input buffering, Specification of tokens, Recognition of tokens, A language of specifying lexical analyzers, Design of a lexical analyzer generator.
Syntax Analysis: The role of the parser, writing a grammar, Top-down parsing; Bottom-up parsing, Operator-precedence parsing, LR parsers, Using ambiguous grammars, Parser generators.

Unit III: **12 lecture hours**

Syntax-Directed Translation: Syntax-direct definitions, Construction of syntax trees, Bottom-up evaluation of S- attributed definitions, L-attributed definitions, and Top-down translation.
Type Checking: Type systems, Specification of a simple type checker.

Run-Time Environments: Source language issues, Storage organization, Storage-allocation strategies, Access to nonlocal names, Parameter passing, Symbol tables, Language facilities for dynamic storage allocation, Dynamic storage allocation techniques.

Unit IV: **8 lecture hours**

Intermediate Code Generation: Intermediate languages, Declarations, Assignment statements, Boolean expressions.
Code Generation: Issues in the design of a code generator, Target machine, Run-time storage management, Basic blocks and flow graphs.
Code Optimization: Introduction, The Principle sources of optimization.

Text Books

1. Aho, Ullman & Ravi Sethi, "Principles of Compiler Design", Pearson Education.

Reference Books/Materials

1. Andrew L. Appel, "Modern Compiler Implementation in C",Delhi, Foundation Books.

2. Dick Gruneet. Al., "Modern Compiler Design", Wiley Dreamtech.

12. R. J. Schalkoff, “Artificial Intelligence – An Engineering Approach”, McGraw Hill Int. Ed. Singapore.
13. M. Sasikumar, S. Ramani, “Rule Based Expert Systems”, Narosa Publishing House.
14. Tim Johns, “Artificial Intelligence, Application Programming”, Wiley Dreamtech.

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 grammar specification develop the lexical analyser	**PO5**
CO2	For a given parser specification design top-down and bottom-up parsers	**PO2**
CO3	Develop syntax directed translation schemes	**PO3**
CO4	Develop algorithms to generate code for a target machine	**PO3**
CO5	Distinguish between computability and non-computability and Decidability and undecidability.	**PO4**

ETCS 412A	Course Code	
Compil er Design	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
4 2	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS309A	Neural Networks and Deep Learning	L	T	P	C
Version 1.0		3	-	-	3
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the basic concepts of neural networks, neurons, and deep learning.

Course Outcomes

On completion of this course, the students will be able to
learn:- CO1. Neural Network, Feed Forward and
Backpropogation.
CO2. Tensorflow and Keras.
CO3. RNN, CNN,
Autoencoders.

Catalog Description

The course begins with key concepts of neural networks, feed-forward neural network, and backpropogation. The student gets an opportunity to learn the programming languages (TensorFlow) to design the deep learning models. The student learns the concepts behind CNN, RNN, LSTM, Autoencoders, and GANs. The hands on learning will help build strong knowledge base for designing advanced deep learning models.

Course Content

Unit I: 10 lecture hours

The neural network: The neuron, linear perceptron, feed-forward neural network, limitations of linear neurons, sigmoid, tanh, relu neurons, softmax output layer, information theory, cross entropy, Kullback- Leibler divergence.

Unit II: 10 lecture hours

Training feed-forward neural network: Gradient Descent, delta rules and learning rates, gradient descent with sigmoidal neurons, the back propagation algorithms, stochastic and mini batch gradient descent, test sets, validation sets and over fitting, preventing over fitting.

Unit III: **10 lecture hours**

TensorFlow: Computation graphs, graphs, sessions and fetches, constructing and managing graph, flowing tensors, sessions, data types, tensor arrays and shapes, names, variables, placeholders and simple optimization, linear regression and logistic regression using tensorflow.

Unit IV: **07 lecture hours**

Implement Neural Network: Introduction to Keras, Build neural network using Keras, Evaluating models, data preprocessing, feature engineering, feature learning, over fitting, under fitting, weight regularization, dropout, universal workflow of deep learning.

Text Books

1.Francois Chollet, Deep Learning with Python, First Edition, Manning Publications.

Reference Books/Materials

1. Reza Zadeh, Bharath Ramsundar, Tensor Flow for Deep Learning, O'Reilly.

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	Neural Network, Feed Forward and Backpropogation.	PO2

CO2	Tensorflow and Keras.	**PO2**
CO3	RNN, CNN, Autoencoders.	**PO3**

Course Code		ETCS 309A
Course		Neural Networ ks
PO1	Engineering Knowledge	
PO2	Problem analysis	3
PO3	Design/developmen t of solutions	
PO4	Conduct investigations of complex problems	2
P O 5	Modern tool usage	
PO 6	The engineer and	
PO7	Environment and	
P O 8	Ethics	
PO9	Individual or team work	
PO10	Communication	
PO11	Project management and finance	
PO12	Life-long Learning	
PSO1	Application of Concepts	3
PSO2	Innovation and Industry Friendly	
PSO3	Ethics and Communication Skills	

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS354A	Deep Learning Practical with Python, TensorFlow and Keras	L	T	P	C
Version 1.0		-	-	4	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the basic concepts of neural networks, neurons, and deep learning.

Course Outcomes

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

CO1. Implementation of Neural Network, Feed Forward and Backpropogation. CO2. Implementation of Tensorflow and Keras.
CO3. Design RNN, CNN, Autoencoders.

Catalog Description

This course complements ETCS309A. It enables them to write algorithms/programs for Implementing Scilit-learn, matplotlib, tensorflow and Quality plotting and graphing. The list of experiments helps organizing the data in variety of ways using python and to solve the given problem efficiently.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS309A.

Text Books

1.Francois Chollet, Deep Learning with Python, First Edition, Manning Publications.

Reference Books/Materials

1. Reza Zadeh, Bharath Ramsundar, Tensor Flow for Deep Learning, O'Reilly.

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	Implementation of Neural Network, Feed Forward and Backpropogation.	**PO2**
CO2	Implementation of Tensorflow and Keras.	**PO2**
CO3	Design RNN, CNN, Autoencoders.	**PO3**

ETCS 354A	Course Code	
Deep Learnin g Practica l with Python, TensorF low and Keras	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
	PO3	Design/development of solutions
2	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work

	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS313A	Data Science - Tools and Techniques	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the conceptual framework of Big Data, Virtualization, MapReduce, HDFS, Pig, Hive, Spark, ZooKeeper, HBase.

Course Outcomes

On completion of this course, the students will be able to
learn:- CO1. Concepts of Hadoop and HDFS.
CO2. Concepts of MapReduce.

CO3. Big data tools Pig, Hive, Spark, Zookeeper, HBase.

Catalog Description

The student learns the architecture of HDFS and MapReduce along with other tools such as pig, hive, spark, Zookeeper, HBase.

Course Content

Unit I: 08 lecture hours

Big Data: Fundamentals of Big Data, defining big data, building successful big data management architecture, big data journey.
Big Data Types: Structured and unstructured data types, real time and non-real time requirements.

Distributed Computing: History of distributed computing, basics of distributed computing.

Unit II: 07 lecture hours

Big Data Technology Foundation: Big Data stack, redundant physical infrastructure, security infrastructure, operational databases, organising data services and tools, analytical data warehouse, big data analytics
Virtualization: Basics of virtualization, hypervisor, abstraction and virtualization, implementing virtualization with big data

Cloud and Big Data: Defining cloud, cloud deployment and delivery models, cloud as an imperative for big data, use the cloud for big data.

Unit III: **08 lecture hours**

Operational Databases: Relational database, nonrelational database, key-value pair databases, document databases, columnar databases, graph databases, spatial databases.
MapReduce Fundamentals: Origin of MapReduce, map function, reduce function, putting map and reduce together, optimizing map reduce.
Hadoop: Discovering Hadoop, Hadoop distributed file system, Hadoop MapReduce, Hadoop file system, dataflow, Hadoop I/O, data integrity, compression, serialization, file-based data structure.

Unit IV: **07 lecture hours**

Avro: Avro data types and schemas, in-memory serialization and deserialization, avro datafiles, schema resolution
Pig: Comparison with databases, pig latin, user defined functions, data processing operators

Hive: Running hive, comparison with traditional databases, HiveQL, tables, querying data, user-defined functions
Spark: Resilient distributed datasets, shared variables, anatomy of a spark job run, executors and cluster managers,
HBase: HBasics, concepts, clients, HBase vs RDBMS, Praxis

ZooKeeper: ZooKeeper services, building application with ZooKeeper.

Text Books

1.Tom White, Hadoop: The Definitive Guide, Fourth Edition, Shroff Publishers & Distributers Private Limited.

Reference Books/Materials

1. James Warren and Nathan Marz, Big Data: Principles and Best Practices of Scalable Real-time Data Systems, Manning 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	Concepts of Hadoop and HDFS.	**PO2**
CO2	Concepts of MapReduce.	**PO3**
CO3	Big data tools Pig, Hive, Spark, Zookeeper, HBase.	**PO5**

ETCS 313A	Course Code	
Data Science - Tools and Techniq ues	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
	PO3	Design/development of solutions

3		
	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
4	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS311A	Natural Language Processing	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The ultimate objective of NLP is to read, decipher, understand, and make sense of the human languages in a manner that is valuable.

Course Outcomes

On completion of this course, the students will be able to
learn:- CO1. Understand approaches to syntax and semantics
in NLP.
CO2. Understand approaches to discourse, generation, dialogue and summarization within NLP. CO3. Understand current methods for statistical approaches to machine translation.
CO4. Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP.

Catalog Description

This course is designed to teach the principles and methods of statistical natural language processing and provide hands-on experience of text analysis using Python. Processing text data is crucial in many domains such as computer science, journalism, social science, psychology, political science, etc. In this era of internet and social media, data is generated in such a huge volume and in such a high speed that it is practically impossible to process it and find insightful patterns out of it in traditional way. That is why students, instructors, and researchers of various domains are embracing computational tools to perform statistical textual content analysis. This course will enable students to perform large-scale statistical analysis of textual data in authoritative way and find useful patterns from the data. The expertise of natural language processing is also highly coveted in industries.

Course Content

Unit I: 08 lecture hours

Introduction to NLP: Natural Language Processing in real world, What is language, Approached to NLP.

Build NLP model: Eights Steps for building NLP Model, Web Scrapping.

Unit II: **07 lecture hours**

Text Representation: Basic Vectorization, One-Hot Encoding, Bag of Words, Bag of N Grams, TF-IDF, Pre-trained Word Embedding, Custom Word Embeddings, Vector Representations via averaging, Doc2Vec Model, Visualizing Embeddings using TSNW and Tensorbaord.

Text Classification: Application of Text Classification, Steps for building text classification system, Text classification using Naïve Bayes Classifier, Logistic Regression, and Support Vector Machine, Neural embedding for Text Classification, text classification using deep learning, interpret text classification model.

Unit III: **08 lecture hours**

Information Extraction: Applications of Information Extraction, Processes for Information Extraction. Key phrase Extraction, Named Entity Recognition, Disambiguation and linking of named entity, Relationship extraction.
Chatbot: Real life applications of chatbot, Chatbot Taxonomy, Dialog Systems, Process of building a dialog, Components of Dialog System, End to End Approach, Rasa NLU.

Unit IV: **07 lecture hours**

NLP for social media: Application of NLP in social media, challenges with social media, Natural Language Processing for Social Data, Understanding Twitter Sentiments, Identifying memes and Fake News.
NLP for E-Commerce: E-commerce catalog, Search in E-Commerce, How to build an e-commerce catalog, Review and Sentiment Analysis, Recommendations for E-Commerce.

Text Books

1.Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, First Edition, O'Reilly Media.

Reference Books/Materials

1. Christopher Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, The MIT Press.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand approaches to syntax and semantics in NLP.	**PO2**
CO2	Understand approaches to discourse, generation, dialogue and summarization within NLP.	**PO2**
CO3	Understand current methods for statistical approaches to machine translation.	**PO5**
CO4	Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP.	**PO3**

ETCS 311A	Course Code	
Natural Langua ge Processi ng	Course Title	

	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETEC 372A	Quantitative Aptitude Reasoning-II	L	T	P	C
Version 1.0		**-**	**-**	**2**	**1**
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

The subject expects students to achieve the following objectives:

1. To develop critical thinking skills
2. To develop the ability to analyze ideas, question assumptions and assess arguments
3. To clarify and interpret concepts and propositions.

Course Outcomes:

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

CO1. Understand and analyze the costs and benefits associated with various Information Systems projects.
CO2 Conduct reasoning to solve organizational problem, make recommendations, and draw logical conclusions.
CO3 Understand the various reasoning concepts to apply in practical life.

Catalog Description

Quantitative Aptitude Reasoning-II is designed for students who have completed Foundations of Mathematical Reasoning and the co-requisite Frameworks for Mathematics and Collegiate Learning

Course Content

Unit I: **10 hours**

Verbal Reasoning: General Mental Ability, Series Completion, Analogy, Classification, Coding-Decoding, Blood Relations, Puzzle Test, Sequential Output Tracing, Direction Sense Test, Logical Venn Diagrams, Alphabet Test, Alpha - Numeric Sequence Puzzle, Number.

Unit II: **10 hours**

Ranking & Time Sequence Test, Mathematical Operations, Logical Sequence of Words, Arithmetical Reasoning, Inserting the Missing Character, Data Sufficiency, Eligibility Test, Assertion and Reasoning, Situation Reaction Test, Verification of Truth of the Statement.

Unit III: **8 hours**

Logical Deduction, Logic, Statement – Arguments, Statement-Assumptions, Statement - Courses of Action, Statement – Conclusions, Deriving Conclusions from Passages, Theme Detection, Cause and Effect Reasoning.

Unit IV: **12 hours**

Non-Verbal Reasoning: Series Analogy, Classification, Analytical Reasoning, Mirror-Images, Water- Images, Spotting Out the Embedded Figures, Completion of Incomplete Pattern, Figure Matrix, Paper Folding, Paper Cutting, Rule Detection, Grouping of Identical Figures, Cubes and Dice, Dot Situation, Construction of Squares and Triangles, Figure Formation & Analysis.

Textbooks:

1. Quantitative Aptitude for Competitive Examination by R S Agrawal, S. Chand publications.

2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.

3. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill 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	Understand and analyze the costs and benefits associated with various Information Systems projects.	**PO2**
CO2	Conduct reasoning to solve organizational problem, make recommendations, and draw logical conclusions.	**PO3**
CO3	Understand the various reasoning concepts to apply in practical life.	**PO4**

Course	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETEC	Quantitative		3	2	3									3		
		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 teamwork	Communication	Project management and finance	Life-long Learning	Application of Concepts	Innovation and Industry Friendly	Ethics and Communication Skills

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS356A	Data Science - Tools and Techniques Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the conceptual framework of Big Data, Virtualization, MapReduce, HDFS, Pig, Hive, Spark, ZooKeeper, HBase.

Course Outcomes

On completion of this course, the students will be able to
learn:- CO1. Concepts and implementation of Hadoop and
HDFS. CO2. Concepts and implementation of
MapReduce.
CO3. Usage of Big data tools Pig, Hive, Spark, Zookeeper, HBase.

Catalog Description

This course complements ETCS313A. It enables them to learn and implement Hadoop, HDFA, MapReduce algorithms/programs. It enables them the Usage of Big data tools Pig, Hive, Spark, Zookeeper, HBase for implementing database operations, machine learning algorithms.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS313A.

Text Books

1.Tom White, Hadoop: The Definitive Guide, Fourth Edition, Shroff Publishers & Distributers Private Limited.

Reference Books/Materials

1. James Warren and Nathan Marz, Big Data: Principles and Best Practices of Scalable Real-time Data Systems, Manning 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	Concepts and implementation of Hadoop and HDFS.	**PO2**
CO2	Concepts and implementation of MapReduce.	**PO3**
CO3	Usage of Big data tools Pig, Hive, Spark, Zookeeper, HBase.	**PO5**

ETCS 356A	Course Code	
Data Science - Tools and Techniq ues Lab	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
	PO3	Design/development of solutions

3		
	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS352A	Natural Language Processing Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The ultimate objective of NLP is to read, decipher, understand, and make sense of the human languages in a manner that is valuable.

Course Outcomes

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

CO1. Understand and implement approaches to syntax and semantics in NLP.

CO2. Understand and implement approaches to discourse, generation, dialogue and summarization within NLP.

CO3. Analysis of current methods for statistical approaches to machine translation.

CO4. Usage of machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP.

Catalog Description

This course complements ETCS311A. It enables them to write algorithms/programs for Implementing Scilit-learn, matplotlib, tensorflow and Quality plotting and graphing. The list of experiments helps organizing the data in variety of ways using python and to solve the given problem efficiently.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS311A.

Text Books

1.Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, First Edition, O'Reilly Media.

Reference Books/Materials

1. Christopher Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, The MIT Press.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and implement approaches to syntax and semantics in NLP.	**PO3**
CO2	Understand and implement approaches to discourse, generation, dialogue and summarization within NLP.	**PO3**
CO3	Analysis of current methods for statistical approaches to machine translation.	**PO2**
CO4	Usage machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP.	**PO5**

ETCS 352A	Course Code	

Natural Langua ge Processi ng Lab	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS420A	Graph Theory	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Discrete Mathematics				
Co-requisites	--				

Course Objectives

1. Use definitions in graph theory to identify and construct examples
2. Apply theories and concepts to test and validate intuition and independent mathematical thinking in problem solving.
3. Reason from definitions to construct mathematical proofs
4. Read and write graph theory in a coherent and technically accurate manner

Course Outcomes

Students are expected to demonstrate the ability to:

CO1. Understand and apply the fundamental concepts in graph theory CO2. Apply the graph theory-based tools in solving practical problems CO3. Improve the proof writing skills
CO4. Understand the concept of plane graph and theory.

Catalog Description

The course covers basic theory and applications of graph theory. Graph theory is a study of graphs, trees and networks. Topics that will be discussed include Euler formula, Hamilton paths, planar graphs and coloring problem; the use of trees in sorting and prefix codes; useful algorithms on networks such as shortest path algorithm, minimal spanning tree algorithm and min-flow max-cut algorithm.

Course Content

Unit I: **11lecture hours**

INTRODUCTION: Graphs, Introduction, Isomorphism, Sub graphs, Walks, Paths, Circuits, Connectedness, Components, Euler Graphs , Hamiltonian Paths and Circuits, Operations on Graph, The Travelling Salesman Problem, Sperner's Leema, Trees, Properties of trees, Distance and Centers in Tree, Rooted and Binary Trees,

Cayley's Theorem, Spanning trees, Fundamental Circuits,Spanning Trees in a Weighted Graph

Unit II: **11 lecture hours**

CONNECTIVITY & PLANARITY:, Cut Sets, Properties of Cut Set, All Cut Sets, Fundamental Circuits and Cut Sets, Connectivity and Separability, Network flows, Isomorphism, Combinational and Geometric Graphs, Planer Graphs , Kuratowski's Two Graphs, Different Representation of a Planer Graph, Detection of Planarity, Applications-The Chinese Postman Problem

Unit III: **12lecture hours**

MATRICES, COLOURING AND DIRECTED GRAPH: Incidence matrix, Submatrices, Circuit Matrix, Cut-Set Matrix,Path Matrix, Adjacency Matrix, Chromatic Number, Chromatic partitioning, Chromatic polynomial, Matching, Covering, Four Color Problem, Directed Graphs, Types of Directed Graphs, Digraphs and Binary Relations, Directed Paths and Connectedness, Euler DiGraphs, Adjacency Matrix of a Digraph, Paired Comparison and Tournaments

Unit IV: **8 lecture hours**

GRAPH ALGORITHM: Algorithms: Connectedness and Components, Spanning tree, Finding all Spanning Trees of a Graph, Set of Fundamental Circuits, Cut Vertices and Separability, Directed Circuits, Shortest Path Algorithm, DFS, Planarity Testing.

Textbooks

1. Graph Theory: With Application to Engineering and Computer Science, Narsingh Deo, PHI.

Reference Books

1. Introduction to Graph Theory, R.J. Wilson, Pearson Education.
2. A First Look at Graph Theory, Clark J. & Holton D.A, Allied Publishers.
3. Elements of Discrete Mathematics, Liu C.L, McGraw Hill.

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

Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and apply the fundamental concepts in graph theory	**PO1, PO2**
CO2	Apply the graph theory-based tools in solving practical problems	**PO3, PO4**
CO3	Improve the proof writing skills	**PO6, PO12**
CO4	Understand the concept of plane graph and theory.	**PO4**

ETCS420A	Course Code	
Graph Theory	Course Title	
3	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions

3	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
1	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
4	PO11	Project management and finance
2	PO12	Life-long Learning
3	PSO1	Application of Concepts
1	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS320A	Distributed Computing Systems	L	T	P	C
Version 1.0		3			3
Pre-requisites/Exposure	Data Structure and Operating Systems				
Co-requisites	--				

Course Objectives

The course aims to provide an understanding of the principles on which the Internet and other distributed systems are based; their architecture, algorithms and how they meet the demands of contemporary distributed applications. The course covers the building blocks for a study of distributed systems and addressing the characteristics and the challenges that must be addressed in their design: scalability, heterogeneity, security and failure handling being the most significant. This course also covers issues and solutions related to the design and the implementation of distributed applications.

Course Outcomes

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

CO1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies

CO2. Demonstrate knowledge of the core architectural aspects of distributed systems;
CO3. Design and implement distributed applications;
CO4. Demonstrate knowledge of details the main underlying components of distributed systems (such as RPC, file systems);

CO5. Use and apply important methods in distributed systems to support scalability and fault tolerance;
CO6. Demonstrate experience in building large-scale distributed applications.

Catalog Description

This course covers general introductory concepts in the design and implementation of distributed systems, covering all the major branches such as Cloud Computing, Grid Computing, Cluster Computing, Supercomputing, and Many-core Computing.

Course Content

Unit I: 8 lecture hours

Introduction: Distributed Systems, Examples of Distributed Systems, Resource Sharing and the Web

Challenges, System Models- Introduction, Architectural Models, Functional Models, Characterization of Distributed Systems, Client-Server Communication, Distributed Objects and Remote Invocation, Communication Between Distributed Objects, Remote Procedure Call, Events and Notifications.

Unit II: **8 lecture hours**

Distributed Operating Systems: Introduction, Issues, Communication Primitives, Inherent Limitations, Lamport's Logical Clock, Vector Clock, Causal Ordering, Global State, Cuts, Termination Detection, Distributed Mutual Exclusion, Non-Token Based Algorithms, Lamport's Algorithm - Token- Based Algorithms, Distributed Deadlock Detection Algorithms and Issues, Centralized Deadlock- Detection Algorithms, Agreement Protocols- Classification, Solutions, Applications.

Unit III: **8 lecture hours**

Distributed Resource Management: Distributed File systems, Architecture, Mechanisms, Design Issues, Distributed Shared Memory, Architecture, Algorithm, Protocols, Design Issues, Distributed Scheduling – Issues, Components, Algorithms

Unit IV: **8 lecture hours**

Introduction to Distributed Algorithms, Kinds of Distributed Algorithm, Timing Models, Synchronous Network Algorithms: Synchronous Network Model, Leader Election in a Synchronous Ring, Algorithms in a General Synchronous Networks, Resource Security and Protection – Introduction, the Access Matrix Model, Implementation of Access Matrix Model, Safety in the Access Matrix.

Text Books

1. Ajay D. Kshemkalyani and MukeshSinghal, "Distributed Computing – Principles, Algorithms and Systems", Cambridge University Press.

Reference Books/Materials

1. George Coulouris, Jean Dellimore and Tim KIndberg, "Distributed Systems Concepts and Design", Pearson Education, 4th Edition.
2. MukeshSinghal and N. G. Shivaratri, "Advanced Concepts in Operating Systems", McGraw-Hill.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Demonstrate knowledge of the basic elements and concepts related to distributed system technologies	**PO1**
CO2	Demonstrate knowledge of the core architectural aspects of distributed systems;	**PO1**
CO3	Design and implement distributed applications	**PO3**
CO4	Demonstrate knowledge of details the main underlying components of distributed systems (such as RPC, file systems);	**PO4**
CO5	Use and apply important methods in distributed systems to support scalability and fault tolerance	**PO3, PO4**
CO6	Demonstrate experience in building large-scale distributed applications.	**PO12**

ETCS 320A	Course Code	
Distribu ted Comput ing Systems	Course Title	

2	PO1	Engineering Knowledge
	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage
4	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
2	PO12	Life-long Learning
	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS310A	**Advanced Computer Architecture**	L	T	P	C
Version 1.0		3	-	-	3
Pre-requisites/Exposure	Computer Organization and Architecture; Microprocessor				
Co-requisites	Digital Electronics				

Course Objectives

1. Understand the Concept of Parallel Processing and its applications.
2. .Implement the Hardware for Arithmetic Operations.
3. Analyze the performance of different scalar Computers.
4. .Develop the Pipelining Concept for a given set of Instructions.
5. .Distinguish the performance of pipelining and non-pipelining environment in a processor.
6. To make students know about the Parallelism concepts in Programming

Course Outcomes

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

CO1. Describe the various architectural concepts that may be applied to optimize and enhance the classical Von Neumann architecture into high performance computing hardware systems.

CO2. Describe the design issues relating to the architectural options.

CO3. Describe the challenges faced in the implementation of these high-performance systems CO4. Understand pipelining, instruction set architectures, memory addressing.
CO5. Understand the various techniques to enhance a processors ability to exploit Instruction-level parallelism (ILP), and its challenges.

CO6. Understand the various models to achieve memory consistency.

Catalog Description

Advanced Computer Architecture (ACA) covers advanced topics in computer architecture focusing on multicore, graphics-processor unit (GPU), and heterogeneous SOC multiprocessor architectures and their implementation issues (architect's perspective). The objective of the course is to provide in-depth coverage of current and emerging trends in computer architecture focusing on performance and the hardware/software interface. The course emphasis is on analyzing fundamental issues in architecture design and their impact on application performance.

Course Content

Unit I: **10lecture hours**

Elements of modern computers (computing problems, algorithms, hardware, OS, system software);

Evolution of computer architecture; Factors affecting system performance; architectural development tracks (Multiple-processor tracks, Multi-Vector& SIMD tracks, Multithread & Dataflow tracks)

Conditions of parallelism (Data dependence, Resource dependence, control dependence, Bernstein's Conditions);Hardware& Software parallelism; Program partitioning & Scheduling; Program flow machines (Control flow, Dataflow, Demand driven); Parallel processor applications; Speedup performance laws (Amdahl's law, Gustafson'slaw); Scalability (Goals, Metrics, evolution of scalable architectures, open issues)

Unit II: **10 lecture hours**

System Interconnect Architectures: Network properties and routing, Static interconnection Networks, Dynamic interconnection Networks, Multiprocessor system Interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.

Advanced processors: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors

Pipelining: Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction,

Unit III: **10 lecture hours**

Memory Hierarchy Design: Cache basics & cache performance, reducing miss rate and miss penalty, multilevel cache hierarchies, main memory organizations, design of memory hierarchies.

Multiprocessor architectures: Symmetric shared memory architectures, distributed shared memory architectures, models of memory consistency, cache coherence protocols (MSI, MESI, MOESI), scalable cache coherence, overview of directory based approaches, design challenges of directory protocols, memory based directory protocols, cache based directory protocols, protocol design tradeoffs, synchronization.

Unit IV: **10 lecture hours**

Parallel Models and Languages :- Parallel Programming Models(Shared-Variable, Message passing, Data-Parallel, Object-Oriented);Parallel languages & Compilers (language features for parallelism, parallel language constructs, optimizing compilers for parallelism);Code optimization & partitioning (Scalar optimization , Local & Global optimization, Vectorization , code generation & scheduling , Trace scheduling compilation); Parallel programming environments

TEXT BOOKS:

3. Advanced computer architecture, Kai Hwang, McGraw Hills.
4. Computer Organization and Design, D. A. Patterson and J. L. Hennessey,Morgan Kaufmann.

REFERENCE BOOKS:

8. Computer Architecture and Organization, J.P. Hayes, McGraw Hills.
9. Memory System and Pipelined Processors,HarveyG.Cragon,Narosa Publication.
10. Parallel Computer, V.Rajaranam&C.S.R.Murthy, PHI.
11. Foundation of Parallel Processing, R.K. Ghose, RajanMoona&Phalguni Gupta, Narosa Publications
12. Scalable Parallel Computers Architecture, Kai Hwang and Zu, MGH.
13. Computer Organization & Architecture, Stalling W, PHI.
14. Computer Architecture, Pipelined and Parallel Processor Design, M.J Flynn, Narosa 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	Describe the various architectural concepts that may be applied to optimize and enhance the classical Von Neumann architecture into high performance computing hardware systems.	**PO1; PO2**
CO2	Describe the design issues relating to the architectural options.	**PO3**
CO3	Describe the challenges faced in the implementation of these high- performance systems	**PO2**
CO4	Understand pipelining, instruction set architectures, memory addressing.	**PO4**
CO5	Understand the various techniques to enhance a processors ability to exploit Instruction-level parallelism (ILP), and its challenges.	**PO5; PO12**
CO6	Understand the various models to achieve memory consistency.	**PO2; PO12**

ETCS 310A	Course Code	
Advanced Architect ure	Course Title	
		Engineering Knowledge

3	PO1	
3	PO2	Problem analysis
2	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
2	PO12	Life-long Learning
3	PSO1	Application of Concepts
2	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS 422A	Computer Vision	L	T	P	C
Version 1.0		2	0	0	2
Pre-requisites/Exposure	Basics of image processing				
Co-requisites	--				

Course Objectives

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

1. To introduce students the fundamentals of image formation;

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

Course Outcomes

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

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

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

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

Catalog Description

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

Course Content

Unit I: 8 lecture hours

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

Unit II: 12 lecture hours

Segmentation, Morphological filtering, Fourier transform. Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools,Feature analysis, feature vectors, distance /similarity measures, data pre-processing.

Unit III: 12 lecture hours

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

Unit IV: 8 lecture hours

Recent trends inActivity Recognition, computational photography, Biometrics.

Text Books

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

Reference Books/Materials

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

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

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

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

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

ETCS610 A	Course Code	
COMPUTER VISION	Course Title	
2	PO1	Engineering Knowledge
	PO2	Problem analysis

	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
3	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS464A	Major Project	L	T	P	C
Version 1.0		-	-	-	6
Pre-requisites/Exposure	--				
Co-requisites	--				

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

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

Course Outcomes

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

CO1. Use applied scientific knowledge to identify and implement relevant principles of mathematics and computer science.

C02. Use the relevant tools necessary for engineering practice.

CO3. Define overall needs and constraints to solve a problem and develop/ design a prescribed engineering sub-system.

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

Catalog Description

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

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

Course Content

The assignment to normally include:

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

Modes of Evaluation: Quiz/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 ofmathematics 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**

ETCS 464A	Course Code	
Major Project	Course Title	
	PO1	Engineering Knowledge
	PO2	Problem analysis
3	PO3	Design/development of solutions
	PO4	Conduct investigations of complex problems
2	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
3	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS453A	Computer Vision Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning of Image Processing & Computer Vision				
Co-requisites	--				

Course Objectives

The students will be able to get an idea on:

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

Course Outcomes

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

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

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

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

Catalog Description

This course introduces students to fundamental problems in image processing and computer vision, as well as their state-of-the-art solutions. Topics covered in detail include: image formation, image filtering, camera geometry, thresholding and image segmentation, edge, point and feature detection, 3D visual

reconstruction etc. The course features extensive practical components including computer labs and term Research projects that provide students with the opportunity to practice and refine their skills in image processing.

Course Content

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

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

Examination Scheme:

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and master basic knowledge, theories and methods in image processing and computer vision.	**PO1**
CO2	Identify, formulate and solve problems in image processing and computer vision.	**PO4**
CO3	Implement and test some fundamental computer vision algorithms e.g. image filtering, restoration, image segmentation, camera calibration.	**PO5, PSO3, PO9**
CO4	Design and demonstrate a working computer vision system through team research project, and project report, presentation.	**PO2**

ETCS453A	Course Code	
Computer Vision Lab	Course Title	
2	PO1	Engineering Knowledge

2	PO2	Problem analysis
	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
3	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
3	PSO3	Ethics and Communication Skills

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

ETCS481A	Practical Training – II	L	T	P	C
Version 1.0		0	0	0	2
Pre-requisites/Exposure	Completion of sixth semester				
Co-requisites	--				

Course Objectives

The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Course Outcomes

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

CO1. Have an exposure to industrial practices and to work in teams.

CO2. Understand the impact of engineering solutions in a global, economic, environmental and societal context.
CO3. Develop the ability to engage in research and to involve in life-long learning. CO4. Communicate effectively and learn to be a team player.

Catalog Description

This course enables students to face the real time problems which are usually faced by working professional while working in the industry. While on this training program, students come to know about technical as well individual skills required by a professional for survival in the market .In fact, this course is about industrial implementation of the technologies. This course enables students to learn technologies on industrial level. The student will be working closely with the technical team. This course enhances student's ability to think out of the box and suggest new ways of implementing ideas in a better manner and should be able to brainstorm and come up with innovative ideas.

Course Content

Six weeks of work at industry site. Supervised by an expert at the industry.

Modes of Evaluation: Internship Report, Presentation and Project Review

Components	Internship Report	Presentation/ Project Review
Weightage (%)	50	50

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Have an exposure to industrial practices and to work in teams.	**PO5**
CO2	Understand the impact of engineering solutions in a global, economic, environmental and societal context	**PO7**
CO3	Develop the ability to engage in research and to involve in life-long learning	**PO3**
CO4	Communicate effectively and learn to be a team player	**PO10**

Course	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	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	Innovation and Industry Friendly	Ethics and Communication Skills
ETCS48	Practical Training			3		3		2			3					

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS314A	Data Visualization and Story Telling	L	T	P	C
Version 1.0		2	-	-	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The basic objective is to understand the data analysis & visualize your data & method, understanding models not just a tool-oriented Analyst.

Course Outcomes

On completion of this course, the students will be able to
learn:- CO1. Design and create data visualizations.
CO2. Conduct exploratory data analysis using visualization.

CO3. Craft visual presentations of data for effective communication.

Catalog Description

Designed to help you become a successful Data Analyst, this Subject is for those just starting their career in Analytics. It will teach you how to understand data fundamental, analyse the data methodology, techniques, powerful dashboards, Power BI & Visualization power of data along with a strong focus on case studies to ensure hands on learning. Once armed with analytics, you will also learn the powerful data visualization tool like Advanced version of Excel, Power Map, Power BI, Business Intelligence software, Tableau desktop version & other open source tools etc to present your analysis.

Course Content

Unit I: 12 lecture hours

INTRODUCTION TO DATA HANDLING Overview of Data analysis, Introduction to Data visualization, Working with statistical formulas - Logical and financial functions , Data Validation & data models, Power Map for visualize data , Power BI-Business Intelligence , Data Analysis using statistical methods, Dashboard designing.

Unit II: **12 lecture hours**

INTRODUCTION TO DATA MANIPULATION USING FUNCTION: Heat Map, Tree Map, Smart Chart, Azure Machine learning , Column Chart, Line Chart , Pie,Bar, Area, Scatter Chart, Data Series, Axes, Chart Sheet , Trendline , Error Bars, Sparklines, Combination Chart, Gauge, Thermometer Chart, Gantt Chart , Pareto Chart etc , Frequency Distribution, Pivot Chart, Slicers , Tables: Structured References, Table Styles , What-If Analysis: Data Tables| Correlation model |Regression model.

Unit III: **10 lecture hours**

Data Strategy & Consumer behaviour Analytics: Understanding Product & Category, Competitive Analysis, Market Share understanding- Market potential Index, Seasonality-Sales Trending, Consumer behaviour Analytics-MIND AND MARKET FACTORS, Budget planning & Execution- MIMI, Regression & Correlation Analysis for Sales trending, Forecasting method with predictive investment modelling, Cohort Analysis, Google Analytics(GA), Case Studies-Assignments.

Unit IV: **12 lecture hours**

TABLEAU SOFTWARE: GETTING STARTED WITH TABLEAU SOFTWARE: What is Tableau? What does the Tableau product suite comprise of? How Does Tableau Work? Tableau Architecture, What is My Tableau Repository? Connecting to Data & Introduction to data source concepts, Understanding the Tableau workspace, Dimensions and Measures, Data Types & Default Properties, Building basic views, Saving and Sharing your work-overview.

Text Books

1.Stephen Few, Information Dashboard Design: Displaying Data for At-a-glance Monitoring, Analytics Press.

Reference Books/Materials

1. Julie Steele, Noah Iliinsky, Beautiful Visualization, Looking at Data Through the Eyes of Experts,

O′Reilly.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Design and create data visualizations.	**PO3**
CO2	Conduct exploratory data analysis using visualization.	**PO4**
CO3	Craft visual presentations of data for effective communication.	**PO10**

ETCS 314A	Course Code	
Data Visualiz ation and Story Telling	Course Title	
	PO1	Engineering Knowledge
	PO2	Problem analysis
	PO3	Design/development of solutions

3		
3	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
3	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS461A	Data Visualization and Story Telling Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The basic objective is to understand the data analysis & visualize your data & method, understanding models not just a tool-oriented Analyst.

Course Outcomes

On completion of this course, the students will be able to
learn:- CO1. Design and implement data visualizations on real life datasets. CO2. Conduct exploratory data analysis using visualization.
CO3. Prepare visual presentations of data for effective communication.

Catalog Description

This course complements ETCS314A. It enables them to write algorithms/programs for Implementing Open Source, Platform Independent, Machine Learning Operations and Quality plotting and graphing. The list of experiments helps organizing the data in variety of ways using R and to solve the given problem efficiently.

Course Content

The industry expert will give 10 or more exercises based upon syllabus ETCS314A.

Text Books

1.Stephen Few, Information Dashboard Design: Displaying Data for At-a-glance Monitoring, Analytics Press.

Reference Books/Materials

1. Julie Steele, Noah Iliinsky, Beautiful Visualization, Looking at Data Through the Eyes of Experts, O′Reilly.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Design and implement data visualizations on real life datasets.	**PO3**
CO2	Conduct exploratory data analysis using visualization.	**PO4**
CO3	Prepare visual presentations of data for effective communication.	**PO10**

ETCS 461A	Course Code	
Data Visualiz ation and Story Telling Lab	Course Title	
	PO1	Engineering Knowledge
	PO2	Problem analysis
	PO3	Design/development of solutions

3		
3	PO4	Conduct investigations of complex problems
	P O 5	Modern tool usage
	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
5 3	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS422A	Cloud Computing	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real-life scenarios.
3. To enable students exploring some important cloud computing driven commercial systems and applications.
4. To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

Course Outcomes

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

CO1. Implement a public cloud instance using a public cloud service provider.

CO2. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.

CO3. Apply the fundamental concepts in data centres to understand the trade-offs in power, efficiency and cost.

CO4. Apply trust-based security model to different layers.

CO5. Develop a risk-management strategy for moving to the Cloud.

CO6. Describe big data and use cases from selected business domains.

CO7.Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.

CO8. Analyze various cloud programming models and apply them to solve problems on the cloud.

Catalog Description

The course presents a top-down view of cloud computing, from applications and administration to programming and infrastructure. Its focus is on parallel programming techniques for cloud computing and large-scale distributed systems which form the cloud infrastructure. The topics include overview of cloud computing, cloud systems, parallel processing in the cloud, distributed storage systems, virtualization, security in the cloud, and multicore operating systems. Students will study state-of-the-art solutions for cloud computing developed by Google, Amazon, Microsoft, Yahoo, VMWare, etc. Students will also apply what they learn in one programming assignment and one project executed over Amazon Web Services.

Course Content

Unit I: 10 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: 6 lecture hours

Virtualization, Server, Storage and Networking: Virtualization concepts, types, Server virtualization, Storage virtualization, Storage services, Network virtualization, service virtualization, Virtualization management, Virtualization technologies and architectures, Internals of virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, Hyper V, VMware hypervisors and their features.

Unit III: 10 lecture hours

Data in Cloud Computing: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map Reduce and extensions: Parallel computing, the map-Reduce model, Parallel efficiency of Map Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map Reduce.

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, Borko Furht, 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 shiftcame 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**

ETCS422A	Course Code	
Cloud Computing	Course Title	
2	PO1	Engineering Knowledge

3	PO2	Problem analysis
3	PO3	Design/development of solutions
2	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
5	PO8	Ethics
3	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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**

ETCA362A	Course Code	
Cloud Computing Lab	Course Title	
2	PO1	Engineering Knowledge
	PO2	Problem analysis

3		
3	PO3	Design/development of solutions
2	PO4	Conduct investigations of complex problems
3	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
3	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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

ETCS418A	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

ETCS418A	Course Code	
Internet of Things	Course Title	
2	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
3	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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 418A. This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions.

List of Experiments (Indicative)

1	Start Raspberry Pi and try various Linux commands in command terminal window	**2 lab hours**
2	Read your name and print Hello message with name.	**2 lab hours**
3	Read two numbers and print their sum, difference, product and division.	
4	Word and character count of a given string	
5	Area of a given shape (rectangle, triangle and circle) reading shape and appropriate values from standard input	**2 lab hours**
6	Print a name 'n' times, where name and n are read from standard input, using for and while loops.	

7	Handle Divided by Zero Exception.	

8	Print current time for 10 times with an interval of 10 seconds.	**2 lab hours**
9	Read a file line by line and print the word count of each line.	
10	To inter face LED/Buzzer with Arduino/Raspberry PiandwriteaprogramtoturnONLEDfor1 secafterevery2 seconds.	**2 lab hours**
11	Switch on a relay at a given time using cron, where the relay's contact terminals are connected to a load.	**2 lab hours**
12	To install MySQL database on Raspberry Pi and perform basic SQL queries.	**2 lab hours**
13	Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.	**2 lab hours**
14	Write a programonArduino/RaspberryPitosubscribetoMQTTbrokerfortemperaturedataan dprint it.	**2 lab hours**
15	WriteaprogramtocreateTCPserveronArduino/RaspberryPiandrespondwithhumidity data to TCP client when requested..	**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**

ETCS457A	Course Code	
Internet of Things Lab	Course Title	
2	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions
3	PO4	Conduct investigations of complex problems
	PO5	Modern tool usage
	PO6	The engineer and society
	PO7	Environment and sustainability
	PO8	Ethics

	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
3	PSO2	Innovation and Industry Friendly
	PSO3	Ethics and Communication Skills

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: **08 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: **10 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**

Course Code	Course Title	PO1	PO 2	PO3	PO4	P O 5	PO 6	PO7	P O 8	PO9	PO1 0	PO11	PO12	PSO1	PSO2	PSO3
		Engineering Knowledge	Problem analysis	Design/development of	Conduct investigations	Modern tool usage	The engineer and	Environment and	Ethics	Individual or team work	Communication	Project management and	Life-long Learning	Application of Concepts	Innovation and Industry	Ethics and Communication
ETCS4 63A	Data	3	3	2	3	3	1							3	3	3

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	Modern tool usage	The engineer and	Environment and	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Innovation and Industry Friendly	Ethics and Communication
Course Code	Course	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	P O 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 463A	Data warehouse	2	2	3	3	3								3	3	3

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

ETCS490A	Industrial Internship	L	T	P	C
Version 1.0		-	-	-	12
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To learn how to carry out extensive research/study in the area of project implementation.
2. To be associated with an area of research/research project and contribute towards domain knowledge.
3. To learn technical report/project documentation writing.
4. To learn and implement the technology that in being used is the specific industry where the training is carried out.

Course Outcomes

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

CO1. Carry out the extensive literature survey/study in the area on internship provided.
CO2. Write technical documentation for the project implement.
CO3. Analyze and develop various methods and techniques applicable to the topic to study/area of implementation.
CO4. Have practical knowledge on the applications of project of implementation on society.

Catalog Description

The student will carry out a minimum of six months in industry or appropriate workplace/ academic and research institutions in India/abroad. The internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship/industrial training should be presented in the form of a report.

Course Content

The assignment will be defined by the organization where the student will carry of his industrial training.

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

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

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

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Carry out the extensive literature survey/study in the area on internship provided.	**PO2**
CO2	Write technical documentation for the project implement.	**PO5**
CO3	Analyze and develop various methods and techniques applicable to the topic to study/area of implementation.	**PO3**
CO4	Have practical knowledge on the applications of project of implementation on society.	**PO6**

ETCS 490A	Course Code	
Industri al Internsh ip	Course Title	
	PO1	Engineering Knowledge
3	PO2	Problem analysis
3	PO3	Design/development of solutions

	PO4	Conduct investigations of complex problems
3	P O 5	Modern tool usage
2	PO 6	The engineer and society
	PO7	Environment and sustainability
	P O 8	Ethics
	PO9	Individual or team work
	PO10	Communication
	PO11	Project management and finance
	PO12	Life-long Learning
3	PSO1	Application of Concepts
	PSO2	Innovation and Industry Friendly
2	PSO3	Ethics and Communication Skills

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