School of Engineering

Syllabi and Course Structure

B. Tech. (Computer Science & Engineering) Full Stack(Xabia) (2025-2029) Academic Programmes

JULY 2025

The curriculum and syllabus for B.Tech. Program conforms to outcome based teaching learning process. In general, several outcomes have been identified and the curriculum and syllabus have been planned in such a way that each of the courses meets one or more of these outcomes. Student outcomes illustrate the students are expected to know and be able to do by the time of graduation. These relate to the skills, understanding, and behavioursthatstudents acquire as they progress through the program. Further each course in the program brings out clear instructional objectives which are mapped to the student outcomes.

B.Tech. (CSE) Program Educational Objective (PEO's):
A graduate of the Computer Science and Engineering Program should:

PEO- I

Students will develop themselves as effective professionals by solving real problems through the use of computer science knowledge and with attention to team work, effective communication, critical thinking and problem solving skills.

PEO- II

Students will develop professional skills that prepare them for immediate employment and for life-long learning in advanced areas of computer science and related fields.

PEO- III

Students will demonstrate their ability to adapt to a rapidly changing environment by having learned and applied new skills and new technologies.

PEO- IV

Students will be provided with an educational foundation that prepares them for excellence, leadership roles along diverse career paths with encouragement to professional ethics and active participation needed for a successful career.

Program Outcome(PO's)

A graduate of the Computer Science and Engineering Program will demonstrate:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. 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.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal andcultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. 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.

PO8: Culture, Values and Ethics: Understand the importance of culture and Values along with the implications it has on learning, teaching, engineering practice, identity, and enculturation as an engineer. Apply ethical principles being committed to professional ethics, responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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.

PO11. 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 and in multidisciplinary environments.

PO12. 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.

Program Specific Outcome:

PSO1: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, cyber security, machine learning and networking for efficient design and automation of computer-based systems of varying complexity. (Professional Skills)

PSO2: The ability to apply standard and modern practices like Python, R language, automation and strategies in software project development using open-ended programming environments to deliver a quality product for business success. (Problem-Solving Skills)

PSO3: The ability to employ modern computer languages, environments, and platforms in creating innovative career paths in the field of AI and Machine learning, Cloud Computing, Robotic automation, cyber security to be an entrepreneur, and a zest for higher studies.(Successful Career and Entrepreneurship)

B. Tech. (common to all disciplines)-I/II Semester

(Common to all disciplines at UG Level)-I Semester
Contact Hours (L-T-P): 2-0-2

DEN001C	*Communication Skills*	*Credits 1-0-1 2*

Course Objectives
1. *To enhance English language competence in reading, writing, listening and speaking.*
2. *Switch the approach from teacher-centred to student-centred one.*
3. *Minimize the Grammar Translation Method of ELT while trying to replace it with Direct Method.*
4. *Introduce Communicative Method of ELT and focusing the teaching pedagogy on the student-centred learning rather than on the teacher-centred learning.*
5. *To link communication skills with the organizational behaviour.*
6. *To inculcate skills which are very much required for employability and adjust in the professional environment.*

Course Outcomes (CO):

At the end of this course students will have:

CO1: Ability to design a language component or process to meet desired need within realistic, Constraints such as economic, environmental, social, political, ethical, scenario
CO2: Ability to analyze the usage of English words in different contexts.
CO3: An understanding of technical and academic articles' comprehension.
CO4: The ability to present oneself at multinational levels knowing the type of different standards of English
CO5: Ability to showcase employability skills and professional writing skills

Syllabus: Theory

UNIT 1	**Basics of Organizational Communication:** Communication: Meaning, Elements, Process, Types, Flows of Communication and Barriers to communication, basics of professional communication and professional ethics including Time-management, Respect for deadlines and corporate culture
UNIT 2	**Basic Writing Skills:** Parts of Speech, Elements of Sentences, Sentence types based on meaning and structure, Tenses, Voice, Narration
UNIT 3	**Composition:**, Basics of Letter Writing, Email Writing, Précis Writing, Essay Writing,
UNIT 4	**Vocabulary Building:** Word Formation from one word form to another, Origin of Words, Affixes, Synonyms, Antonyms

UNIT 5	**Professional and Technical Communication :** *Basics of Drafting a CV/Resume, Basics of Telephonic Interview and Online Interview, Basics of PPT presentation*

Syllabus: Lab DEN001D

UNIT 1	**Basics of Organizational Communication:** *Role Plays and presentations related to different corporate related matters- How to greet, how to deny politely, how to handle different types of problems related to the types of communication, how to avoid grapevine and use it in a positive manner, how to keep positive mindset during work pressure, Activities to teach Time-management, Following Deadlines etc*
UNIT 2	**Write Dialogue from the different contexts of corporate culture:** *Employee and Employer, Customer and Service Provider, Customer and Product Review, How to react on Day to day corporate interactions- Memo, Notice, Email, Circular etc*
UNIT 3	**Composition:**, *Letter Writing, Email Writing, Précis Writing, Essay Writing, Practice sessions by using Ms Word- Following the process of Drafting-Redrafting, Proof Reading, Editing etc*
UNIT 4	**Vocabulary Building:** *Word Formation from one word form to another, Origin of Words, Affixes, Synonyms, Antonyms- Using video clips and comprehension passages to find out the difference between words, similarity between words, origin of words, neologism concepts etc*
UNIT 5	**Professional and Technical Communication :** *Drafting a CV/Resume, Practice Sessions on Telephonic Interview and Online Interview, Presenting projects, proposals etc through PPT Making,*

Methodology for Evaluation

1. Internal Assessment (Theory)
   a) Home Assignments: One from each Unit   :   15 Marks
   b) In Semester Tests (Minimum two)   :   30 Marks
   c) Attendance   :   05 Marks
2. Term End (Theory)   :   50 Marks
3. Internal Assessment (Lab)
   (a) Daily Performance in the Lab   :   50 Marks
4. Term End (Lab)   :   50 Marks

Course Articulation Matrix: (Mapping of COs with POs andPSOs)

Course Outcome	Program Outcome							Program Specific Outcome					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3					2	3	3	2	3	3
CO2	2	3	3					1	2	3	3	3	2
CO3	3	2	1				3	1		3	2	2	3
CO4	2	3	3					2	2	3	3	3	3
CO5	3	3	3				3	3	1	1	3	3	3

Suggested Reading:
  A. *Practical English Usage. Michael Swan. OUP. 1995*
  B. *Remedial English Grammar. F.T. Wood. Macmillan. 2007*

  C. *Raymond V. Lesikar and Marie E. Flatley. Basic Business Communication, Tata McGraw Hill Pub. Co. New Delhi. 2005. Tenth Edition.*
  D. *On Writing Well. William Zinsser. Harper Resource Book. 2001*
  E. *Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.*
  F. *Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.*
  G. *Exercises in Spoken English. Parts. I-III, Hyderabad. Oxford University Press.*

  H. *Syamala, V. Speak English in Four Easy Steps, Improve English Foundation Trivandrum: 2006*
  I. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
  J. *The BBC and British Council online resources*

B. Tech. (common to all disciplines)-I Semester
Contact Hours (L-T-P): 3-1-0

DMA001A	Engineering Mathematics-I	3: 1:0 4

OBJECTIVE:
The objectives of this course are to make the students:

- To increase the student's appreciation of the basic role played by mathematics in modern technology.
- Incorporate the knowledge of advanced mathematics to support their concurrent and subsequent engineering studies.
- To develop the conceptsandtoolsthatwillserve asbuildingblockstowards tacklingmoreadvancedlevelofmathematicsthatthey arelikely tofindusefulintheirprofession whenemployedinthefirm/industry/corporationinpublic or privatesector

UNIT 1	Point of inflexion and curve tracing (Cartesian coordinates only), curvature, convexity, concavity, point of inflexion and curve tracing.
UNIT 2	Limit, continuity and partial derivatives, Euler's theorem on homogenous functions, total derivative, approximate calculations; Maxima and minima of two and more independent variables; Method of Lagrange multipliers.
UNIT 3	Beta and Gamma functions and their properties. Surface and volumes of solids of revolutions. Double integrals, change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes.
UNIT 4	Vectors covering,lawsof vectoralgebra,operations- dot,cross,triple products;Vector function- limits,continuityandderivatives,geometricinterpretation; Gradient,divergenceand cur-formulae.
UNIT 5	Lineintegrals,simpleconnectedregions,Lineintegrals, surface integrals, volume integral, Green's theorem, Stokestheorem and Gauss theorem.

Text Books:
   1. B.V.Ramana, Higher Engineering Mathematics, Tata McGraw Hill, 2011.

Reference Books:

   1.   Erwin Kreyszig , Advanced Engineering Mathematics, Wiley 9th Edition, 2008
   2.   Maurice D. Weir and Joel Hass, Thomas Calculus, Pearson, 11th Edition, 2005.
   3.   Higher Engineering Mathematics- B. S. Grewal, Khanna Publications.

Course Outcomes
Upon successful completion of this course, the student will be able to:

CO1   Understand the concepts of Asymptotes, curvature and curve tracing.

CO2 Understand the functions of more than one independent variable and calculate partial derivatives along with their applications .Also obtain an idea for finding the extreme values of functions of more the one variable.

CO3 Will able to integrate a continuous function of two or three variables over a bounded region and able to trace the curves.

CO4 Understand the representation of vector and its properties.

CO5 Understand line integral, surface integrals, volume integral, Green's theorem, Stokestheorem and Gauss theorem

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	H			M		M					M	H	L	
CO2		M		L	M		H				L	M	M		
CO3	H	H		M	M		H			L		M	M	M	
CO4	H	M		M	L		M					M		M	
CO5	H	H			M		H					M	H	M	

H = Highly Related; M = Medium L = Low

B. Tech. (common to all disciplines)-I/II Semester
Contact Hours (L-T-P): 3-0-2

DPH001B	APPLIED PHYSICS	Total Credits: 3

Course Objectives:

1. Students will be able to demonstrate competency and profound understanding of physics relevant to the various streams of engineering and technology.
2. Students will be able better to understand and learn the concepts of Quantum Mechanics and its applications.
3. Students will be able acquire the knowledge of semiconductors, laser system to meet desired needs within realistic constraints such as health and safety, manufacturability.
4. The graduates will able to understand the applications of quantum optics through Holography and communication through optical fibers and application of optical technologies.

UNIT 1	**Introduction to Quantum Mechanics:** Development of Quantum Mechanics, Compton Scattering, Uncertainty's Principle, Wave Particle Duality, Phase and Group velocities, Wave Packet, - Physical significance and its properties, Operators, Expectation values. Schrödinger's time dependent and time independent equations. **Applications:** Motion of a particle in one-dimensional box and three-dimensional box, Concept of Non-degeneracy and Degeneracy. Qualitative: Quantum Tunnelling (Barrier penetration) - **Alpha Decay**.
UNIT 2	**Free Electron Theory and Band Theory of Solids:** Overview of Drude & Lorentz theory, Quantum (Sommerfield's) theory of free electrons, Density of energy states, Fermi-Dirac Statistics, Fermi level. Band Theory of solids: Formations of band, Classification of Solids - Energy Band Diagram.
UNIT 3	**Semiconductor Devices**: Intrinsic and Extrinsic semiconductors, Carrier concentrations, Position of Fermi levels in semiconductors, Conductivity and Mobility, determination of bandgap, P-N junction diode: Formation, Energy band diagram, Calculation of internal potential barrier, diode equation and V-I characteristics under forward and reverse bias; Zener diode, Varacter diode, LED and Photodiode.
UNIT 4	**Quantum Optics:** **Laser:** Introduction to Coherence; Einstein's coefficients, relations between Einstein's coefficients, Threshold conditions for laser action. Solid-Nd-Yag Laser, Ruby laser, Gaseous-He-Ne, CO_2 laser, and Semiconductor laser. **Holography**: Holography versus photography. Construction and re-construction of a Hologram and Applications. **Communication**: Optical fiber-Construction, Numerical Aperture and Angle of Acceptance, fractional refractive index, types of optical fibres and applications
UNIT 5	**Electromagnetic Waves**

	Scalar and Vector fields, Theorems- Gauss', Stokes and Gradient; Maxwell's equations – Differential and Integral Form, Significance of Equations, Ampere's Law and correction; Wave equation and its solution for free space. Transverse nature of EM waves; Poynting vector and theorem, Applications in communications

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO1: Understand the fundamentals of quantum mechanics to analyze the quantum behavior of matter in its micro state and its applications.

CO2: Analyze and apply quantum theory and quantum statistics in understanding the physics of materials.

CO3: Acquire the experiential learning with demonstration of knowledge about semiconductors and devices role in Electronics.

CO4: Acquire and demonstrate the knowledge about the fundamentals of Lasers and its importance in real life.

CO5: Learn the basics and nature of EM radiations and role in communications.

Suggested Books

1. Arthur Beiser, **Perspectives in Modern Physics**, McGraw Hill International.
2.   H. S. Mani and G. K. Mehta, **Modern Physics**, East-West Press.
3. H Malik and AK Singh, **Engineering Physics**, McGraw Hill Education.
4. A. K. Ghatak, **Optics**, Tata McGraw Hill.
5   D. K. Bhattacharya and A. Bhaskaran: **Engineering Physics**, Oxford University Press.
6. S. Mani Naidu, **Engineering Physics**, Pearson.
7. M.N. Avadhanulu, P.G. Kshirsagar, "**A Textbook of Engineering Physics**", S. Chand Publications
8. S. O. Pillai, **Solid State Physics**, Wiley Eastern.

 MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	M	H	M	L						M	H	M	
CO2	H	H	L	H	M	M						L	H	M	L
CO3	H	H	M		M	M	L	M	H			M	M	H	L
CO4	H	L	M		H	M	L		L			M	M	H	M
CO5	H	L	H	M	H	L						L	M	H	M

H = Highly Related, M = Medium, L = Low.

BCO370A	**DIGITAL TRANSFORMATION AND AGILE PRACTICES**	3-0-0 [3]

OBJECTIVE:

- Introduction to digital transformation, business model generation and defining value proposition
- Building digital products, product lifecycle and introduction to product management
- Product development methodologies: systems thinking, value chain, lean thinking and agile
- Achieving digital innovation using design thinking; phases of design thinking and design sprints
- Lean startup concepts: MVP, continuous deployment, pivot and metrics
- Introduction to UI/UX design, prototyping and performance evaluation
- Product marketing, including digital marketing concepts

UNIT 1	Introduction, Challenges of Traditional Business Model, Why Digital Transformation, Design Thinking, Different Phases of Design Thinking, Divergence, Emergence and Convergence of Design Thinking, Design Thinking vs. Agile vs. Lean, Agile Practices, Design Sprint and its Phases, Design Thinking Vs Design Spirit
UNIT 2	Introduction to Product Management & Service Mindset, Product Manager, Building Products and services, Product lifecycle and phases, product development & Methodology; systems thinking, value chain, Introduction of Capability Optimization and Capability Maturity Model, Business Integration methods, Agile methodology, Product Marketing; User Experience Design
UNIT 3	Agile Methodology, Software, History of Software Engineering and Software, Development Methodologies, Traditional Software Development Models, Waterfall Model, Classical Waterfall Model, Traditional IT Organizations, Developers vs IT Operations Conflict, Birth of Agile, Four Values of the Agile Manifesto, Agile and Lean
UNIT 4	Scrum, Scrum Theory, Scrum Values, Scrum Roles, Scrum Master Scrum Sprints, Benefits of Scrum, Planning and Estimation, Agile Planning, Levels of Agile Planning, Conditions of Satisfaction, Velocity, Estimating Techniques, Soft Skills in Agile, Kanban Model.
UNIT 5	Kanban Principle, Kanban Board, Kanban Core Practices, Make work visible, Limit work in progress (WiP), Manage flow, Make progress policies explicit, Implement feedback mechanisms, Improve collaboratively (using methods and models).

Course OUTCOME (CO):

CO1: Understand the challenges of traditional business model
CO2: Explore the product management and service mindset
CO3: Understand agile methodology
CO4: Understand the scrum theory and values
CO5: Explore the Kanban principles

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	L	M	L	L	L			L	L	L	L	L	L
CO2	L	L	M	L	L				L	L	L	L	L	L
CO3	L	M	L	L	L					L		L	L	L
CO4	L	M	L	L	L		L			L		L	L	L
CO5	L	L	L	L	L	M			L	L		L	L	L

H = Highly Related; M = Medium; L = Low

Text Books:

1. Software Engineering: A Practitioner's Approach Book by Roger S. Pressman

Reference Books:

2. Agile and Lean Concepts for Teaching and Learning: Bringing Methodologies from Industry to the Classroom- David Parsons, Kathryn MacCallum

DCO013A	Computer Programming and Logical Thinking	3: 0:0	3

Course Objectives

1. To impart adequate knowledge on the need for programming languages and problem-solving techniques.
2. To develop an in-depth understanding of functional and logical concepts of Programming Language
3. To provide exposure to problem-solving through programming skills
4. To familiarize the basic syntax and semantics of programming Language
5. To familiarize the different Operations on arrays, functions, pointers, structures, unions and files

Unit I

Unit–1 Computer Fundamentals, Functional units of Computer: I/O devices, Primary and secondary memories Number System: Decimal, Binary, Octal, and hexadecimal, Fixed and floating Points, Character Representations, ASCII, EBCDIC, Binary Arithmetic, Negative Numbers and their Arithmetic, Floating point representation, Binary Codes, Cyclic Codes

Unit–2 Programming Fundamentals, Algorithm development, Techniques of Problem-solving, Flowcharting, Stepwise Refinement.

Unit –3 Basic of C Programming, Introduction of C language, Representation of Integer, Character, real, Data Types: Constants and Variables, Operators, Arithmetic Expression, Logical expression, Assignment statement, Structure of a C program, Header files, Directives

Unit–4 Programming in C, Decision Control Structure, Alteration, and Iterations (While, do while, for loop, switch case), Arrays, String processing,

Unit–5 Advance Concepts in C, Functions, Recursion, Pointers, Structure, Union, Files

Course Outcomes (CO)

CO1   Understand the basic structure of computer and numbering methods
CO2   Understand the representations of data and various algorithm
CO3   Choose the right data representation formats based on the requirements of the problem
CO4   Develop programming skills using the fundamentals and basics of Programming Language
CO5   Implement different Operations on arrays, functions, pointers, structures, unions and files

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF
PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

Course Outcome	Program Outcome												Program Specifice Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M												M		
CO2			H		H									H	L
CO3			H		M				M		M		H		
CO4				L								M		L	
CO5	H		H	M							M		H	M	L

Reference Books:

1. Introduction to computer by Alexis Leon, Leon Press, Channai.
2. Computer fundamentals And C programming by E. Balagurusamy, The MsGraw-Hill publishing company Ltd.
3. Let us C by YaswantKanitkar.
4. Exploring in C by YaswantKanatkar.

B. Tech. (common to all disciplines)-I/II Semester
Contact Hours (L-T-P): 3-0-2

DPH002B	APPLIED PHYSICS LAB	Total Credits: 1

List of Experiments

Students are required to perform any ten experiments out of the following list of experiments.

1	**Study the V-I characteristics of p-n junction diode under forward and reverse bias.**
2	**Study the V-I characteristics of a zener diode under forward and reverse bias.**
3	To study the V-I characteristics of Solar Cell
4	To determine the Planck's constant "h" by measuring radiations.
5	To study the variation in resistance of a Semiconductor with temperature and to determine its energy bandgap.
6	**Study the temperature dependence of resistivity of a semiconductor (Four probe method) and to determine bandgap of semiconductor materials (Si and Ge).**
7	**Study of various LC and LCR circuits**
8	To determine Resolving power of Telescope.
9	To determine Dispersive Power of a Prism using Mercury light source and Spectrometer.
10	To determine the wavelength of prominent lines of Mercury by using plane Diffraction Grating and Spectrometer.
11	To measure Numerical Aperture of an Optical Fiber.
12	To determine the profile of He-Ne LASER beam.
13	To determine wavelength of Sodium light source using Newton's Rings experiment.
14	*To study shift in fringes in interference experiment using Michelson's interferometer

Course Outcomes-
While graduating, students of the Applied Physics Lab program would be able to:
CO1: Learn the concepts and understandings through the experiments of electrical, electronics, optical and mechanical in engineering disciplines.
CO2: Develop the technical skill by conducting experiments and analyzing the reasons behind.
CO3: Demonstrate the concepts of Quantum optics via using modern tools for better learning.
CO4: Express their theoretical understanding more effectively by performing experiments and simulations.
CO5: Communicate their ideas effectively, both orally and in writing, and function effectively in multidisciplinary teams

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcome												Program Specific Outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	H		M	M						M	H	M	
CO2	H	M	L	M	L							M	H	L	
CO3	M	M	L		H	M						M	H	M	L
CO4		H		M	M			M			M	L	M	H	L
CO5		L						H	H	H		M	M	M	H

H = Highly Related; M = Medium L = Low

B. Tech. (common to all disciplines)-I/II Semester

DCO014A	**Computer Programming and Logical Thinking Lab**	**0:0:2(1 Credit)**

1. Write a program to print a hello world in c .

2. Write a program in c to check even or odd.

3. Write a program to find odd numbers in c.

4. Write a program to print Armstrong numbers from 1 to 500.

5. Write a program for prime numbers between 1 to 100.

6. Write a program to check a palindrome number.

7. Factorial program in c using for loop

8. Write a c program to reverse a given number.

9. Write a program to add the two numbers.

10. Write a program to swap a number using a third variable.

11. write a program to make personal information as in CV.

12 Write a program to print the following pattern.

*

* *

* * *

14 Write a program to print the following pattern.

* * *

* *

*

15 Write a program to reverse an input string in c .

16 Write a program to print addition, multiplication, division, and subtraction of the numbers.

17 Write a program to print a table of any number.

18. Write a program to implement switch case .

19. Write a program to implement Function.

20. Write a program to implement Recursive Function.

21. Write a program to implement structure in C.

22. Write a program to implement UNION in C.

23. Write a program to implement ENUM in C.

BCO570A		*Digital Data and AI Literacy*	0:0:4(2 Credit)

Course Objective

1. To equip students with hands-on skills in digital tools, data handling, and artificial intelligence.
2. Understand how to analyze information and present it using charts, graphs, and visual tools
3. Understand basic digital tools and platforms
4. Identify and use digital tools specific to your academic or professional stream.
5. Understand what AI is and how it works in everyday life

Module	Practical Exercise #	Exercise Details
Module-1: *Digital Foundations, Chatbots, their usage & Tools*	1	Creating Login on AI Bots - Gemini, Chat GPT, Grok & Copilot & comparing the output for the same tasks as provided by the instructor.
	2	Write prompts to use Chat GPT as - Interviewer, Doctor, Motivational Speaker, Advertiser & an Excel.
	3	Use ChatGPT to: Generate blog outlines and headlines, Expand bullet points into full paragraphs, Use Grammarly to polish tone and grammar
	4	Create a digital personal portfolio using Google Sites or Notion-Part-1
	5	Create a digital personal portfolio using Google Sites or Notion-Part-2
Module-2 *Data Collection, Quiz & PPT Creation using AI*	6	Google Forms - Part-1: Collect sample data via Google Forms, using various types of question input options & publishing the form for open response from any domain & generating a QR Code.
	7	Google Forms - Part-2: Collect sample data via Google Forms and Clean and organize data using MS Excel
	8	Creating a Quiz on Quizizz.com using AI & publishing the same.
	9	Generate a PPT using PI tool & compare the output with other tools like Gamma.AI & AIPPT.com
Module-3 *Exploring AI & Society*	10	Use Claude.AI to enhance your already prepared Project Reports & also generate a new fresh project report.
	11	Build a simple chatbot using Dialogflow or similar no-code tools.
	12	Use Canva AI to: Generate a poster for a college event
	13	Design a tri-fold brochure for a student club, Use DALL·E or Adobe Firefly to generate background images or illustration
	14	Create a social media post (Instagram/Facebook) promoting a fictional event using AI- generated visuals
Module-4 *Blogging, Summarization, Data Analysis & Multimedia Tasks using AI*	15	Use Lumen5 or Pictory to: Convert a blog or script into a short video, Add AI-generated voiceovers and subtitles
	16	Use Notion, AI to summarize or rephrase content, Write a 300-word blog post on "The Role of AI in Student Life" using AI tools
	17	Using Julius AI create dashboard from the given data set and visualize data using Julius
	18	Using Julius AI Analyze the Sales Data Provided for ABC Corporation & provide summary & insights
	19	Using Otter.AI convert speech to text for meeting audio or sample conversations. Also integrate Otter.AI with google calendar and automatically prepare Meeting Summary & key actions.
	20	Using Magichour.AI & similar AI based applications, generate images for various situations from text commands using AI.
	21	Using Veed.io & similar tools generating Short videos based upon scenarios & situations.
Module-5 Capstone Project	22	Analyze the given data and present the report in form of PPT with Key insights, summary & visualization.
	23	Build a Chabot as per the given instructions.

	24	Prepare a Blog & a Poster for Instagram with AI tools

Course Outcome

CO-1	Student understands basic digital tools and platforms. Learn how to stay safe online by practicing cyber hygiene and responsible digital behavior. Become aware of digital footprints and ethical online conduct.
CO-2	Student learns to collect, clean, and organize data. Student Understand how to analyze information and present it using charts, graphs, and visual tools. Develop basic skills in tools like Excel or Google Sheets.
CO-3	Student understands what AI is and how it works in everyday life. Explore how AI is used in areas like education, health, and social media. Discuss ethical concerns and the social impact of AI.
CO-4	Identify and use digital tools specific to your academic or professional stream. Apply them in projects, research, and real-world problem-solving. Build digital readiness for higher studies or jobs.
CO-5	Student works on a final project that combines everything you've learned. Use digital, data, and AI skills to solve a problem or present a creative idea. Showcase your work to peers or mentors confidently.

CO-PO-PSO Mapping Table (H: High, M: Medium, L: Low)

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	H	M			M	H	M	L	M	M		M	M		M
CO-2		H		M	M		M		M	H			H	M	
CO-3	M	M	H			M					L		M	M	L
CO-4	H	H	H	H	H	H	H		L	H		H	H	H	
CO-5	H	H	H	H	H	M	H	L				L	H	H	H

B. Tech. (common to all disciplines)-I/II Semester
Contact Hours (L-T-P): 0-0-2

DME001A	Engineering Graphics with AutoCAD-DME001A	Credits:2

Basic Concepts
Importance of drawing, Basic principles of engineering drawing, Standards and conventions.

Introduction to AutoCAD
Introduction to drafting software, standard tool bar/menus, navigational tools. Co-ordinate system and reference planes. Principles and methods of dimensioning, Scaling Creation of 2-dimensional drawing environment. Selection of drawing size and scale. Sketching of 2D simple geometries, editing and dimensioning of 2D geometries, Layout and printing of drawing.

OrthographicProjections: - Introduction to different types of projections and their uses, Orthographic projection, I angle and III angle projections.

Projection of regular solids and simple objects like tetrahedron, cube, polygonal prism and pyramid etc.

Cases of solids placed in different positions with axis, faces and/or side of solids making given angles with reference planes.

Sections
Importance of sectioning, Principles and types of sectioning, cutting plane representation, Sections of solids, Sectional views and true shape of sections, Hatching.

Development of Surfaces
 Development of surface of simple and sectioned solids.

Method of drawing projections
Isometric and oblique projections drawing of elements like screws, nuts and bolts, locking, welding and riveting joints and symbols

Text Books:
1. Bhat, N.D.& M. Panchal (2008), Engineering Drawing, Charotar Publishing House
2. James D. Bethune (2015),Engineering Graphics with AutoCAD 2015, Macromedia Press.

Reference Books:
1 Dhawan, R.K. (2007), A Text Book of Engineering Drawing, S. Chand Publications
2 Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

Course Outcomes: After learning the course the students should be able to:-
CO1. Understand the engineering drawing standards and their usage.
CO2. Interpret engineering drawings. Construct and dimension 2-D geometries using
CAD software.
CO3.Understand the concepts of orthographic projections and isometric projection.
CO4. Communicate information by graphical means, using also CAD software

packages.

CO5. Visualize and understand spatial relationships, and the competence to select anduse appropriate graphical methods for representing design concepts.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				H	L									L
CO2			L		M									H
CO3		M												
CO4					H								H	
CO5	*M*		*M*		H								H	

H = Highly Related; M = Medium L = Low

Text Books:

1. Bhat, N.D.& M. Panchal (2008), Engineering Drawing, Charotar Publishing House

2. Shah, M.B. & B.C. Rana (2008), Engineering Drawing and Computer Graphics, Pearson Education

Reference Books:

1 Dhawan, R.K. (2007), A Text Book of Engineering Drawing, S. Chand Publications

2 Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

B. Tech. (common to all disciplines) II Semester

(Common to all disciplines at UG Level)-II Semester
Contact Hours (L-T-P): 1-0-1

DEN002C	*Professional Skills*	*Credits 1-0-1 2*

Course Objectives
1. *To enhance Professional competence in reading, writing, listening and speaking.*
2. *Switch the approach from providing information about the language to use the language.*
3. *Minimize the Grammar Translation Method of ELT while trying to replace it with Direct Method.*
4. *Introduce Communicative Method of ELT and focusing the teaching pedagogy on the student-centred learning rather than on the teacher-centred learning.*
5. *Ability to master three major forms of communications which are vital in academic and professional settings namely professional presentations, interviews and group communications respectively.*
6. *Providing a deep insight into the techniques for delivering effective presentations, winning job interviews, and actively participating in various forms of group communication.*

Course Outcomes (CO):

At the end of this course students will have:

CO1: Ability to design a language component or process to meet desired need within realistic, Constraints such as economic, environmental, social, political, ethical, scenario
CO2: Ability to analyze the usage of English words in professional scenario.
CO3: An understanding of technical and academic articles' comprehension.
CO4: The ability to present oneself at multinational levels as per the demand of the corporate culture
CO5: Ability to enhance professional writing skills in tune with professional scenario.

Syllabus: Theory

UNIT 1	*Professional Grooming and Professional Culture:* *Basics of corporate culture, Dressing sense-personal hygiene, Cultural adaptability, Body language components: undesirable and desirable body language, Team-ship, Leadership, Stress and Conflict management*
UNIT 2	*Advanced Grammar: Common errors related to prepositions, articles, models , Conditionals, Determiners etc, Punctuation, Proof-reading and Editing of Documents*

UNIT 3	**Composition:**, Memo, Notice, Circular, Book Review, Research Article, Reports
UNIT 4	**Vocabulary Building:** Words often misspelt, One Word Substitution, Phrasal Verbs, Idioms
UNIT 5	**Reading Comprehension:** Reading different types of documents including Passages, Reports, Technical Essays, Speeches, Research Articles, Newspaper articles, Interviews etc-Skimming and Scanning-Inference and Deduction,

Syllabus: Lab DEN002B

DEN002D	*Professional Skills Lab*	*Credits*	*1-0-1 2*

UNIT 1	**Professional Grooming and Professional Culture:** Role plays and Activities on Dressing sense-personal hygiene, Cultural adaptability, Body language components: undesirable and desirable body language, Team-ship, Leadership, Stress and Conflict management
UNIT 2	**Advanced Grammar:** Exercise Sessions forCommon errors related to prepositions, articles, models , Conditionals, Determiners etc, Punctuation, Proof-reading and Editing of Documents
UNIT 3	**Composition:**, Memo, Notice, Circular, Book Review, Research Article, Reports – Giving Assignments based on practical applications, Practice sessions on different topics
UNIT 4	**Vocabulary Building:** Words often misspelt, One Word Substitution, Phrasal Verbs, Idioms- Activities related to the appropriate use of words
UNIT 5	**Reading Comprehension:** Practice Reading Unseen Paragraphs- Finding Suitable title, Summarizing, Analyzing, Finding new words etc

Course Articulation Matrix: (Mapping of COs with POs andPSOs)

Course Outcome	Program Outcome							Program Specific Outcome					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3					2	3	3	2	3	3
CO2	2	2	3					1	2	3	3	3	M
CO3	3	2	1				3		1	3	2	2	3

		3	3						2	M	3	3	3	3
CO4	2														
CO5	3	3	1						2	2	3	3	3	3

Suggested Readings:

1. *FelixaEskey. Tech Talk, University of Michigan. 2005*
2. *Michael Swan. Practical English Usage, Oxford University Press. 2005*
3. *Anderson, Paul. Technical Communication: A Reader Centered Approach, V Edition, Hercourt, 2003.*
4. *Thampi, G. Balamohan. Meeting the World: Writings on Contemporary Issues. Pearson, 2013.*
5. *Lynch, Tony. Study Listening. New Delhi: CUP, 2008.*
6. *Kenneth, Anderson, Tony Lynch, Joan Mac Lean. Study Speaking. New Delhi: CUP, 2008.*
7. *Marks, Jonathan. English Pronunciation in Use. New Delhi: CUP, 2007.*
8. *Syamala, V. Effective English Communication For You (Functional Grammar, Oral and Written Communication): Emerald, 2002.*

Non Credit Course

DCH004A	**Environmental Sciences**	2-0-0	0

The objectives of Environment science are to-

1.Creat an awareness about environmental problems among students
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate public through students to participate in environment protection and environment improvement.
5. Acquiring skills to help the concerned individuals in identifying and solving environmental problems.

UNIT 1	**The Multidisciplinary Nature of Environmental Studies:** The Multidisciplinary Nature of Environmental Studies Definition, scope and importance need for public awareness.
UNIT 2	**Natural Resources Renewable and Non-renewable Resources**: •Natural resources and associated problems. (a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, Case studies. (e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.
UNIT 3	**Ecosystems, Biodiversity and Its Conservation:** •Concept of an ecosystem. •Structure and function of an ecosystem. •Producers, consumers and decomposers. • Energy flow in the ecosystem. Ecological succession. •Food chains, food webs and ecological pyramids. •Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

	Biodiversity and Its Conservation •Introduction, definition: genetic, species and ecosystem diversity. •Biogeographical classification of India. • Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. •Biodiversity at global, National and local levels. •India as a mega-diversity nation. Hot-spots of biodiversity. •Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. •Endangered and endemic species of India. • Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.
UNIT 4	**Environmental Pollution:** •Definition ,Causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards • Solid waste management: Causes, effects and control measures of urban and industrial wastes. • Role of an individual in prevention of pollution. •Pollution case studies. •Disaster management: Foods, earthquake, cyclone and landslides.
UNIT 5	**Social Issues and the Environment, Human Population and the Environment, Field Work:** • From unsustainable to sustainable development. • Urban problems related to energy. •Water conservation, rain water harvesting, watershed management. • Resettlement and rehabilitation of people; its problems and concerns. Case studies. •Environmental ethics: Issues and possible solutions. •Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. •Wasteland reclamation. • Consumerism and waste products. • Environment Protection Act. • Air (Prevention and Control of Pollution) Act. • Water (Prevention and Control of Pollution) Act. • Wildlife Protection Act. •Forest Conservation Act. •Issues involved in enforcement of environmental legislation. •Public awareness. **Human Population and the Environment** •Population growth, variation among nations. •Population explosion—Family Welfare Programme. • Environment and human health.

	• Human rights.
	•Value education.
	HIV/AIDS.
	• Women and Child Welfare. •Role of Information Technology in environment and human health.
	Field Work
	• Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain.
	• Visit to a local polluted site—Urban/Rural/Industrial/Agricultural.
	• Study of common plants, insects, birds.
	•Study of simple ecosystems—pond, river, hill slopes, etc.
	(Field work equal to **5 lecture hours**) • Case Studies.

Course Outcome (CO)

After the completion of the course, student will be able to:

CO-1: Recognize the history, structure, function, interactions and trends of key socio-environmental systems on personal, organizational and intellectual level regarding our surroundings through different media.

CO-2: Examine the generation of scientific knowledge and how that knowledge is presented, evaluated, framed and applied for environmental protection by conservation of Natural resources.

CO-3: Articulate a coherent philosophy of the environment and consider ethical bases for responding to environmental questions.

CO-4: Understand the role of conservation of resources and public awareness in prevention of pollution and ultimately for the sustainable development of society.

CO-5: Understand the social responsibility towards protection of environment and society

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO-1	H	M	H	H	H	H	M
CO-2	M	H	H	M	M	H	M
CO-3	M	H	H	L	H	H	H
CO-4	M	M	H	M	H	H	H
CO-5	H	H	H	H	H	H	H

Contact Hours (L-T-P): 0-0-2

DMA002A	**Engineering Mathematics-II**	3:1:0 [4]

Objective: At the end of the course, the student should be able to:

- To provide a brief, hands-on overview of ordinary differential equations and Higher order linear differential equation with constant coefficients.
- To understand the second order linear differential equations with variable coefficients.
- To make utilization of Linear Partial differentialequations–someimportantequations Heat, wave and Laplace equation.
- To understand the Laplace transform, Inverse Laplace transform and their applications
- To familiarize and Analyzenumerical solution of a differential equation by Euler's, Modified Euler's, Predictor Corrector and Runge Kutta fourth order Methods.

UNIT1	Introduction, Elementary row and column transformations ,Linear dependence, Consistency of linear system of equations, Inverse of a matrix, Rank of a Matrix, System of linear equations (Homogenous and Non-homogeneous);Eigenvaluesandeigenvectors, Cayley's Hamilton theorem.
UNIT2	Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.
UNIT3	Ordinarydifferential equation (first order first degree), Homogenous differential Equation, Linear differential equation, Exact differential equation, Higher order linear differential equation with constant coefficients.
UNIT4	Linearequations withvariablecoefficients: Homogenous form, Exact form, Change of dependent variable, Normal form, Change of independent variable and method of variation of parameters.
UNIT 5	Series solutions of second order linear differential equations with variable coefficients (Complementary functions only). First order partial differential equations, solutions of first order linear and non-linear PDEs.

Text Books: 1. B.V.Ramana, Higher Engineering Mathematics, Tata McGraw Hill, 2011.**Reference Books:**
Recommended Books:1. Erwin Kreyszig , Advanced Engineering Mathematics, Wiley
9th Edition, 2008

2. Thomas and Finney, Calculus and Analytical Geometry, Narosa Publishing House. New Delhi, 2002.
3. M.Ray and Chaturvedi, A Text Book of Differential Equations, Students Friends & Co. Publisher, Agra, 1998.
4. Maurice D. Weir and Joel Hass, Thomas Calculus, Pearson, 11th Edition, 2005.

Outcomes:
At the end of this course, students will be able to:

CO1: Use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra. Understand the definitions of Vector Space and its linear Independence.Solve Eigen value problems and apply Cayley Hamilton Theorem.
CO2: Understanding convergence of sequence and series.
CO3: Identify, analyze and subsequently solve physical situations whose behavior can be described by First order and first degree ordinary differential equations and Higher order linear differential equation with constant coefficients.
CO4: Determine solutions to second order linear differential equations with variable coefficients.
CO5: Understanding the series solutions of second order linear differential equations with variable coefficients

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specifice Outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	H	M	L	L	M				L			L	M		
CO2	H	M	M	M	M				L			L	H		
CO3	H	M	M	M	M		M		L			L		H	M
CO4	H	H	M	M	M			L	L			L			M
CO5	H	H	M	M	M	L			L			L	H		

H = Highly Related; M = Medium   L=Low

B. Tech. (common to all disciplines)-II Semester
Contact Hours (L-T-P): 3-0-0

DEE003A	**Basic Electrical and Electronics Engineering**	**3-0-0**

Objective

- *To understand basic concepts required in understanding electrical and electronic circuits*
- *To understand the concept of Semiconductor Diode and their applications.*
- *The student will be able to understand fundamental circuit analysis techniques and basic electronics backgrounds, including PN Diode and Opto-Electronic Devices.*
- *To understand basic concepts of construction and working of single phase Transformer.*
- *To understand basic concepts of Electrical DC Circuit.*
- *The student will be able to understand the concept of Various Binary Number Systems and conversions.*
- *To understand Logic Gates and Logic Circuit focusing on basic and universal gates.*

UNIT 1	**Electrical-DC Circuit**– *Ohm's law, Kirchoff's Current Law(KCL) &Kirchoff's Voltage Law (KVL), Voltage & Current Sources, Star-Delta and Delta-Star transformations, Nodal & Mesh Analysis.*
UNIT 2	**Transformers -** *Principle of operation and construction of single phase transformers (core and shell types). EMF equation, losses, efficiency and voltage regulation*
UNIT 3	**Semiconductors-** *Comparison of Insulator, conductor and semiconductor with energy band diagrams. Semiconductor materials-Intrinsic and Extrinsic semiconductor (P-type and N-type SC), Crystal structures of p-type and N type materials, resistivity, conductivity, mobility.*
UNIT 4	**Electronics Devices**- *Diode, PN diode-construction, working and V-I plot, Diode as a Rectifier, Half Wave and Full Wave Rectifiers, Zener Diode – construction, Operation, characteristics; Opto-Electronic Devices – LEDs, Photo Diode.*
UNIT 5	**Digital Electronics**-*Number Systems: Binary system, Hexadecimal System, Octal system, Decimal system, Code conversions.* **Basic Logic Gates** *(AND, OR , NOT), Universal Gates(NAND and NOR) and other gates(EX-OR,EX-NOR), Truth Tables.*

Course Outcome (CO):

At the end of this course students will have:

CO1- To understand, analyze and solve DC electrical circuits
CO2- To understand basic concepts of construction and working of single phase Transformer.

CO3- Ability to understand the physical properties of different types of semiconductors used in fabricating devices.

CO4- Ability to understand the functioning of PN junction diode and explains its main application as rectifiers and opto-electronic devices.
CO5- Ability to understand the concept of Various Binary Number Systems and Codes, Logic Gates and Logic Circuit.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H											H	H	H	H
CO2	H	L				L		H					H	H	H	H
CO3	H	L	H	M	L								H	H	H	H
CO4	H			H	H				H				H	H	H	H
CO5	H	L				M	M						H	H	H	H

H = Highly Related; M = Medium L = Low
Text Books:
R. L. Boylestad& Louis Nashlesky (2007), Electronic Devices &Circuit Theory, Pearson Education
Reference Books
SantiramKal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India
David A. Bell (2008), Electronic Devices and Circuits, Oxford University Press
Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals, Pearson Education

R. S. Sedha (2010), A Text Book of Electronic Devices and Circuits, S.Chand&Co.R. T. Paynter (2009), Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education

DCO001B	Computer Programming in C++	**2: 0:0 2**

OBJECTIVE:
- To perform object oriented programming solution and develop solutions to problems demonstrating usage of control structure, modularity, classes, I/O and the scope of the class members
- To demonstrate adeptness of object oriented programming in developing solution to problems demonstrating usage of data abstraction, encapsulation and inheritance
- To demonstrate ability to implement one or more patterns involving dynamic binding and utilization of polymorphism in the solution of problems
- To learn syntax and features of exception handling
- To demonstrate the ability to implement solution to various I/O manipulation operations and the ability to create two-dimensional graphic components using applets

UNIT 1	C++ Overview, C++ Characteristics, Object-Oriented Terminology, Polymorphism, encapsulation ,inheritance, Abstract Data Types, I/O Services, , Functions and Variables. Declaration and Definition.
UNIT 2	Variables: Dynamic Creation and Derived DataClasses in C++, Defining Classes in C++, Classes and Encapsulation, Member Functions, Friend function ,Inline function
UNIT 3	Using Constructors, Using Destructors to Destroy Instances, Using Destructors to Destroy Instances, Operator Overloading: operator overloading of unary and binary operator, Function Overloading, Working with Overloaded Operator Methods
UNIT 4	Constant and Static Class Members, Inheritance, Overview of Inheritance, Defining Base and Derived Classes, Single, Multiple, multilevel, hybrid hierarchical inheritance, virtual function, virtual base class,
UNIT 5	Input and Output in C++ Programs, Standard Streams, Manipulators, Unformatted Input and Output. Working with files.

Course Outcome (CO):

At the end of this course, students will demonstrate ability to:

CO1: Understand object-oriented programming features in C++,

CO2: Apply these features to program design and implementation,

CO3: Develop applications using Object Oriented Programming Concepts.

CO4: Implement features of object oriented programming to solve real world problems.

CO5:Develop the ability to implement software in high-level programming language like C++

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specifice Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M												M		
CO2			H		H									H	L
CO3			H		M				M		M		H		
CO4				L								M		L	
CO5	H		H		M			L	M				H	M	

Text Books

1. Let Us C: BalaGuruswamy, TATA McGraw Hill.
2. **Programming with C, C++: Yashwant Kanetkar**

Reference Books

1. C++:The Complete Reference.
2. The C++ Programming Language:BjarneStroustrup

| DCH002A | Engineering Chemistry | 3-0-0 |

Objectives of Chemistry

1.The purpose of this course is to emphasize the relevance of fundamentals and applications of chemical sciences in the field of engineering.

2.The courses have been conceived in such a way that they take into account appropriate combinations of old and new emerging concepts in the chemical sciences area and their current and potential uses in engineering.

3.The Course attempt to address the principles of general chemistry and specific topics relevant to various engineering disciplines, wherein the students can apply this learning in their respective areas of expertise.

UNIT 1	**Water and Analysis :** Types of impurities in Water, Hardness of Water, Disadvantages of Hard Water, Temporary and Permanent hardness. Units and inter conversions of Units. Estimation of hardness by EDTA Methods.. Methods of Treatment of Water for Domestic Purposes - Sedimentation, Coagulation, Filtration, Disinfection, Sterilization, Chlorination, Break point chlorination, Ozonization. Water for Industrial purpose, Water for Steam Making-Boiler Troubles, Carry Over, Priming and Foaming, Boiler Corrosion, Scales and Sludges, Caustic Embrittlement. **Water Treatment:** Internal Treatment methods, Colloidal, Phosphate, Calgon, Carbonate, Sodium aluminate Conditioning of Water. External Treatment methods, Lime-Soda Process, Zeolite Process, Ion- Exchange Process, Numerical Problems on EDTA Methods and Lime-Soda process.
UNIT 2	**Fuels :**Classification of Fuels, Calorific value,Determination of calorific value of a solid and liquid fuel, Bomb & Boy's Gas Calorimeter, Carbonization, Beeheive Oven Method, Ottohaffman'sByproduct Method, Petroleum,Cracking- fluidized catalytic cracking. Reformation of petrol, Knocking, Octane number, Cetane number, Synthetic petrol, Bergius process and Fischer-Tropsch process. **Lubricants:** Principles and function of lubricants - Types of Lubrication and Mechanism -Thick Film or Hydrodynamic Lubrication, Thin Film or Boundary Lubrication, Extreme Pressure Lubrication. Classification and properties of lubricants-Viscosity, flash and fire point, cloud and pour point, aniline point and Neutralization Number, Precipitation No.
UNIT 3	**Electrochemistry and Corrosion** Electrochemical Cell, EMF of Cell, Electrode potential. Electrochemical Series. Chemical (Dry) and Electrochemical(Wet) corrosion. Types of corrosion; stress corrosion, stress cracking, water line corrosion, bimetallic corrosion etc. Factors

	affecting corrosion, Protection from corrosion, Protective coatings, cathodic protection, sacrificial Anodic protection and modification in designs.
UNIT 4	**Nano particles& New engineering materials:** Terminology- scales of nano-systems- nanoparticles: introduction-atoms to molecules-quantum dots-shrinking of bulk materials to quantum dots. Different types of nanoparticles. Various approaches in nanoparticle synthesis Characterisation of nanomaterials : Important methods for the characterisation of nanomaterials Applications of nanomaterials :Catalysis, Electronics & Telecommunication, Medicines, Composites, Energy sciences Molecular electronic devices, An Introduction to polymers for electronic industry, Organic conducting polymers
UNIT 5	**Principles and Concepts of Green Chemistry**: Sustainable development, atom economy, reducing toxicity. Waste: production, problems and prevention. Green Synthesis and Catalysis; Environmentally benign processes, Green oxidation and photochemical reactions, Microwave and Ultrasound assisted reactions. Water as a reaction medium. Green chemistry in material science, synthesis of porous polymers, green nanotechnology. Green energy sources, efficiency and sustainability, energy from biomass and solid waste, Biofuels, alcohol, hydrogen production technology, biofuels from Jatropa. Industrial case studies.

Suggested Books

1. Engineering Chemistry by J C Kuriacose and J. Rajaram, Tata McGraw-Hill Co, New Delhi (2004)

2. B.K. Sharma, "Engineering Chemistry", Krishna Prakasam Media (P) Ltd., Meerut, 2001.

3. A text book of Engineering Chemistry by Jain & Jain, Dhanpat Rai Publishing Company, New Delhi(15 Ediction) (2006).

4. An introduction to Electrochemistry by Samuel Glasstone,Affiliated east west press private Ltd.

5. C. N. R. Rao and A.Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry

6. Chemistry of Engineering Materials by C.P. Murthy, C.V. Agarwal and A. Naidu BS Publication Hyd. 2007.

7. Text book of Engineering Chemistry by Shashi Chawala, Dhanpat Rai Publishing Company,

15th edition New Delhi (2004).

8.Green Chemistry: An Introductory Text: Edition 3 Author: Mike Lancaster

Course outcome

CO-1 Students will be able to explain the impurities of water (mainly hardness) and boiler troubles and also different methods to remove hardness of water.

CO-2 Students will be able to analyze the basic knowledge of various types of Fuels, Lubricants their properties and Industrial Applications.

CO-3 Students will be able to understand relate electrochemistry and corrosion.

CO-4 Students will be able to understand about different types of nano materials and polymers

CO-5 Students will be able to understand the basic concept of Green chemistry and its emrging applications in Industries and for protection of environment.

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DCH003A	Chemistry Laboratory	0-0-2

List of Experiments

1.Determination of cell constant and conductance of solutions.

2.Calibration of pH meter and determination of pH of a solution

3. Identification of a drugs using thin layer chromatography (TLC) and Column chromatography

4. Estimation of total hardness of water-EDTA method

5.Estimation of dissolved oxygen by Winkler's method

6.Estimation of chloride in water

7. Estimation of fluoride content in water by SPANDANS method

8.Determination of the viscosity of a lubricating oil by using Redwood viscometer

9.Determination of the Flash & Fire point of a lubricating oil by using Pensky Martin's apparatus

10.Determination of the Cloud& pour point of a lubricating oil

11.Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution

12. Flame photometric estimation of Na^+ to find out the salinity in sand

13.Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin and their characterization

14.Adsorption of acetic acid on charcoal and Isotherm study

15. Preparation of Biodiesel from vegetable oil

Suggested Books
1. Text book of Engineering Chemistry Practicals by Shashi Chawala, Dhanpat Rai Publishing Company, 15th edition New Delhi (2004).
2. Vogel's text book for quantitative analysis
3. Vogel's text book for qualitative analysis

DCO018A	Advanced Excel	0-0-4(2 Credits)

Course Objectives:

1. To enable students to understand and apply essential features of Microsoft Excel.

2. To develop skills in data entry, formatting, charting, and formula usage.

3. To introduce students to advanced Excel functionalities like pivot tables, lookup functions, and data analysis tools.

4. To encourage the use of Excel for solving real-world problems and preparing reports.

5. To build confidence in creating automated tasks using Excel macros and dashboards.

Module-wise Lab Exercise

Module 1: Excel Basics & Formatting
1. Introduction to Excel Interface and Cell Referencing (Relative, Absolute, Mixed)
2. Data Entry and AutoFill Techniques
3. Formatting Cells: Font, Color, Borders, Cell Styles
4. Conditional Formatting Rules (Text, Numbers, Dates)
5. Use of Find, Replace, and Data Sorting

Module 2: Functions and Formulas
1. Basic Functions: SUM, AVERAGE, MIN, MAX, COUNT
2. Conditional Functions: IF, Nested IF
3. Logical Functions: AND, OR, NOT
4. Lookup Functions: VLOOKUP, HLOOKUP
5. Text Functions: LEFT, RIGHT, MID, LEN, CONCATENATE

Module 3: Data Analysis Tools
1. Date and Time Functions: TODAY, NOW, NETWORKDAYS
2. Data Validation: Drop-down lists and Input Restrictions
3. Sorting and Filtering Data (Custom Filters)
4. Charts: Column, Line, Pie, Bar, Combo Charts
5. Creating and Using Pivot Tables and Pivot Charts

Module 4: Advanced Excel Usage
1. Use of Named Ranges
2. What-If Analysis: Goal Seek and Data Tables
3. Scenario Manager and Solver Tool

4. Data Consolidation and Subtotals
5. Creating and Using Macros for Automation

Module 5: Capstone Excel Projects
1. Create a Dashboard with Linked Charts and KPIs
2. Prepare a Sales Report with Pivot Table Analysis
3. Design a Student Marksheet with Conditional Formatting and Summary Table
4. Final Project: Prepare and Present a Business Report Using Excel (Data + Visualization)

Course Outcomes:

CO-1: Student understands and applies basic Excel operations and formatting tools.

CO-2: Student developed proficiency in using formulas, functions, and logical expressions.

CO-3: Student has analyzed data using Pivot Tables, Charts, and What-If tools.

CO-4: Student has Automate tasks using Macros and design interactive dashboards.

CO-5: Students has applied Excel tools in real-world scenarios through hands-on projects.

CO\PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H				M										
CO2	H	M			M								M		
CO3	H	M	M		H								M	M	
CO4			H	M	H				M	M	M	M	M	M	M
CO5	M	M	M	M	M	L	L	L	M	M	M	M	M	M	M

DCO002B	Computer Programming in C++Lab	0:0:4(2 credit)

[1].C++ Program to Add Two Matrix Using Multi-dimensional Arrays.

[2]. Write a C++ program to demonstrate the use of scope resolution operator.

[3]. Write a program for understanding of C++ program structure without any CLASS declaration. Program may be based on simple input output, understanding of keyword using.

[4]. Write a Program to Understand Structure & Unions.

[5]. Write a program in C++ to define class Person having multiple data members for storing the different details of person e.g. name, age, address, height.

[6]. Write a C++ program to demonstrate concept of declaration of class with public & private member, constructors, object creation using constructors, access restrictions, defining member functions within and outside a class.accessing an object's data members and functions through different type of object .

[7]. Write a Program, involving multiple classes (without inheritance) to accomplish a task demonstrate composition of class.

[8]. Write a Program to Demonstrate Friend function and bridging gap of two classes using friend function.

[9]. Write a program to demonstrate use of friend class in c++.

[10]. Write a Program to Demonstrate Inline functions.

[11]. Write a Program to Demonstrate pointers to derived classes.

[12]. Write a Program to demonstrate dynamic memory management using new & delete & static class members.

[13].Write a Program to demonstrate an operator overloading, operator functions as member function and or friend function, overloading stream insertion and stream extraction, operators, overloading operators etc.

[14].   Write a Program to demonstrate use of protected members, public & private protected classes, multilevel inheritance etc.

[15]. Write a Program for multiple inheritance, virtual functions, virtual base classes, abstract classes.

[16]. Write a C++ program to demonstrate order of invocation of constructor and destructor in multiple inheritance.

[17]. Write a C++ program to show the order of constructor call in single inheritance.

[18].Write a Program to Demonstrate use different type of Constructors and Destructors in single inheritance.

[19].Write a C++ program that demonstrates the concept of function overriding.

[20].   Write a C++ program to swap data using function templates.

[21].   Write a program to demonstrate the use of pure virtual functions and abstract class.

[22].   Write a program to implement basic operation of ios class setf,unsetf,precision etc.

[23].   Write a program to demonstrate use of manipulators in c++.

[24].   Write a program to demonstrate unformatted input output operations .

BCO371A	**Software Craftsmanship**	3-0-0 [3]

OBJECTIVE:

- Define craftsmanship: Mastery of the paradigm.
- Identify the fundamental characteristics of good design.
- Explain the SOLID design principles.
- Discuss horizontal and vertical formatting.
- Describe the basic test-driven development.
- Define code smells: Symptoms of poorly designed code.
- Learn how to Keep your stuff organized.
- Know about common frameworks and code architectures.
- Understand about choosing a programming strategy.
- Defining your goals in becoming a craftsman
- Introduction to Software Craftsmanship

UNIT 1	Definition, History of the emergence of software craftsmanship, Software craftsmanship, Process versus paradigm, Software development processes, Software development models, Software design paradigms, Software development paradigms, Major programming paradigms Procedural programming paradigm, Object-oriented programming paradigm, Functional programming paradigm, Dimensions of craftsmanship, Craftsmanship - Mastery of the paradigm Describing and defining well-crafted code, Becoming a craftsman,The programming process
UNIT 2	Clean code and its fundamental concepts, Code Design, Software design considerations, Kent Beck's principle of simple design, Fundamental characteristics of good design, Design Patterns: Reusing best practices, SOLID design principles, Programming Principles
UNIT 3	Classes, packages and methods: building blocks of code, organizing code: the size of methods and classes, What makes methods and classes "good", Software metaphors, Objects and data structures, data transfer objects, Using libraries, Overview of the best practices in structure: Law of demeter and open close principle
UNIT 4	Introduction, Variants, Vertical Openness, Vertical Density, Distance and Ordering, Naming Best Practices, Intention-Revealing Names, Avoid Mental

	Mappings, Naming Classes, Methods and Functions, Comments, Writing Code Documentation
UNIT 5	Testing and Debugging, Basic Test-driven Development (TDD), Categories of TDD and Unit tests, Unit Testing Techniques, Automating Testing Using Junit, Refactoring: Improving Structure, Refactoring: Changing Code Structure without Changing Functionality, The need for Refactoring, The Refactoring Process and the Different Levels of Refactoring, Refactoring Strategies, Code Smells: Symptoms of Poorly Designed Code, Categories of Code Smells, Code Base, Using Frameworks & Tools.

Course OUTCOME (CO):

CO1: Explain the essentials of software craftsmanship.
CO2: Understand the clean code concepts and code design.
CO3: Understand the concept of classes and packages.
CO4: Understand the working with functions.
CO5: Explore Testing and refactoring concepts.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	M	L	L	L			L	L	L	L	M	H	M
CO2	L	L	M	L	L				L	L	L	L	M	H	M
CO3	L	M	L	L	L					L		L	M	H	M
CO4	L	M	L	L	L		L			L		L	M	H	M
CO5	L	L	L	L	L	M			L	L		L	M	H	M

H = Highly Related; M = Medium; L = Low

Text Books:

1. The Software Craftsman: Professionalism, Pragmatism, Pride, Sandro Mancuso, Pearson Education

Reference Books:

2. Fundamentals of Software Architecture:An Engineering Approach, Mark Richards, Neal Ford, O'Reilly
3. Clean Code: A Handbook of Agile Software Craftsmanship, Robert C. Martin, Prentice Hall

BCO372A	**Software Craftsmanship**	3-0-0 [3]

• Promote writing clean, maintainable, and testable code using principles of software craftsmanship.

• Apply SOLID principles and clean code techniques in coding exercises.
• Use Test-Driven Development (TDD) and unit testing frameworks for writing quality software.
• Refactor legacy code to improve readability and maintainability.
• Foster peer code reviews, pair programming, and continuous learning culture.

List of Experiments with CO Mapping

S. No.	Experiment Title	CO
	ite clean and maintainable code using meaningful variable names, modularity, and comments.	CO1

S. No.	Experiment Title	CO
	bly SOLID principles in small programs using object-oriented design patterns.	CO2
	blement a feature using Test-Driven Development (TDD) with a unit testing framework like JUnit or PyTest.	CO3
	actor an existing poorly structured program to improve code quality without changing its functionality.	CO4
	pair programming to develop a feature collaboratively with real-time feedback and coordination.	CO5
	ate reusable components or utility functions that follow clean code and DRY principles.	CO1

	form mock-based unit testing to isolate and verify specific components of code.	CO3
	ite a small CLI or GUI-based application that follows modular and scalable design practices.	CO2
	nduct a structured peer code review to give and receive feedback on code clarity and adherence to standards.	CO5
	cument a codebase using internal documentation and markdown for maintainability and onboarding.	CO4

Course Outcomes (COs)

Code	Description
1	ite clean, readable, and maintainable code using best practices.
2	ply SOLID principles and reusable design patterns.
3	ctice Test-Driven Development and create effective unit tests.
4	actor and document legacy or poorly written code.

Code	Description
5	Participate in pair programming and peer code reviews to improve code quality.

Text Books:

1. The Software Craftsman: Professionalism, Pragmatism, Pride, Sandro Mancuso, Pearson Education

Reference Books:

2. Fundamentals of Software Architecture:An Engineering Approach, Mark Richards, Neal Ford, O'Reilly
3. Clean Code: A Handbook of Agile Software Craftsmanship, Robert C. Martin, Prentice Hall

BCO373A	**DevOps Engineering**	3-0-0 [3]

OBJECTIVE:

- Enumerate the pitfall of traditional IT systems and its processes
- Describe the evolution of DevOps
- Explain the core concepts of DevOps
- Enumerate the core principles of DevOps
- Understand the benefits of embracing DevOps
- Identify the need for building a business case for DevOps

UNIT 1	Definition of DevOps: Challenges of traditional IT systems & processes,History and emergence of DevOps, DevOps definition and principles governing DevOps, DevOps and Agile,The need for building a business use case for DevOps, Purpose of DevOps, Application Deployment, Automated Application Deployment, Application Release Automation (ARA), Components of Application Release Automation (ARA), Continuous Integration, Best Practices of CI, Benefits of CI, Continuous Delivery, Proces
UNIT 2	DevOps: An Overview, Achieving DevOps, Continuous Practices, Continuous Integration (CI), How does CI Work?, Continuous Integration Practices, Benefits of Continuous Integration A Quick Recap of Continuous Delivery, Continuous Delivery Process, Benefits of Continuous Delivery, Continuous Deployment, Continuous
UNIT 3	History of Version Control Systems (VCS), Basic operations in a VCS, Examples of version control systems, Subversion (SVN), Features and Limitations, Mercurial, Git, Overview, History - Linux and Git by Linus Torvalds, Advantages of Git, Explain how local version control works, Centralized Version Control Systems (CVCS), Distributed Version Control Systems (DVCS), advantages of DVCS, Private Workspace
UNIT 4	Understanding Containers: Transporting Goods Analogy, Problems in Shipping Industry before Containers, Shipping Industry Challenges, Container: Virtualization Introduction, Hypervisor, Scope of Virtualisation, Containers vs Virtual Machines, Understanding Containers, Containerisation Platform, Runtime and Images, Container Platform, Container Runtime, The Chroot System, FreeBSD Jails, LinuX Containers (LXC), Docker
UNIT 5	Docker architecture, Docker Daemon (Container Platform), Docker Rest API , CLIDifferent environments: (Dev, QA and Prod), Overcoming issues with different environments, Development Environment Docker Swarm and Kubernetes, Architecture, AWS (ECS,EKS), AWS Elastic Container Services Architecture, Azure Kubernetes Services, Openshift, KUBERNETES ON CLOUD, Monitoring of container

Course OUTCOME (CO):

CO1: Explore the advent of software engineering.
CO2: Analyse the challenges in traditional IT System
CO3: Learn the purpose and benefits of DevOps.
CO4: Understand the CAMS methods.
CO5: Learn the concepts of Test-Driven Development

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M	M	H	L	L			L	L			L	L	L
CO2	L	M	M	H	L							L	L	L	L
CO3	L	M	M	M	L							L	L	L	L
CO4	L	M	M	M	L							L	L	L	L
CO5	L	M	M	M	L							L	L	L	L

H = Highly Related; M = Medium; L = Low

Text Books:

- The DevOps Handbook - Book by Gene Kim, Jez Humble, Patrick Debois, and Willis Willis

Reference Books:

1. What is DevOps? - by Mike Loukides
2. Git Essentials: Create, Merge, and Distribute Code with Git, Ferdinado Satacroce, Packt Publishing
3. Developing with Docker - by Jarosław Krochmalski.
4. Orchestrating, clustering, and managing containers - by Adrian Mouat.

DCO006A	**Engineering Workshop CSE**	**0-0-2(1)**

1. Introduction to PC Hardware
   a. RAM, ROM, Motherboard, SMPS, Processor
2. Hardware installation and assembly of PC
   a. Desktop
   b. Laptop
3. PC debugging, troubleshooting and Maintenance
4. Software installation and Configuration
   a. Installation of operating System (Windows, Linux/UNIX, Server)
   b. Basic utility and maintenance software
5. Working and functioning of different Buses, I/O Ports, graphic cards.
6. Installation of printer / modem /scanner and other input and output devices.
7. Configuring BIOS set up, Recovery, Preventive maintenance & Anti-Virus
8. Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool
9. Configuring and Practically implement Network Devices
   a. Repeater
   b. Hub
   c. Switch
   d. Bridge
   e. Router
   f. Gate Way
10. Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.
11. Connect the computers in Local Area Network.
12. Transfer files between systems in LAN using FTP Configuration, install Print server in a LAN and share the printer in a network
13. Installation of Ms Office 200x.

DEPARTMENT OF LAW ; JECRC UNIVERSITY

RECOMMENDED SYLLABUS FOR B TECH FIRST YEAR

DLW001A- CONSTITUIONAL LAW

Ser No	Recommended Subject	Number of Proposed Lecture
1.	Salient Features of the Indian Constitution	01
2.	Preamble of the Constitution	01
3.	Nature of the Constitution	01
4.	**Fundamental Rights**	
	(a) Articles 12 & 13	01
	(b) Articles 14 to 18	01
	(c) Articles 19	02
	(d) Articles 21	02
	(e) Articles 32 and Writs	01
5.	Directive Principles and Fundamental Duties	02

B.Tech CSE Semester III

BCO011B	COMPUTER NETWORKS	3-1-0 [4]

OBJECTIVES:
- To build an understanding of the fundamental concepts of computer networking.
- To familiarize the student with the basic taxonomy and terminology of the computer networking area.
- To introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
- To allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

UNIT 1	**Introduction:** Hardware and software, Data communication, Networking, Protocols and standards. Data transmission concepts. Analog and digital transmission. Transmission impairments. Layered Architecture of Computer Networks, OSI and TCP/IP architectures **Physical Layer -** Guided transmission media and wireless transmission,Data communication interface - asynchronous and synchronous transmission, Multiplexing
UNIT 2	**Link Layer** :Medium Access Control- CDMA, ALOHA, and Ethernet; Link Layer Addressing and Forwarding; The Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANs, Broadband Wireless, Bluetooth, Data Link Layer Switching, Switched networks. Circuit-switched networks, switching concepts, Control signaling. Packet switching principles, Flow control, Error detection and error control. HDLC and other data link protocols.
UNIT 3	**Network Layer:** Network layer design issues, Routing algorithms- Flooding, Shortest path routing, Distance-Vector, Path Vector routing, OSPF routing,, Intra-Domain Routing: Link- State, Hierarchical routing, Broadcast and multicast routings, Routing in the Internet, The network layer in the Internet: IP protocol, ARP and RARP, BOOTP, ICMP, DHCP, Network Address Translation(NAT), Internetworking
UNIT 4	**Transport Layer:** TCP introduction, Reliable/Un- Reliable Transport, TCP, UDP, Congestion Control, Wireless Networks: 802.11 MAC, Efficiency considerations
UNIT 5	**Application Layer**: DNS-The Domain Name System, Electronic Mail, HTTP, FTP, Simple network management protocol (SNMP), The World Wide Web

Course Outcome (CO) of **Computer Network**

At the end of this course studentswill have:

CO1: To provide an in-depth understanding of the terminology of network and concepts of OSI reference model and TCP/IP model.
CO2: To equip our students with technical concept of protocols, network interfaces, and   design/performance issues in networks.
CO3: To be familiar with contemporary issues in networking technologies.
CO4: To be familiar with network tools and to enhance analytical skills to develop innovative solutions.
CO5: To be familiar with message structure used in various type of network applications using the various protocols like SMTP,HTTP,FTP.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H			L									H		
CO2	M		H									L		L	
CO3		M							M				M		L
CO4					H										L
CO5	H	H		M						M	M	L	M	L	

H = Highly Related; M = Medium L = Low

Text Books:
1. Computer Networks, by Andrew S Tanenbaum, PHI. (2010)

Reference Books:
- Data Communications, Computer networking on OSI , by Fred Halsall, Addison Wesley Publishing Co.1998
- Computer Networking -A Top-Down Approach Featuring the Internet ,James F. Kurose and Keith W. Ross ,Addison Wesley Publishing Co. 2004
- Computer Networks: Protocols standards and interfaces , by Uyless Black, Prentice Hall.2002
- Data communication &Networks , by Behrou A. Forouzan, Tata McGraw Hill. 2002
- Data and Computer Communications, by Walliam Stallings, PHI. (2002)

BCO002B	**DATA STRUCTURES AND ALGORITHMS**	3-1-0 [4]

OBJECTIVE:

- To study various data structure concepts like Stacks, Queues, Linked List, Trees and Files
- To overview the applications of data structures.
- To be familiar with utilization of data structure techniques in problem solving.
- To have a comprehensive knowledge of data structures and algorithm.
- To carry out asymptotic analysis of algorithm.

UNIT 1	Introduction: Notions of data type, abstract data type and data structures. Importance of algorithms and data structures in programming. Notion of Complexity covering time complexity, space complexity, Worst case complexity & Average case complexity. BigOh Notation, Omega notation, Theta notation. Examples of simple algorithms and illustration of their complexity. Sorting- Bubble sort, selection sort, insertion sort, Quick sort; Heap sort; Merge sort; Analysis of the sorting methods. Selecting the top k elements. Lower bound on sorting.
UNIT 2	Stack ADT, Infix Notation, Prefix Notation and Postfix Notation. Evaluation of Postfix Expression, conversion of Infix to Prefix and Postfix Iteration and Recursion- Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers. Tradeoffs between iteration and recursion.
UNIT 3	List ADT. Implementation of lists using arrays and pointers. Stack ADT. Queue ADT. Implementation of stacks and queues. Dictionaries, Hash tables: open tables and closed tables. Searching technique- Binary search and linear search, link list- single link list, double link list, Insertion and deletion in link list.
UNIT 4	Binary Trees- Definition and traversals: preorder, post order, in order. Common types and properties of binary trees. Binary search trees: insertion and deletion in binary search tree worst case analysis and average case analysis. AVL trees. Priority Queues -Binary heaps: insert and delete min operations and analysis.
UNIT 5	Graph: Basic definitions, Directed Graphs- Data structures for graph representation. Shortest path algorithms: Dijkstra (greedy algorithm) and Operations on graph, Worshall'salgorithm , Depth first search and Breadth-first search. Directed acyclic graphs. Undirected Graphs, Minimal spanning trees and algorithms (Prims and Kruskal) and implementation. Application to the travelling salesman problem.

Course OUTCOME (CO):

CO1: Show the understanding of various data structure concepts like Stacks, Queues, Linked List, Trees and Files

CO2: Understand the applications of data structures.

CO3: Understand with utilization of data structure techniques in problem solving.

CO4: Use comprehensive knowledge of data structures and algorithm.

CO5: Use asymptotic analysis of algorithm.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H												M		
CO2			H		M								M		
CO3		H							M			L		H	
CO4	H	M											L		L
CO5		M		H											L

H = Highly Related; M = Medium; L = Low

Text Books:

1. Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft , Addison-Wesley Series (1983)

Reference Books:

1. T.H. Cormen, C.E. Leiserson, and R.L. Rivest. Introduction to Algorithms.The MIT Press and
2. McGraw-Hill Book Company, Cambridge, Massacusetts, 1990 (Available in Indian Edition).
3. Steven S. Skiena. The Algorithm Design Manual.Springer, Second Edition, 2008.
4. Data Structures and Algorithm Analysis in Java (3rd Edition) by Mark Allen Weiss, Addison Wesley(2011).

BAS007B	DISCRETE MATHEMATICS	3-0-0 [3]

Objective:
- To introduce a number of Discrete Mathematical Structures (DMS) found to be serving as tools even today in the development of theoretical computer science.
- To solve problems occurred in the development of programming languages.
- Tofamiliarize students with concepts and techniques of graph theory, and sets apart from languages of logic and proof methods.

UNIT 1	**Sets:** Definition and types, Set operations, Partition of set, Cardinality (Inclusion-Exclusion & Addition Principles), Recursive definition of set. Functions: Concept, Some Special Functions (Polynomial, Exponential & Logarithmic, Absolute Value, Floor & Ceiling, Mod &Div Functions), Properties of Functions, Cardinality of Infinite Set, Countable & Uncountable Sets,
UNIT 2	**Graph Theory**: Graphs – Directed, Undirected, Simple,. Adjacency & Incidence, Degree of Vertex, Subgraph, Complete graph, Cycle & Wheel Graph, Bipartite & Complete Bipartite Graph, Weighed Graph, Union of Simple Graphs. Complete Graphs. Isomorphic Graphs, Path, Cycles & Circuits Euclerian& Hamiltonian Graphs. Planar Graph: Kuratowski's Two Graphs, Euler's Formula, Kuratowski's Theorem. Trees: Spanning trees- Kruskal'sAlgo, Finding Spanning Tree using Depth First Search, Breadth First Search, Complexity of Graph, Minimal Spanning Tree.
UNIT 3	**Semigroups, Groups and Coding**: Binary Operations, Semigroups, Products and Quotients of Semigroups, Groups, Product and Quotients of Groups, Coding of Binary Information and Error Correction, Decoding and Error Correction. **Language of Logic**: Proposition, Compound Proposition, Conjunction, Disjunction, Implication, Converse, Inverse &Contrapositive, Biconditional Statements, tautology, Contradiction & Contingency, Logical Equivalences, Quantifiers, Arguments.
UNIT 4	**Proof Methods**: Vacuous, Trivial, Direct, Indirect by Contrapositive and Contradiction, Constructive & Non-constructive proof, Counterexample. The Division Algorithm, Divisibility Properties (Prime Numbers & Composite Numbers), Principle of Mathematical Induction, The Second Principle of Mathematical Induction, Fundamental Theorem of Arithmetic. Algorithm Correctness: Partial Correctness, Loop Invariant. Testing the partial correctness of linear & binary search, bubble & selection sorting.
UNIT 5	Relations: Boolean Matrices, Binary Relation, Adjacency Matrix of Relation, Properties of Relations, Operations on Relations, The Connectivity Relations, Transitive Closure-Warshall's Algorithm, Equivalence relations- Congruence Relations, Equivalence Class, Number of Partitions of a Finite Set, Partial & Total Orderings.

Course Outcome (CO):

At the end of this course, students will demonstrate ability to:

CO1: Demonstrate complete knowledge on various discrete structures available in literature.
 CO2: Realization of some satisfaction of having learnt that discrete structures are indeed useful in computer science and engineering.
CO3: Gaining of some confidence on how to deal with problems which may arrive in computer science and engineering in near *future.*
*CO4:*Construct mathematical arguments using logical connectives and quantifiers and verify the correctness of an argument using propositional and predicate logic and truth tables.
CO5:Able to model and solve real world problems using graphs and trees.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		H		M						L				
CO2		H		H								M	M		
CO3								H	M	L				H	
CO4								H	M	L				H	
CO5								H	M	L				H	

- H = Highly Related; M = Medium L = Low

Text Books

1. B.Kolman et.al- Discrete mathematical Structures, 5th Edn, Pearson Education, New Delhi - 2004.

Reference Books

1. K.H. Rosen – Discrete Mathematics and Its Applications – 4th Edn, Tata McGraw Hill, New Delhi – 2001
2. J.P. Tremblay et.al – Discrete Mathematical Structures with Applications to Computer Science, TMH, New Delhi – 2004.

3. Mott. J.L., Kandel A. and Baker, T.P. "Discrete mathematics", for computer scientists and Mathematicians", Second Edition, Prentice Hall 1986.

4. Tremblay J.P. and Manohar, R. "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill, 1975.

BCO001B	**SOFTWARE ENGINEERING**	3-0-0 [3]

Objective
- To learn about generic models of software development process.
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the different design techniques and their implementation.
- To learn various testing and maintenance measures

UNIT 1	Introduction- Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Engineering aspects of Software production – necessity of automation .Job responsibilities of Programmers and Software Engineers as Software developers.Software Development Life Cycle (SDLC)
UNIT 2	Process Models and Program Design Techniques- Software Development Process Models – Code & Fix model, Waterfall model, Incremental model, Rapid Prototyping model, Spiral (Evolutionary) model.Software Requirement Specifications (SRS), Management of User Needs, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, Design Techniques – Structured Programming, Coupling and Cohesion, Abstraction and Information Hiding, SoftwareModeling Tools –Data flow Diagrams, UML and XML.
UNIT 3	Software Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Verification and Validation: Testing of Software Products – Black-Box Testing and White-Box Testing, Static Analysis, Symbolic Execution and Control Flow Graphs –Cyclomatic Complexity.
UNIT 4	Software Project Management: Management Functions and Processes, Project Planning and Control, Organization and Intra-team Communication, Risk Management. Software Cost Estimation – underlying factors of critical concern. Metrics for estimating costs of software products – Function Points. Techniques for software cost estimation –Expert judgment, Work break-down structure and Process breakdown structure, COCOMO and COCOMO-II.
UNIT 5	Software Maintenance,Need for Maintenance, Categories of Maintenance, An Overview of CASE Tools.

Course Outcome (CO):

At the end of this course students will have:

CO1: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
CO2: An ability to identify, formulates, and solve engineering problems.
CO3: An understanding of professional and ethical responsibility.
CO4: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specifice Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		H		M						L				
CO2		H		H								M	M		
CO3								H	M	L				H	
CO4	L		L			L	M								L

H = Highly Related; M = Medium L = Low

Text Books:
1. Fundamentals of Software Engineering – Carlo Ghezziet. Et.al.
2. Software Engineering – Design, Reliability Management – Pressman.

Reference Books:

1. Software Engineering – Ian Sommerville.
2. Software Engineering - Shoeman.
3. Software Engineering with Abstraction – Berzins and Luqi
4. Pankaj Jalote, Software Engineering, Wiley

BCO008B	OPERATING SYSTEMS	3-0-0 [3]

OJECTIVE:

- To understand the structure and functions of OS
- To learn about Processes, Threads and Scheduling algorithms
- To understand the principles of concurrency and Deadlocks
- To learn various memory management schemes
- To study I/O management and File systems

UNIT 1	Introduction : Operating system and functions, Classification of Operating systems-Batch, Interactive, Time sharing, Real Time System, Multiprocessor Systems, Multiuser Systems, Multiprocess Systems, Multithreaded Systems, Operating System Structure- Layered structure, System Components, Operating System services, Monolithic and Microkernel Systems.
UNIT 2	Process Management-Process & Threads – Process States - Process Control Block – Process Scheduling – Operations on Processes, Threads, CPU Scheduler – Preemptive and Non- Preemptive; Dispatcher, Scheduling Criteria, Scheduling Algorithms – Process Management in UNIX
UNIT 3	Process Synchronization & Inter process Communication-Concurrent Processes, Co-operating Processes, Precedence Graph, Hierarchy of Processes, Critical Section Problem – Two process solution, Synchronization Hardware, Semaphores – Deadlock- detection, handling, prevention, avoidance, recovery, Starvation, Critical Regions, Monitors, Inter process communication
UNIT 4	Memory Management-Objectives and functions, Simple Resident Monitor Program (No design), Overlays – Swapping; Schemes – Paging – Simple, Multi-level Paging; Internal and External Fragmentation; Virtual Memory Concept, Demand Paging – Page Interrupt Fault, Page Replacement Algorithms; Segmentation – Simple, Multi-level, Segmentation with Paging, Memory Management in UNIX.
UNIT 5	I/O Management and Disk Scheduling: I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling. File System: File concept, File organization and access mechanism, File directories, and File sharing, File system implementation issues, File system protection and security.

Course Outcome (CO):

At the ends of this course studentswill have:

CO1: Classify Unix Kernel mode with user mode & contrast between Kernel structures.
CO2: Identify and estimate process management & thread management strategies along with their different operations
CO3: Implement different system calls for various file handling operations.
CO4: Determine paging and Caching techniques related to Virtual Memory.
CO5: Ability to understand and analyze various disk scheduling and file system techniques

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H			M				L			L		H		L
CO2		M	L						M					M	
CO3			M		M									M	M
CO4	M		L									L			
CO5	M	M		H					L				M	M	

H = Highly Related; M = Medium L = Low

Text Books:
1. Operating Systems Concepts – Silberschatz, Galvin, Wiley Publications (2008)
2. Modern Operating Systems - Andrew S. Tanenbaum, Pearson Education Asia / PHI(2005)
Reference Books:
1. Operating Systems – William Stallings, Pearson Education Asia (2002)
2. UNIX System Programming Using C++, by Terrence Chan: Prentice Hall India, 1999.
Advanced Programming in UNIX Environment, by W. Richard Stevens: 2nd Ed, Pearson Education, 2005

BCO374A	**THINK PYTHON**	3-1-0 [4]

OBJECTIVE:

- Explain how to get the Python environment up and running and the basics of Python programming language.
- Describe how to program using Python, by learning concepts like variables, flow controls, data types, type conversion, objects, and classes; functions and how they are considered as objects; basics of iterators and generators; Python as a functional programming language and the concepts that help understand the functional programming aspect.
- Discuss the methods involved in data preprocessing and how outliers can be detected and treated.
- Define the basic concepts of exploratory data analysis and statistical modeling.

UNIT 1	Compiler vs. Interpreter, statically vs. Dynamically Typed Languages, Introduction to Python, Installing Python, Anaconda, Jupyter Notebook, Spyder, Components and Versions of Python, Difference between Python 2 and Python 3, Python Distributions
UNIT 2	Python REPL, Variables, control structures, functions and objects, First-class functions, immutable data, strict and non-strict evaluation, Recursion instead of an explicit loop state, Functions, iterators, and generators, writing pure functions, functions as first-class objects, Using strings, tuples and named tuples,
UNIT 3	Using lists, dicts, and sets, The itertools module, Best practices and clean coding, Reading data files into Python, writing files,, Introduction to Python libraries
UNIT 4	Introduction to Pandas and Basic Concepts of Pandas, Data Cleaning and Preparation, Handling Missing Data, filtering out Missing Data, Filling in Missing Data, Data Transformation, Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Renaming Axis Indexes, Discretization and Binning, Detecting and Filtering Outliers, Permutation and Random Sampling, String Manipulation, Feature Engineering
UNIT 5	Derived Variables, Basic Exploratory Data Analysis, Methods for EDA and Examples, Statistical Modeling, Curve Fitting: Linear Regression, Nonlinear Regression

Course OUTCOME (CO):

CO1: Understand working with the IDEs and installation of important libraries.
CO2: Understand Python flow, structure, and functions.
CO3: Explore working with Python Lists
CO4: Explore the key concepts of pandas and data transformation.
CO5: Understand the working of derived variables.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	M	L	L		L			L	L			M	H	L
CO2	M	H	H	H	L							L	M	H	M
CO3	M	H	H	H				L				L	M	H	M
CO4	M	H	H	H			L				L	L	M	H	M
CO5	M	M	M	M					L			L	M	H	M

H = Highly Related; M = Medium; L = Low

Text Books:

1. Head-First Python, 2nd edition: Paul Barry (O'Reilly, 2016)

Reference Books:

a. Dive into Python, Mike
b. Introduction to Machine Learning with Python by Andreas C. Müller, Sarah Guido

| BCO375A | **THINK PYTHON Lab** | **3-1-0 [4]** |

Lab Objectives

Develop Python programs using variables, control flow, and functions.

- Manipulate data using strings, lists, tuples, dictionaries, and sets.
- Apply object-oriented programming principles using Python classes.
- Work with file I/O and error handling in Python programs.
- Use libraries like NumPy or Pandas for basic data operations.
- Perform sorting, searching, and recursive operations in Python.
- Utilize modularity, packages, and external libraries for scalable code.

List of Experiments

S. No.	Experiment Title	CO
	ite a Python program that accepts user input and applies conditional logic to make decisions.	O1
	loops to display numeric and character patterns and calculate series like factorial and Fibonacci.	O1
	lement functions and use recursion to solve mathematical operations like factorial, GCD, or power.	O2
	nipulate data using lists and tuples for operations like sorting, slicing, and element swapping.	O2
	dictionaries and sets for storing key-value pairs and performing set-based operations.	O2
	ate reusable modules and import them in different Python programs using package concepts.	O5
	rk with file handling: write to, read from, and append to files; implement error handling using exceptions.	O3
	ite classes and implement constructors, methods, and inheritance in Python.	O4
	monstrate encapsulation and abstraction using access modifiers in a Python class.	O4
	form simple data visualization using matplotlib or seaborn to plot line and bar charts.	O5

	NumPy arrays for matrix operations and Pandas for tabular data manipulation.	O5
	lement searching algorithms like linear and binary search in Python.	O2
	form sorting techniques such as bubble sort, selection sort, and insertion sort using Python.	O2
	Python for basic automation—e.g., reading from Excel, sending emails, or renaming files in bulk.	O5

Course Outcomes (COs)

CO Code	Description
1	ite Python programs using variables, loops, and conditions.
2	Python data structures and functions for modularity.
3	form file I/O operations and handle exceptions.
4	lement object-oriented concepts using Python classes.
5	ly Python libraries like NumPy, Pandas, and Matplotlib for data manipulation and visualization.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	L	L		L			L	L			M	H
CO2	M	H	H	H	L							L	M	H
CO3	M	H	H	H				L				L	M	H
CO4	M	H	H	H			L				L	L	M	H
CO5	M	M	M	M					L			L	M	H

H = Highly Related; M = Medium; L = Low

Text Books:

    2.   Head-First Python, 2nd edition: Paul Barry (O'Reilly, 2016)

Reference Books:

    c. Dive into Python, Mike
    d. Introduction to Machine Learning with Python by Andreas C. Müller, Sarah Guido

BCO376A	**UI Specialist**	3-0-0 [3]

OBJECTIVE:

o   Introduction to HTML5, CSS3
o   Introduction to modern JavaScript

UNIT 1	Intoduction, Need of HTMl, HTML Tags, HTML Elements, Formatting Text in HTML, Headings,HTML Paragraphs,Identifying HTML Elements, HTML Basics & Attributes,HTML Links, Lists, Colors, Tables, Symbols, Attributes, Overview of Attributes, Core Attributes, Styles, Class Attribute, Generic Attributes
UNIT 2	HTML5 introduced features, HTML5 form validate/no validate, HTML5 canvas, embedding audio, and video in a webpage, drag and drop,HTML5 Local Storage, HTML5 web workers and server sent events, HTML Attributes, Forms, Form Validation, Validation to HTML Page , CSS Semantics, CSS Selectors CSS Styling, CSS Color, CSS Backgrounds, Borders, Margins, Padding, Box Model, Heightwidth, Tables, Selectors, Display,CSS Buttons, CSS Animation, CSS Display, CSS Float & Clear, CSS Overflow, CSS Align- Horizontal & Center Responsive Web Design, View Port, Grid View, Media Queries, Flex Box
UNIT 3	Javascipt, importance, What can JavaScript Do, Need of Javascript, Javascript with HTML Content, HTML Attributes, HTML DOM Elements Java script with CSS, HTML Nodes, Syntax, Rules, Writing Javascript, Tags, Programming Errors, Syntax Error, Runtime Error, Logical Errors, Data Types, Non-primitive, Javascript Data Types, Objects in Javascript, Events in Javascript Objects, Changing HTML Styles, Events, Event Handler Attributes, Adding Event Handlers, Using Element Attribute directly, Using Event Attribute, Using HTML DOM, Reacting to Events
UNIT 4	Introduction, Execution of Functions, Invoking Functions, As methods, As constructor, call(), arguments, apply(), bind(), Nesting Functions & Closure, Objects, Primitive Values, Strings & Objects, Creating JS Object, Literal Syntax, New Keyword,Adding Methods to Objects
UNIT 5	Creating arrays, elements in array access, changing array elements, objectsVs Arrays, recognitizing Arrays, Looping Array, Array Methods, Adding Array Elements using Array Methods, Removing Last Array Elements, Converting Array into Strings, Converting and Joining Array into Strings with special

	separator, Array Methods & Manipulations, Sorting Array Methods , Iteraion Methods, The Map()

Course OUTCOME (CO):

CO1: Explain the essentials of HTML.
CO2: Understand the CSS Styling and selectors
CO3: Understand the JavaScript need and implementation.
CO4: Understand the JavaScript Functions, Objects and Events
CO5: Explore JavaScript Arrays

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	L	M	L	L	L			L	L	L	L	M	H
CO2	L	L	M	L	L				L	L	L	L	M	H
CO3	L	M	L	L	L					L		L	M	H
CO4	L	M	L	L	L		L			L		L	M	H
CO5	L	L	L	L	L	M			L	L		L	M	H

H = Highly Related; M = Medium; L = Low

Text Books:

1) Head First HTML and CSS: A Learner's Guide to Creating Standards-Based Web Pages, Second Edition (Greyscale Indian Edition), Elisabeth Robson, O'Reilly
2) JavaScript from Beginner to Professional: Learn JavaScript quickly by building fun, interactive, and dynamic web apps, games, and pages, Laurence Lars Svekis, Rob Percival, Maaike van Putten, Packt

Reference Books:

1) HTML & CSS: The Complete Reference, Fifth Edition, Thomas Hill, McGraw-Hill
2) Responsive Web Design with HTML5 and CSS - Fourth Edition: Build future-proof responsive websites using the latest HTML5 and CSS techniques, Ben Frain, Packt
3) Head First JavaScript Programming: A Brain-Friendly Guide, Elisabeth Robson and Eric Freeman, O'Reilly
4) JavaScript Cookbook: Programming the Web, Third Edition, Adam D Scott, Matthew MacDonald and Shelley Powers, O'Reilly

BCO377A	UI Specialist Lab	3-0-0 [3]

1. Lab Objectives

- Design static and dynamic web interfaces using HTML4, HTML5, CSS2, and CSS3 standards.
- Apply layout techniques such as float, flex, and grid for responsive and structured design.
- Create functional applications using JavaScript for interactivity and data management.
- Demonstrate CRUD operations using DOM manipulation and local storage.
- Deploy projects on GitHub to simulate real-world delivery and hosting practices.

2. List of Experiments

S.No	Title	Mapped CO
1	**Create one web page to display college time table using HTML only.**	CO1
2	**Create UI of online shopping using HTML 4 and CSS 2.** **a. You don't have to use features of CSS 3.** **b. Web page must contain fixed position headers** **c. Navigation and Search bar should be included** **d. Display products in row and column format using float.**	CO1
3	**Create UI of social networking site using HTML 5 and CSS 3.** **a. Use of flex and grid must be there.** **b. Use HTML 5 Semantics** **c. Use libraries for displaying fonts**	CO2
4	**Create music player application using HTML 5 audio tag. UI could be replica of any popular music website.**	CO2
5	**Create video player application using HTML 5 video tag. Build replica of any popular video player website.**	CO2
6	**Build advance calculator like we have in windows or in mobile phone. Use HTML and CSS for UI. Use JavaScript to make calculator working properly.**	CO3
7	**Build a Tic Tac Toe game using JavaScript only. Use dynamic way of creating UI of game.**	CO3

| 8 | **Build a task manager application to perform CRUD operations.**

a. **User can create task list**
b. **User can delete task (one or multiple)**
c. **User can update task**
d. **User can save task in local storage** | CO4 |

VA1	**Integrate CRUD operations in any of the above application to make them dynamic and live on Git Hub.**	CO4
VA2	**Build one web resume and display all projects and web pages on that.** a. **Use HTML 5 and CSS 3 for UI** b. **Use JavaScript to make web resume interactive.** c. **Live on GitHub**	CO5

Course OUTCOME (CO):

CO1: Explain the essentials of HTML.

CO2: Understand the CSS Styling and selectors

CO3: Understand the JavaScript need and implementation.

CO4: Understand the JavaScript Functions, Objects and Events

CO5: Explore JavaScript Arrays

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	M	L	L	L			L	L	L	L	M	H	M
CO2	L	L	M	L	L				L	L	L	L	M	H	M
CO3	L	M	L	L	L					L		L	M	H	M
CO4	L	M	L	L	L		L			L		L	M	H	M
CO5	L	L	L	L	L	M			L	L		L	M	H	M

H = Highly Related; M = Medium; L = Low

Text Books:

3) Head First HTML and CSS: A Learner's Guide to Creating Standards-Based Web Pages, Second Edition (Greyscale Indian Edition), Elisabeth Robson, O'Reilly

4) JavaScript from Beginner to Professional: Learn JavaScript quickly by building fun, interactive, and dynamic web apps, games, and pages, Laurence Lars Svekis, Rob Percival, Maaike van Putten, Packt

Reference Books:

5) HTML & CSS: The Complete Reference, Fifth Edition, Thomas Hill, McGraw-Hill
6) Responsive Web Design with HTML5 and CSS - Fourth Edition: Build future-proof responsive websites using the latest HTML5 and CSS techniques, Ben Frain, Packt
7) Head First JavaScript Programming: A Brain-Friendly Guide, Elisabeth Robson and Eric Freeman, O'Reilly
8) JavaScript Cookbook: Programming the Web, Third Edition, Adam D Scott, Matthew MacDonald and Shelley Powers, O'Reilly

BCO 005B	Data Structure and Algorithms Lab	0-0-2

Advance <u>ist of Experiments</u>

1.Write a program to implement following searching algorithms using array data structure
    1.1 Matrix Addition and Subtraction
    1.2 Matrix Multiplication and Transpose
2.Write a program to implement following searching algorithms using array data structure
    2.1. Linear Search
    2.2. Binary Search
3. Write a program to implement following searching algorithms using array data structure
    3.1. Insertion Sort
    3.2 Bubble Sort
4. Write a program to implement following searching algorithms using array data structure
    4.1. Selection Sort
    4.2 Quick Sort
5. Write a program to implement following operations on stack using array data structure.
    5.1 Traversing
    5.2 Push
    5.3 POP
6. Write a program to implement following examples of recursion
    6.1 Fibonacci Series
    6.2 Factorial Function
    6.3 Tower of Hanoi
7. Write a program to implement Merge Sort.
8. Write a program to implement following operations on Queue using array data structure.
    8.1 Insertion8.2 Deletion8.3 Traversing
9. Write a program to implement Postfix evaluation.

10. Write a program to implement Infix to Postfix Notation.

11. Write a program to implement following operations on Link List data structure.
    11.1 Insertion at beginning
    11.2 Insertion at last
    11.3 Insertion at any location

12. Write a program to implement following operations on Link List data structure.
    12.1 Deletion at beginning
    12.2 Deletion at last
    12.3 Deletion at any location

13. Write a program to implement Doubly Link List
    13.1 Insertion13.2 Traversing
14. Write a program to implement Breadth First Search Algorithm.

15. Write a program to implement Depth First Search Algorithm.

Course Outcomes:

CO1: Show the understanding of various data structure concepts like Stacks, Queues, Linked List, Trees and Files
CO2: Understand the applications of data structures.
CO3: Understand with utilization of data structure techniques in problem solving.
CO4: Use comprehensive knowledge of data structures and algorithm.
CO5: Use asymptotic analysis of algorithm.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO
CO1	H												M		
CO2			H		M								M		
CO3		H							M			L		H	
CO4	H	M											L		L
CO5		M		H											L

H = Highly Related; M = Medium; L = Low

BCO 014B	OPERATING SYSTEMS LAB	0-0-2 [2]

List of Experiments

Experiment No	Aim
1	Write a C program to implement the various process scheduling mechanisms such as FCFS scheduling.
2	Write a C program to implement the various process scheduling mechanisms such as SJF Scheduling.
3	Write a C program to implement the various process scheduling mechanisms such as Round Robin Scheduling.
4	Write a C program to implement the various process scheduling mechanisms such as Priority Scheduling.
5	To implement deadlock avoidance & Prevention by using Banker's Algorithm.
6	To implement page replacement algorithms FIFO (First In First Out).
7	To implement page replacement algorithm LRU (Least Recently Used).
8	To implement page replacement algorithms Optimal (The page which is not used for longest time)
9	To implement the memory management policy- Paging.
10	To implement the memory management policy-segmentation.
11	Write a C Program to implement Sequential File Allocation method.
12	Write a C Program to implement Indexed File Allocation method.
13	Write a C Program to implement Linked File Allocation method.
14	Write a program to implement multi program variable task (MVT).
15	Write a program to implement multi program fixed task (MFT).

Course Outcome (CO):
At the ends of this course studentswill have:
CO1: Classify Unix Kernel mode with user mode & contrast between Kernel structures.
CO2: Identify and estimate process management & thread management strategies along with their different operations
CO3:Implement different system calls for various file handling operations.
CO4: Determine paging and Caching techniques related to Virtual Memory.
CO5: construct shell scripts.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS
CO1	H			M				L			L		H		L
CO2		M	L						M					M	
CO3			M		M									M	M
CO4	M		L									L			
CO5	M	M	L	M								L	H		

H = Highly Related; M = Medium L = Low

BCO594A	**Computer Networks Lab**	**Total Credits: 1**

List of Experiments

Students are required to perform any ten experiments out of the following list of experiments.

1	Using, linux-terminal or Windows-cmd, execute following networking commands and note the output: ping, traceroute, netstat, arp, ipconfig, Getmac, hostname, NSLookUp, pathping, SystemInfo
2	Using Packet Tracer, create a basic network of two computers using appropriate network wire. Use Static IP address allocation and show connectivity
3	Using Packet Tracer, create a basic network of One server and two computers using appropriate network wire. Use Dynamic IP address allocation and show connectivity
4	Using Packet Tracer, create a basic network of One server and two computers and two mobile / movable devices using appropriate network wire. Show connectivity
5	Using Packet Tracer, create a network with three routers with RIPv1 and each router associated network will have a minimum of three PCs. Show Connectivity
6	Using Packet Tracer, create a network with three routers with RIPv2 and each router associated network will have a minimum of three PCs. Show Connectivity
7	Using Packet Tracer, create a network with three routers with OSPF and each router associated network will have a minimum of three PCs. Show Connectivity
8	Using Packet Tracer, create a network with three routers with BGP and each router associated network will have a minimum of three PCs. Show Connectivity
9	Using Packet Tracer, create a wireless network of multiple PCs using appropriate access points.
10	Using Wireshark, network analyzer, set the filter for ICMP, TCP, HTTP, UDP, FTP and perform respective protocol transactions to show/prove that the network analyzer is working

Course Outcomes-

While graduating, students would be able to:

CO1. Execute and interpret basic network diagnostic and configuration commands using command-line interfaces (CLI).

CO2. Design and simulate a small-scale wired network using Packet Tracer with static IP addressing.

CO3. Design and simulate a client-server network using Dynamic Host Configuration Protocol (DHCP).

CO4. Implement and simulate hybrid networks including mobile or wireless devices.

CO5. Configure and simulate routing protocols (RIPv1, RIPv2, OSPF, BGP) in multi-router environments.

CO6. Design and simulate a wireless network with multiple PCs using access points.

CO7. Capture and analyze network traffic using Wireshark with protocol-level filtering and verification.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	-	M	M							M	H	M	
CO2	H	M	H	M	H							M	H	M	
CO3	H	M	H	M	H							M	H	M	
CO4	H	M	H	M	H							M	H	H	
CO5	H	H	H	H	H							M	H	H	
CO6	H	M	H	M	H							M	H	H	
CO7	H	H	-	H	H							M	H	H	

H = Highly Related; M = Medium L = Low

BCO610A	*Prompt Engineering for C and C++*	Total Credits: 4

Course Objective:

Lab Objective:

To equip students with hands-on experience in leveraging AI models through prompt engineering for writing, debugging, testing, optimizing, and understanding C and C++ programs.

List of Experiments

Module No.	Title	Lab Activities
1	Introduction to Prompt Engineering	Use prompts to generate basic C/C++ programs (Hello World, basic input/output)
2	Prompt Patterns	Experiment with different styles of prompts (descriptive, imperative, structured)
3	Prompting for Logic Building	Use prompts to generate logic for loops, conditions, and arrays in C
4	Prompt-based Code Generation	Generate and execute C programs for mathematical problems (e.g., factorial, Fibonacci)
5	Prompting for Modular Programming	Prompt for functions and parameterized code in C
6	Prompt Debugging – C Programs	Provide prompts to detect and fix logical and syntactical errors
7	Prompting for Data Structures in C	Generate code for structures, unions, and pointers using AI
8	Introduction to C++ Prompting	Generate simple class-based programs (constructors, methods, objects)
9	OOP Concepts through Prompts	Use prompts to implement inheritance, polymorphism, and encapsulation
10	Prompting for STL	Generate and modify programs using vectors, maps, and iterators
11	Code Optimization via Prompting	Prompt AI to refactor and optimize inefficient C/C++ code
12	Prompting for File Handling	Generate programs for reading/writing files in C and C++
13	AI-assisted Testing	Use prompts to generate test cases and check edge conditions
14	Prompt-driven Project Planning	Prompt AI to help with design, logic, and documentation of a mini project
15	Final Project & Ethical Considerations	Build a small AI-supported C/C++ project with documentation and reflection on ethical use

Course Outcomes (COs)

CO No.	Course Outcome
CO1	Understand the fundamentals of prompt engineering and its relevance to C/C++
CO2	Design effective prompts to generate, debug, and refactor C programs
CO3	Apply prompting techniques to automate OOP and STL-based C++ development
CO4	Evaluate and optimize C/C++ code with the help of AI-assisted tools
CO5	Demonstrate prompt-driven project development and ethical use of AI in coding

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M	M					L	M		H	MM		
CO2				M			L								H
CO3						L									H
CO4															
CO5	H		M			M									H

H = Highly Related; M = Medium L = Low

BCO009B	**COMPUTER ORGANIZATION AND DESIGN**	3-1-0 [4]

OJECTIVE:

• To understand the number system conversions and logic gates.
• To study the design of logic unit and bus memory transfer.
• To study the addressing modes and instruction set architecture, register transfer RISC/CISC
• To study the hierarchical memory system including cache memories and its address mapping.
• To study the different ways of communicating with I/O devices and standard I/O interfaces.

UNIT 1	Introduction to number system, methods of base conversions; Binary, octal and hexadecimal arithmetic; Basic organization of computers; logic gates, Information representation, Fixed-Point Arithmetic: Floating point representation (Single &double precision), Complements.
UNIT 2	Using Karnaugh map methods, SOP, POS simplification, Logic design: Half adder, full adder, Adder–Subtractor. Multiplexer/ de-multiplexer, decoders. Fetch, decode and execute cycle. RTL, Bus & Memory Transfer, Tri state Buffer.
UNIT 3	Instruction set architectures, addressing modes, instruction cycles, Differentiate RISC versus CISC architectures. Arithmetic Micro-operation: Addition, Subtraction, Multiplication (Booth's Algorithm),Array Multiplier
UNIT 4	Memory Technology, static and dynamic memory, Random Access and Serial Access Memories, Cache memory and Memory Hierarchy, Address Mapping, Cache updation schemes,
UNIT 5	I/O subsystems: Interfacing with IO devices, keyboard and display interfaces; Basic concepts Bus Control, Read Write operations, Programmed IO, Concept of handshaking, Polled and Interrupt-driven I/O, DMA data transfer.

Course Outcome (CO):

At the ends of this course studentswill have:

CO1: Awareness of computer organization.
CO2: Design and architecture of machine.
CO3:Implement different system calls for various units.
CO4: Logical representation of storage, representation and management.
CO5: Analysis of I/O subsystem.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H											M	H		
CO2			H		M									M	
CO3				M					M				L		
CO4				H						M			M		L
CO5				H						M					L

H = Highly Related; M = Medium L = Low

Text Book:
1. Digital Design, M.Morris Mano, Pearson
2. Computer System Architecture by Mano, Pearson

Reference books:
1. Modern Digital Electronics, R.P. Jain, TMH
2. Computer Organization by V. Carl Hamacher, Safwat G. Zaky and Zvonko G. Vranesic , McGraw-Hill series(2002)
3. Digital Fundamental, Floyd & Jain, Pearson.
4. Computer Architecture and Organization, by Hayes, J.P.1998, McGraw-Hill
5. Digital Logic And Computer Design, Mano, Pearson

.BCO010C	DATABASE MANAGEMENT SYSTEMS	3-1-0 [4]

OJECTIVE:
- To provide knowledge of relational model
- To learn about ER diagrams.
- To learn about Query Processing and Transaction Processing

UNIT 1	Introduction - Database Systems versus File Systems, View of Data, Data Models, database languages, Database Users and Administrators. Transaction Management, Components of a Database management System. Entity-Relationship Model – Basic Concepts, Constraints, Keys, Design Issues, E-R Diagrams.
UNIT 2	Relational Database Design- Functional Dependencies, Multi-valued Dependencies, Normal Forms, Decomposition into Normalized Relations.
UNIT 3	Relational Model- Structures of relational databases, Integrity Constraints, Logical database Design, Tables, Views, Data Dictionary. Relational Algebra, Relational Calculus. SQL – Basic Structures, Query Handling,Triggers,Nested SQL Query, Embedded SQL,
UNIT 4	Fundamental Concepts of Transaction Management, ACID property. Serializability and testing for serializability, concurrency control schemes, lock-based protocols, two-phase locking protocols, graph-based protocols, time stamp-based protocols, deadlocks.
UNIT 5	File System: File organization- Heap File, Sequential File, Hash File, Clustered file, file operations, indexing, B-tree, B+ tree, Introduction to Data Mining, Data Farming, Data Warehousing

Course Outcome (CO):

At the ends of this course studentswill have:

CO1: Awareness of database management basics and different models that we use for database.
CO2: Design and architecture of relational model, relational algebra and SQL queries.
CO3: Implement different form of normalization.
CO4: Logical representation of internet database.
CO5: Analysis and concepts of transaction, concurrency and recovery systems.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H												H	M	
CO2			H		M				M						L
CO3				H		M							M		
CO4				M								M		L	L
CO5	M	L		H					L				M		

H = Highly Related; M = Medium L = Low

Text Books:
1. Database Systems Concepts – Korthe, TMH
2. An Introduction to Database Design – Date
Reference Books:
1. Fundamentals of Database Systems – Elmasri and Navathe
2. Database Management and Design – Hansen and Hansen .
3. Object-Oriented Database Design – Harrington

BCO378A	**UX Expert with React Redux**	3-1-0 [4]

OBJECTIVE:

- Understand Refreshing ES6 Specifications and Features
- Knowing React.js
- Know How does React Works?
- Learn Setting up React.
- Understand JSX
- Explain State in React.js
- Describe Props in React.js
- Discuss State Vs. Props

UNIT 1	Specifications and Features, Introduction, The let and const, The arrow functions, New Literal Syntax, Classes, Inheritance using extends, Default Parameter Values, Spread Operator (...), Iterators and Generators, Introduction to React, Features of React, Why we Need React
UNIT 2	ECMA Script, ES6 let and const, the arrow functions, New Literal Syntax, Classes, Inheritance using extends, Default Parameter Values, Spread Operator (...), Iterators and Generators, Features of React, Practical Application, Why need React, How React Works, Leveraging Virtual DOM, Setting up React
UNIT 3	Why JSX, Embedding JavaScript, Expression in JSX, JSX as an Expression, Nested elements in JSX, JSX Attributes, JSX Comments, JSX Styling and representation as object, The State of the Component, Defining State, Changing the State, Props, Validation, Validators
UNIT 4	Rendering Element, About render (), Creating React Element, Updating Element,components, Introducing Components, Types of Components, Functional Component, Functional Components as Stateless, Using Functional Component
UNIT 5	Redux Concepts, Redux Principles, Data Flow, Actions, Functions, Reduces, Testing , DevTools, React & Redux Integrate

Course OUTCOME (CO):

CO1: Understand specifications and features ES6
CO2: Lean about ECMA Script
CO3: Analyse expression in JSX
CO4: Learn rendering elements
CO5: Understand Redux Concepts

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	L	H	L	L			L	L	L	L	L	M
CO2	M	M	M	H	L				L			L	M	M
CO3	M	M	M	H	M							L	M	M
CO4	M	M	M	H	M		L					L	M	M
CO5	M	L	M	H	M	M			L			L	M	M

H = Highly Related; M = Medium; L = Low

Text Books:
1. Full Stack React, Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Guttman, and Tyler McGinnis, Fullstack.io

Reference Books:

1. Learning React: Functional Web Development with React and Redux, Alex Banks and Eve Porcello)'Reilly
2. React in Action, Mark Tielens Thomas, Manning Publishing
3. Learn React Hooks, Daniel Bugl, Packt

1. Lab Objectives

- Understand ES6 features for frontend component development.
- Design dynamic UI components using React and JSX.
- Develop applications with state, props, and lifecycle methods.
- Work with user inputs, events, and component-level logging.
- Apply multiple styling strategies to React components.

2. List of Experiments

S.No	Title	Mapped CO
1	Using keyword Class, creating object and passing parameters to the method ()	CO1
2	Embed JavaScript functions as an expression inside the curly brackets{} for use in JSX Using String Literal as JSX attribute with nesting elements Designing a clock showing current time Using both Props and State combined	CO2
3	Creating Components rendering a function multiple time Declaring functions inside a Functional Component returning what's rendered as JSX	CO3
4	Using Class Components returning a React Element to display list of Courses Creating a list of students with their age detail using both functional and class components	CO3
5	Creating Functional Stateless Component as recommended Using this.state and this.setstate() to display different greeting message upon clicking the text Reusing the given button component and creating another button element	CO3
6	Changing the content of the web page using setState() through creating a Generating a random number every time you click using force Update	CO4
7	Using and calling multiple Component's Lifecycle methods executing multiple elements Using Lifecycle methods to Design a clock ticking every second	CO5
8	Using onChange event to return the text entered by user inside a box Using onClick event to update the state and change the text upon click Creating a project to list the Courses offered and using onClick to log them in console signifying dynamic content	CO6
VA1	Using multiple form inputs to submit multiple details and register Using Uncontrolled Components to create multiple form inputs and submit them Creating list using .map() from Array Elements Creating list & rendering it inside component Using keys for creating a list & rendering it inside component	CO5

VA2	Using the Inline Styling Approach creating a JS Object to style Component Using CSS Stylesheet to style Component	CO3
	Using CSS Module to style Component	
	Styling Component using styled-component library	
	Creating two buttons with one being passed props and styling them using styled-components library	

3. Course Outcomes (COs)

Code	urse Outcome
1	ntify and apply ES6 features, including class and object usage.
2	velop React apps using JSX and manage props/state.
3	eate reusable UI components using functional/class methods.
4	ndle dynamic UI updates with state and events.
5	e lifecycle methods and multiple styling strategies.
6	ild event-driven apps with real-time user interaction.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	H	L	L			L	L	L	L	L	M	M
CO2	M	M	M	H	L				L			L	M	M	M
CO3	M	M	M	H	M							L	M	M	M
CO4	M	M	M	H	M		L					L	M	M	M
CO5	M	L	M	H	M	M			L			L	M	M	M

H = Highly Related; M = Medium; L = Low

Text Books:

2. Full Stack React, Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Guttman, and Tyler McGinnis, Fullstack.io

Reference Books:

4. Learning React: Functional Web Development with React and Redux, Alex Banks and Eve Porcello)'Reilly
5. React in Action, Mark Tielens Thomas, Manning Publishing
6. Learn React Hooks, Daniel Bugl, Packt

BCO380A	**Backend Development**	**3-1-0 [4]**

OBJECTIVE:

- Understand the Nodejs framework
- Learn asynchronous programming
- Learn about non-blocking, event-driven servers
- Understand reusable modules and distributable packages
- Understand the techniques and working of express

UNIT 1	What is Node.js, History of Node.js, Why Node.js, Node.js Architecture, Working and Features, Installation and Setup, Installing Node.js, Launching REPL, Environment, Installing Visual Studio, Code Editor, Components of Node.js
UNIT 2	Module Exports, Export Object, Export Functions, Export Functions as Class, Loading module from, Separate Folder, Modules, File System Module, Reading and Writing into, Files, Appending and Opening Files, Events and Event Emitters, Handling Events, Customized Class for Handling Events, In-built Modules File Systems, Operating System
UNIT 3	Writing to Buffers, Reading from Buffers, Concatenating Buffers, Copying Buffers, Slicing Buffers, The Stream Module, Reading From Stream, Writing to Stream, Pipes, Pipe Chaining
UNIT 4	Explain REST API, Describe Node.js express, Discuss the importance of express, Explain the installing process of express, Learn express request and response, Describe routing, REST API : Intro to API, History of API Development, Development of AJAX, CRUD

Course OUTCOME (CO):

CO1: Explain the Node.js architecture
CO2: Understand the concept of Modules, file system and events
CO3: Explain the operations and buffers
CO4: Explain REST API and Express
CO5: Explain AJAX

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Sp Outcor	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	L	H	L	L			L	L	L	L	L	M
CO2	M	M	M	H	L				L			L	M	M
CO3	M	M	M	H	M							L	M	M
CO4	M	M	M	H	M		L					L	M	M
CO5	M	L	M	H	M	M			L			L	M	M

H = Highly Related; M = Medium; L = Low

Text Books:
1. Manuel Kiessling, 'The Node Beginner Book', Leanpub
2. Griggs Bethany, 'Node Codebook', Packt

Reference Books:

1. Ethan Brown, 'Web Development with Node and Express', O Reilly
2. David Herron, 'Node.JS Web Development', Packt
3. Express in Action: Writing, Building, and Testing NodeJS Applications, Evan Hahn, Manning
4. Node.js Design Patterns: Design and implement production-grade Node.js applications using proven patterns and techniques, 3rd Edition, Mario Cascairo and Luciano Mammino, Packt
5. Node.js Web Development, David Herron, Packt

BCO381A	**Backend Development Lab**	**3-1-0 [4]**

1. Lab Objectives

- • Understand Node.js architecture and server setup.
- • Work with asynchronous file handling and buffer operations.
- • Use event-driven programming in backend systems.
- • Build REST APIs and route handling using Express.
- • Develop full backend applications for industry use cases.

2. List of Experiments

S.No	Title	Mapped CO
1	Exporting an object using exports	CO1
2	Export nested object and functions from a module	CO1
3	Reading into a file asynchronously and writing code for handling error if the file is not found	CO2
4	Reading a text file on the server using http and fs module	CO2
5	Develop a Node.js application that processes multiple files asynchronously, exploring different asynchronous techniques to handle large volumes of data efficiently and non-blockingly.	CO3
6	Firing two events simultaneously simulating connection and receiving information from any database or server	CO3
7	Writing to the server using request-response statements as a callback in createServer() function	CO4

8	Create an application in Express.js to manage a simple resource, such as a collection of products, books, or users. Performing routing to access items effectively	CO4
9	Create a RESTful API using Express.js to manage students, add student, delete student, update student, show students.	CO5
10	Create e-commerce application using Express.js that will have a home page to show all products data coming through API, cart page to show products in cart and calculate total of all items added in cart.	CO6
VA1	Create a registration and login page for students. Student can register and upload CV in registration form. Process CV details using FS module in back-end using NodeJS	CO6
VA2	Create a CRUD application to handle employees of a company. Use MVC to perform CRUD operations and test APIs using postman.	CO6

3. Course Outcomes (COs)

CO Code	Course Outcome
CO1	Describe fundamentals of Node.js and module exports.
CO2	Work with file system and buffers in backend systems.
CO3	Apply asynchronous programming for scalable tasks.
CO4	Use Express routing and server setup.
CO5	Implement RESTful APIs with CRUD operations.
CO6	Develop backend projects using advanced Node.js features and architecture.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	H	L	L			L	L	L	L	L	M	M
CO2	M	M	M	H	L				L			L	M	M	M
CO3	M	M	M	H	M							L	M	M	M
CO4	M	M	M	H	M		L					L	M	M	M
CO5	M	L	M	H	M	M			L			L	M	M	M

H = Highly Related; M = Medium; L = Low

Text Books:
3. Manuel Kiessling, 'The Node Beginner Book', Leanpub
4. Griggs Bethany, 'Node Codebook', Packt

Reference Books:

6. Ethan Brown, 'Web Development with Node and Express', O Reilly
7. David Herron, 'Node.JS Web Development', Packt
8. Express in Action: Writing, Building, and Testing NodeJS Applications, Evan Hahn, Manning
9. Node.js Design Patterns: Design and implement production-grade Node.js applications using proven patterns and techniques, 3rd Edition, Mario Cascairo and Luciano Mammino, Packt
10. Node.js Web Development, David Herron, Packt

BCO611A	**Google cloud computing foundation LAB**	**Total Credits: 1**

List of Experiments

Students are required to perform any ten experiments out of the following list of experiments.

1	**Module 1: Google Cloud Computing Foundations: Cloud Computing Fundamentals** A Tour of Google Cloud Hands-on Labs Getting Started with Cloud Shell and gcloud
2	**Module 2: Google Cloud to build your application** Create a Virtual Machine, App Engine: Qwik Start - Python Cloud Run Functions: Qwik Start - Command Line Google Kubernetes Engine: Qwik Start
3	**Module 3: Google Cloud Computing Foundations: Infrastructure in Google Cloud** Cloud Storage: Qwik Start - CLI/SDK Cloud SQL for MySQL: Qwik Start Pub/Sub: Qwik Start - Python User Authentication: Identity-Aware Proxy Cloud IAM: Qwik Start
4	**Module 4: Google Cloud Computing Foundations: Networking & Security in Google Cloud** Multiple VPC Networks VPC Networks - Controlling Access Application Load Balancer with Cloud Armor Cloud Monitoring: Qwik Start
5	**Module 5: Google Cloud Computing Foundations: Data, ML, and AI in Google Cloud** Dataproc: Qwik Start - Console Dataproc: Qwik Start - Command Line Dataflow: Qwik Start - Templates Dataflow: Qwik Start - Python Dataprep: Qwik Start
6	**Module 6: Machine learning- Explain what machine learning is, the terminology used, and its value proposition** Cloud Natural Language API: Qwik Start Speech-to-Text API: Qwik Start Video Intelligence: Qwik Start

7	**Module 7: Implement Load Balancing on Compute Engine** Set Up Network and Application Load Balancers Implement Load Balancing on Compute Engine: Challenge Lab
8	**Module 8: Perform Foundational Infrastructure Tasks in Google Cloud** Cloud IAM: Qwik Start Cloud Storage: Qwik Start - Cloud Console Cloud Monitoring: Qwik Start Cloud Run Functions: Qwik Start - Console Set Up an App Dev Environment on Google Cloud: Challenge Lab
9	**Module 9: Build a Secure Google Cloud Network** Securing Virtual Machines using Chrome Enterprise Premium Multiple VPC Networks VPC Networks - Controlling Access
10	**Module 10**: **Cloud infrastructure** Application Load Balancer with Cloud Armor Create an Internal Load Balancer Build a Secure Google Cloud Network: Challenge Lab
11	**Module 11: Prepare Data for ML APIs on Google Cloud** Cloud Natural Language API: Qwik Start Speech-to-Text API: Qwik Start Video Intelligence: Qwik Start Prepare Data for ML APIs on Google Cloud: Challenge Lab

Course Outcomes-

While graduating, students of GCCF program would be able to:

CO1: Understand Core Concepts and Tools of Google Cloud Platform (GCP)

CO2: Deploy and Manage Applications Using GCP Services

CO3: Work with GCP Infrastructure and Data Services

CO4 Implement Cloud Networking, Security, and Monitoring

CO5: Explore Machine Learning and AI Capabilities in GCP.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcom	Program OutComes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	O 9	PO1 0	O 11	O 12	SO1	SO2	SO3
CO1		M							M		H		M	H	
CO2	L		M		H		L	L		M		M		H	M
CO3		M		H	M	L		L			H		M	H	
CO4	L		H	M			L	M	M		H		M	H	
CO5															

H = Highly Related; M = Medium; L = Low

BCO613A	Salesforce Administrator LAB	Total Credits: 1

List of Experiments

S. No.	Title of Lab Exercise
1	To create and manage Salesforce Trailhead Playground and explore Salesforce Lightning Interface.
2	To create custom objects, fields, and relationships using the data modeling features in Salesforce.
3	To import data using Data Import Wizard and validate data using Validation Rules.
4	To create users, assign roles and profiles, and configure permission sets.
5	To configure organization-wide settings including business hours and company information.
6	To set up organization-wide defaults, role hierarchy, and sharing rules to manage access control.
7	To automate business processes using Workflow Rules and Email Alerts.
8	To automate record updates using Process Builder.
9	To build record-triggered flows for automating data handling and logic.
10	To create custom reports and dashboards for visualizing business data.
11	To customize page layouts and record types, and build apps using Lightning App Builder.
12	To deploy changes using Change Sets in sandbox and production environments.
13	To create single-step approval process for record approval.
14	To implement a mini capstone project such as Student Record Manager, Lead Tracker, or Leave Approval System.

Course Outcomes

While graduating, students of the Salesforce Administrator Lab program would be able to:

CO1: Understand and apply core Salesforce administrative features like object creation, user management, and access control.
CO2: Implement automation tools like Workflow, Process Builder, and Flows in business scenarios.
CO3: Perform data operations, reports, dashboards, and app customization using Salesforce platform.
CO4: Work collaboratively on small Salesforce projects and communicate results effectively.
CO5: Demonstrate the ability to configure and deploy Salesforce changes across environments using sandboxes and change sets.

Mapping Course Outcomes Leading to the Achievement of Program Outcomes and Program Specific Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	H	L							L		H		
CO2	M	H	H	M		L							M	M	
CO3	H	M	H	L							M		H	H	
CO4			L		H				M	H			M	M	
CO5	H	M	H	M	M								M	H	

BCO 013A	DATABASE MANAGEMENT SYSTEMS LAB	0-0-2 [2]

List of Experiments

1	Installation of MySQL
2	Analyze the problem and come with the entities in it. Identify what Data has to be persisted in the databases.
3	Represent all entities in a tabular fashion. Represent all relationships in a tabular fashion.
4	Creating of Tables on given problem
5	Applying Not Null, Check, Unique Constraints on database Tables.
6	Applying Primary Key, References, Foreign Key Constraints on database Tables.
7	Applying Insert, Select, Distinct Clause, Where Clause on database Tables.
8	Applying Update, Delete, Drop, on database Tables.
9	Applying table creation with select, Insert data using select, Renaming on database Tables.
10	Practice Queries using MINUS, UNION, INTERSECT, % operator.
11	Practice Queries using Group Functions.
12	Practice Queries using Group By, Having, Order By Functions.
13	Practice Queries using Arithmetic Operators, Comparison Operator.
14	Practice Queries using Logical Operator.
15	Practice Queries using any four String Functions.
16	Practice Queries using any four String Functions.
17	Practice Queries using Numeric Functions.
18	Practice Queries using Date Functions.

Course Outcome (CO):

At the ends of this course studentswill have:

CO1: Awareness of database management basics and different models that we use for database.
CO2: Design and architecture of relational model, relational algebra and SQL queries.
CO3: Implement different form of normalization.
CO4: Logical representation of internet database.
CO5: Analysis and concepts of transaction, concurrency and recovery systems.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H												H	M	
CO2			H		M				M						L
CO3				H		M							M		
CO4				M							M			L	L
CO5	M	L		H					L				M		

H = Highly Related; M = Medium L = Low

BCO612A	**Competitive Coding using AI (DSA)**	**Total Credits: 2**

List of Experiments

Students are required to perform any ten experiments out of the following list of experiments.

1	Write the shortest codes that you can think of for the following tasks:
	
	   I. Given a string that represents a base X number, convert it to equivalent string in base Y, 2 ≤ X, Y ≤ 36. For example: "FF" in base X = 16 (Hexadecimal) is "255" in base Y1 = 10 (Decimal) and "11111111" in base Y2 = 2 (binary). (More details in Section 5.3.2).
	  II. Given a list of integers L of size up to 1M items, determine whether a value v exists in L by not using more than 20 comparisons? (More details in Section 2.2.1).
	 III. Given a date, determine what is the day (Monday, Tuesday, . . ., Sunday) of that date? (e.g., 9 August 2010 – the launch date of the first edition of this book – is Monday).
	 IV. Given a string, replace all 'special words' of length 3 with 3 stars "***". The 'special word' starts with a lowercase alphabet character and followed by two consecutive digits, e.g.
	S = "line: a70 and z72 will be replaced, but aa24 and a872 will not" will be transformed to
	S = "line: *** and *** will be replaced, but aa24 and a872 will not".

2	Write the shortest possible code to read in a double (e.g. 1.4732, 15.324547327, etc) and print it again, but now with minimum field width 7 and 3 digits after decimal point (e.g. ss1.473 (where 's' denotes a space), s15.325, etc).
3	Generate all possible permutations of {0, 1, 2, . . ., N-1}, for N = 10.
4	Generate all possible subsets of {0, 1, 2, . . ., N-1}, for N = 20.
5	Implement an algorithm that computes the length of the Longest Common Subsequence (LCS) between two given strings.
6	Design and implement a program that generates and displays all prime numbers within a specified range.
7	Develop a program that counts the number of words in a given line of text, where a word is defined as a sequence of alphabetic characters (A–Z, a–z).
8	Implement a program that repeatedly sums the digits of a given integer until a single-digit result (known as the digital root) is obtained.

9	Develop a program that checks whether a given square matrix is symmetric about its main diagonal and contains only non-negative elements.
10	Write a program that simulates the process of generating anagrams of a word using a stack-based operation model.
11	Given a graph represented by an Adjacency Matrix, transpose it (reverse the direction of each edge). How to do the same with Adjacency List?
12	Determine whether a given sequence of non-negative integers can represent the degree sequence of a simple undirected graph.
13	Write a code that takes in a Directed Graph and then convert it into a Directed Acyclic Graph (DAG).
14	To simulate the logic behind the classic game Minesweeper by writing a program that processes a minefield grid and calculates the number of adjacent mines for each empty cell.
15	Write a program to implement Tic-Tac-Toe game.

Course Outcomes-

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

CO1 Apply the basic, sorting and searching techniques, to solve the problem components etc.
CO2 Analyze the concepts of path finding algorithms for flows and cuts, strings and greedy algorithms
CO3 Evaluate the AI models pre-processed through various feature engineering algorithms.
CO4 Develop the code for the recommender system using Natural Language processing.
CO5 Design various reinforcement algorithms to solve real-time complex problems.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M	M					L	M		H	M		
CO2				M				L							H
CO3							L								H

CO4														
CO5	H		M			M								H

H = Highly Related; M = Medium L = Low

BCO017B	FORMAL LANGUAGES & AUTOMATION THEORY	3-1-0 [4]

Objective:

- To understand various Computing models like Finite State Machine, Pushdown Automata, and Turing Machine.
- To understand Decidability and Undesirability of various problems
- To construct pushdown automata and the equivalent context free grammars.
- To prove the equivalence of languages described by pushdown automata and context free grammars.
- To construct Turing machines and Post machines and prove the equivalence of languages described by Turing machines and Post machines.

UNIT 1	**FINITE AUTOMATA (FA):** Introduction, Deterministic Finite Automata (DFA) - Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Designing of Finite Automata, Minimization of Deterministic Finde Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.
UNIT 2	**REGULAR EXPRESSIONS (RE):** Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. **REGULAR GRAMMARS:** Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular-Pumping lemma applications, Closure properties of regular languages.
UNIT 3	**CONTEXT FREE GRAMMER (CFG):** Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL (Proof's omitted).
UNIT 4	**PUSHDOWN AUTOMATA:** Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA **TURING MACHINES (TM):** Formal definition and behaviour, Languages of a TM, TM as accepters, and TM as a computer of integer functions, Types of TMs.
UNIT 5	**RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES (REL):** Properties of recursive and recursively enumerable languages, Universal Turning machine, The Halting problem. Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCP), undecidability of PCP.

Course Outcomes: At the end of the course, the student should be able to:

CO1:Understand and construct finite state machines and the equivalent regular expressions.
CO2:Prove the equivalence of languages described by finite state machines and regular expressions.

CO3:Construct pushdown automata and the equivalent context free grammars.
CO4:Prove the equivalence of languages described by pushdown automata and context free grammars.
CO5:Construct Turing machines and Post machines and prove the equivalence of languages described by Turing machines and Post machines

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		L										H		
CO2		H											L		
CO3	H		H												M
CO4		H		M											
CO5	H											H		L	

H = Highly Related; M = Medium L = Low

Text Books:

1.Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory,Languages and Computations", Second Edition, Pearson Education, 2008.

Reference Book:

1. Mishra K L P and Chandrasekaran N, "Theory of Computer Science – Automata, Languages and Computation", Third Edition, Prentice Hall of India, 2004.
2. Harry R Lewis and Christos H Papadimitriou, "Elements of the Theory of Computation", Second Edition, Prentice Hall of India, Pearson Education, New Delhi, 2003.
3. Peter Linz, "An Introduction to Formal Language and Automata", Third Edition, Narosa Publishers, New Delhi, 2002.
4. Kamala Krithivasan and Rama. R, "Introduction to Formal Languages, Automata Theory and Computation", Pearson Education 2009.
5. John C Martin, "Introduction to Languages and the Theory of Computation", Third Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.

BCO023B	DESIGN AND ANALYSIS OF ALGORITHMS	3-0-0 [3]

OBJECTIVES:
At the end of the course, the student should be able to:
- Design effective, efficient, elegant, and readable algorithms for various classes of computing problems
- Determine space and time complexity of algorithms by the use various algorithm design techniques like (divide and conquer, backtracking, greedy, etc.)

UNIT 1	Introduction, Review of algorithms specification, time and space complexity, performance analysis, recurrence relations. Divide and Conquer – Binary Search, Quick Sort, And-Or Graphs
UNIT 2	Dynamic Programming: 0/1 Knapsack problem, Longest common subsequence, matrix chain multiplication. Greedy Algorithms: Fractional Knapsack Problem, Job sequencing, Optimal Merge patterns and Minimal Spanning trees. Backtrack: 4-queen problem, Branch and Bound: assignment problem
UNIT 3	Graph algorithms–Maximum flow problem, String Matching Algorithms: Naive algorithm, automata and KMP matcher algorithms, Boyer-Moore algorithm
UNIT 4	Number Theory Problems – CRT, GCD algorithms, modular arithmetic; Approximate Algorithms – Set cover, vertex cover, .Randomized Algorithms – Las Vegas and Monte Carlo methods
UNIT 5	NP Completeness: Definitions of P, NP-Hard and NP-Complete Problems. Decision Problems.

OUTCOMES: After study of this subject student will be able to know
CO1: Various methods of calculating complexity
CO 2: Finding out thebestmethod for different algorithms
CO3: About computational geometry, like Lower bound theory, modular arithmetic and CRT
CO4: Various Decision Problems like NP Complete, NP hard
CO5: Knowledge of Graph and its algorithm

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M		M			M				L	H	M	
CO2	H	H			H							L	H	M	M
CO3	M	H	L		M			M				M			M
CO4	H	L	M		M							L	M	H	
CO5	H	M	M		M			L				L	M	M	L

Textbooks:
1. Cormen, Leizerson&Rivest, Introduction to algorithms, Prentice-Hall. 2002
2. Horowitz &Sahni, Fundamentals of Computer Algorithms, Galgotia Publication. 1999

Reference Books:
1. Aho, HopCroft, Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley. 2001.
2. Introduction to Design and Analysis of Algorithms, Anny Levitin, Person Education Press. 2007.
3. Gilles Brassard & Paul Bratley, Fundamental Algorithms, Prentice-Hall. 1998

BCO382A	**Database Engineering – MongoDB**	**3-1-0 [4]**

OBJECTIVE:

- Explain Traditional File system and its components.
- Explain the fundamental concepts of NoSQL database
- Understand the way Sharding works and the different approaches to sharding.
- Describe the CRUD operations in MongoDB
- Discuss arrays and nested Arrays in MongoDB
- Learn projections operations
- Explain the Aggregation facets in MongoDB
- Explore the data modelling concepts

UNIT 1	Introduction to Data Storage, Types of Data Storage Media, Traditional Storage Devices, The File System Namespace – an Introduction, File Systems, File System Terminologies, Extents and Attributes, File Metadata, Directories, Some Basic Filesystem Operations, File System Hierarchy, Common File Systems, Limitations of Traditional File Systems What is the NoSQL approach? Why Use the NoSQL Approach? Benefits of NoSQL, Types of Databases, Key-Value Stores, Wide-column Stores/ Columnar Databases, Document/Document-store/Documentoriented Databases, Graph-based Databases
UNIT 2	Managing Database for Availability and Performance, Database Scaling, Database Distribution Models, Database Replication, Types of Database Replication, Master-Slave Replication, Peer-to-Peer Replication, Advantages and Disadvantages of Peer-to-Peer Replication, Introduction to Sharding, Why Sharding, The Lookup Strategy, The Range Strategy, The Hash Strategy, When to Shard?, Sharding Challenges, Combining Sharding and Replication, Scaling of NoSQL Databases with Sharding, Algorithmic Sharding, Dynamic Sharding, Entity Groups, Hierarchical keys and Column-Oriented Databases
UNIT 3	Introduction to MongoDB, CAP Theorem, Collections & documents, understanding data types in MongoDB, Features of MongoDB Module, Overview of MongoDB, Principles & Design Goals for MongoDB Server and Database, MongoDB tools, MongoDB Installation on Windows, and Cloud, CRUD operations, Basic MongoDB Commands
UNIT 4	Importing data, Nested documents, Arrays in MongoDB, Sorting Documents, Mongo Shell / Driver, Query Comparison Operators, Nested Documents, Matching an embedded document, Query on Nested Field, Setting up filters using query operators, Arrays in MongoDB, Querying on Array, Querying the array for an Element, Querying for an Element, using operator, Querying to meet multiple criteria. Nested Arrays in MongoDB, Querying on Nested Arrays, Querying on Array of Embedded Documents, querying with multiple conditions on nested Fields, Projections Operations, Working with Indexes

UNIT 5	Discuss the concepts of modelling database, Array Updates ($push and $pull) Aggregation, The aggregation pipeline, The map-reduce function 12 The single purpose aggregation methods 13 3 Introduction to Data Modeling, Flexible Schema, Document Structure, Atomicity of Writing Operations, Data Use & Performance, Concepts in Data Modeling, Embedded Data Models (Denormalized Models), Using References (Normalized Models) Joining Collections using $lookup, Modeling Relationship, Transactions in MongoDB

Course OUTCOME (CO):

CO1. Understand the Traditional File System and its components with detailing on NoSQL Database

CO2. Explain NoSQL Database Approach and sharding approaches

CO3. Explain the essentials of MongoDB with CRUD operations

CO4. Discuss the Read and Write Query Operations

CO5. Discuss the concepts of modelling database, Array Updates and Aggregation,

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO
CO1	M	M	M	H	L	L			L	L	L	L	L	M	M
CO2	M	M	M	H	L				L			L	M	M	M
CO3	H	H	M	H	M							L	M	M	M
CO4	H	H	M	H	M		L					L	M	M	M
CO5	H	H	M	H	M	M			L			L	M	M	M

H = Highly Related; M = Medium; L = Low

<u>**Text Books:**</u>
1. Kristina Chodorow, "MongoDB: The Definitive Guide",   O Reilly
2. Eelco Plugge, Peter Membrey, Tim Hawkins, DUPTim Hawkins, "The Definitive Guide to MongoDB

Reference Books:

1. NoSQL Database for Cloud and Desktop Computing", Apress
2. Kyle Banker, Douglas Garrett, Peter Bakkum, Shaun Verch, "MongoDB in Action Manning"
3. Alex Giamas, "Mastering MongoDB 3.x", Packt

BCO383A	Database Engineering – MongoDB Lab	3-1-0 [4]

1. Lab Objectives

Students will be able to:

- Set up and manage NoSQL databases using MongoDB for real-world applications.
- Perform CRUD operations efficiently in different application domains.
- Model, validate, and query complex documents with operators like $lookup, $and, $type.
- Apply advanced querying and aggregation techniques for analytics and recommendations.
- Simulate database-driven backends for SaaS, media, retail, and food delivery domains.

3. List of Experiments with CO Mapping

S.No	Title	Mapped CO
1	Configuring a Local NoSQL Database for a Product Catalog System: Set up MongoDB locally to simulate a scalable product catalog backend, enabling rapid development and testing of NoSQL- based applications.	CO1
2	Creating and Tearing Down Databases for Multi-Client SaaS Solutions: Learn to manage database lifecycles by creating and removing MongoDB databases to support separate client environments in a SaaS architecture.	CO1
3	Structuring Content Repositories for a Media Platform: Organize and optimize data storage by creating standard and capped collections to handle user-uploaded content and real-time logs in a media application.	CO2
4	Populating a Customer Database in an E-Commerce Application: Insert customer and order data using insertOne, insertMany, and batch methods to efficiently populate collections in a simulated e-commerce system.	CO2

5	Building a Library Management System with Custom Queries: Create and retrieve book, author, and borrowing records to understand document modeling and querying in the context of a digital library system.	CO3
6	Building Advanced Filters for a Job Search Platform: Apply logical operators like $and, $or, and $not to implement complex job filters based on role, location, and experience.	CO3
7	Validating User Profiles in a Social Networking App: Use $exists and $type to ensure key fields like email and birthdate exist and are of correct types, ensuring consistent user data in a social app.	CO3
8	Updating Product Listings and Managing Inventory in a Retail System: Modify product information and delete outdated listings to reflect stock changes and ensure inventory accuracy in a retail backend.	CO3
9	Querying Embedded Address Details in a Food Delivery App: Access nested fields like delivery addresses or payment metadata to personalize orders and manage delivery logistics.	CO4
10	Filtering Restaurant Menus Based on Dietary Preferences: Perform multi- condition array queries to find dishes based on ingredients, dietary tags, and availability for a food-tech application.	CO4
11	Managing Order History and Recommendations in a Streaming Platform: Use array manipulation techniques to track watch history, apply slicing for recent activity, and sort recommendations based on user behavior.	CO4
12	Simulating SQL Joins to Merge Orders with User Profiles in a CRM System: Use the $lookup operator to combine data from user and order collections, mimicking SQL joins for comprehensive customer insights in a CRM dashboard.	CO5

3. Course Outcomes (COs)

CO Code	Course Outcome
CO1	Configure and manage NoSQL databases using MongoDB.
CO2	Perform insert and bulk data operations for application-specific use cases.
CO3	Write complex queries using logical, type, and update operators.
CO4	Query embedded documents and arrays to support real-time app features.
CO5	Use aggregation pipelines and joins to simulate relational-like analytics.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	H	L	L			L	L	L	L	L	M	M
CO2	M	M	M	H	L				L			L	M	M	M
CO3	H	H	M	H	M							L	M	M	M
CO4	H	H	M	H	M		L					L	M	M	M
CO5	H	H	M	H	M	M			L			L	M	M	M

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Text Books:
3. Kristina Chodorow, "MongoDB: The Definitive Guide",   O Reilly
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4. NoSQL Database for Cloud and Desktop Computing", Apress
5. Kyle Banker, Douglas Garrett, Peter Bakkum, Shaun Verch, "MongoDB in Action Manning"
6. Alex Giamas, "Mastering MongoDB 3.x", Packt

BCO384A	**Test Automation**	3-1-0 [4]

OBJECTIVE:

- Define seven principles of Software testing
- Differentiate between SDLC v/s STLC
- Explain software testing life cycle
- Describe various types testing
- Understand the Selenium Components
- Explain Selenium Architecture
- Describe Selenium 3.x advantages and implementation.
- Define drivers for Firefox, IE, chrome, Iphone, Android etc
- Understand test scenario.

UNIT 1	Seven principles of Software Testing, SDLC vs STLC, Testing Life Cycle, Usability Testing, Why do we need Usability Testing, How to do Usability testing, Advantages & Disadvantages, Functional Testing, End to End Testing,Methods, Advantages & Disadvantages, Compatibility Testing, Types GUI testing, Techniques API testing, Advantages
UNIT 2	Selenium components, Selenium Architecture, TestNGInstalling TestNg in Eclipse,TestNG annotations – Understanding usage, Setting priority of execution for test cases, Hard Assertion, Soft Assertion, TestNG Reports, ANT-Downloading & Configuring, XSLT report generation generation using TestNg and Ant
UNIT 3	Describe Selenium 3.x advantages and implementation, Define drivers for Firefox, IE, chrome, Iphone, Android etc, Analyse first Selenium Code, Differentiate between Close and Quit, Describe Firepath and firebug Add-ons installation in Mozilla, Inspect elements in Mozilla, Chrome and IE, Identifying WebElements using id, name, class, Generate own CssSelectors. Differentiate between performance of CssSelectors as compared to Xpaths, Define class attribute, Handle Dynamic objects/ids on the page, Analyse whether object is present on page or not
UNIT 4	Manual Testing, Manual Testing – How to Approach?, Manual Testing – Myth and fallacy, Defect Life Cycle, Qualities of a good Manual Tester, Manual Testing vs Automation Testing, Types, System Testing, Acceptance Testing, Unit Testing, Techniques, Integration Testing, Smoke- Sanity Testing

UNIT 5	Test Scenario, Test Case Design, Test Basis Traceability Matrix

Course OUTCOME (CO):

CO1: Understand the testing life cycle.
CO2: Lean about the selenium components.
CO3: Analyse Selenium 3.x advantages and implementation
CO4: Learn the essentials of manual testing.
CO5: Understand the test design framework.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	L	L	L			L	L	L	L	L	M	M
CO2	L	M	M	M	L				L			L	M	M	M
CO3	L	M	M	M	M							L	M	M	M
CO4	L	M	M	M	M		L					L	M	M	M
CO5	L	L	M	M	M	M			L			L	M	M	M

H = Highly Related; M = Medium; L = Low

Text Books:

1. Selenium Testing Tools Cookbook (Second Edition), Unmesh Gundecha, Packt OpenSource
2. Science of Selenium, Kalilur Rahman, BPB

Reference Books:

1. Flexible Test Automation - by Vitaliano Inglese, Pasquale Arpaia
2. Experiences of Test Automation: Case Studies of Software Test Automation - by Mark Fewster, Dorothy Graham

2. Lab Objectives

Students will be able to:

- Set up and manage NoSQL databases using MongoDB for real-world applications.
- Perform CRUD operations efficiently in different application domains.
- Model, validate, and query complex documents with operators like $lookup, $and, $type.

- Apply advanced querying and aggregation techniques for analytics and recommendations.
- Simulate database-driven backends for SaaS, media, retail, and food delivery domains.

3. List of Experiments with CO Mapping

S.No	Title	Mapped CO
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	Creating and Tearing Down Databases for Multi-Client SaaS Solutions: Learn to manage database lifecycles by creating and removing MongoDB databases to support separate client environments in a SaaS architecture.	CO1
	Structuring Content Repositories for a Media Platform: Organize and optimize data storage by creating standard and capped collections to handle user-uploaded content and real-time logs in a media application.	CO2
	Populating a Customer Database in an E-Commerce Application: Insert customer and order data using insertOne, insertMany, and batch methods to efficiently populate collections in a simulated e-commerce system.	CO2
	Building a Library Management System with Custom Queries: Create and retrieve book, author, and borrowing records to understand document modeling and querying in the context of a digital library system.	CO3

	Building Advanced Filters for a Job Search Platform: Apply logical operators like $and, $or, and $not to implement complex job filters based on role, location, and experience.	CO3
	Validating User Profiles in a Social Networking App: Use $exists and $type to ensure key fields like email and birthdate exist and are of correct types, ensuring consistent user data in a social app.	CO3
	Updating Product Listings and Managing Inventory in a Retail System: Modify product information and delete outdated listings to reflect stock changes and ensure inventory accuracy in a retail backend.	CO3
	Querying Embedded Address Details in a Food Delivery App: Access nested fields like delivery addresses or payment metadata to personalize orders and manage delivery logistics.	CO4
	Filtering Restaurant Menus Based on Dietary Preferences: Perform multi- condition array queries to find dishes based on ingredients, dietary tags, and availability for a food-tech application.	CO4
	Managing Order History and Recommendations in a Streaming Platform: Use array manipulation techniques to track watch history, apply slicing for recent activity, and sort recommendations based on user behavior.	CO4
	Simulating SQL Joins to Merge Orders with User Profiles in a CRM System: Use the $lookup operator to combine data from user and order collections, mimicking SQL joins for comprehensive customer insights in a CRM dashboard.	CO5

4. Course Outcomes (COs)

CO Code	Course Outcome
CO1	Configure and manage NoSQL databases using MongoDB.
CO2	Perform insert and bulk data operations for application-specific use cases.
CO3	Write complex queries using logical, type, and update operators.
CO4	Query embedded documents and arrays to support real-time app features.
CO5	Use aggregation pipelines and joins to simulate relational-like analytics.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
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CO1	L	L	L	L	L	L			L	L	L	L	L	M	M
CO2	L	M	M	M	L				L			L	M	M	M
CO3	L	M	M	M	M							L	M	M	M
CO4	L	M	M	M	M		L					L	M	M	M
CO5	L	L	M	M	M	M			L			L	M	M	M

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Text Books:

3. Selenium Testing Tools Cookbook (Second Edition), Unmesh Gundecha, Packt OpenSource
4. Science of Selenium, Kalilur Rahman, BPB

Reference Books:

3. Flexible Test Automation - by Vitaliano Inglese, Pasquale Arpaia
4. Experiences of Test Automation: Case Studies of Software Test Automation - by Mark Fewster, Dorothy Graham

BCO 025A	DESIGN& ANALYSIS OF ALGORITHMS LAB	0-0-2

List of Experiments

1. Write a Program to Explore a Binary Heap
2. Write a Program for Merging of two search trees
3. Write a program to implement Huffman tree construction
4. Write a Program for Computing a spanning tree having smallest value of largest edge
5. Write a Program for Finding the decimal dominant in linear time
6. Write a Program for Problems on Graphs. Etc.
7. Write a program to find Greatest Common Divisor
8. Write a program for fractional Knapsack problem
9. rite a program for 0/1 Knapsack problem
10. Write a program to implement Naive algorithm,
11. Write a program to implement KMP matcher algorithms,
12. Write a program to implement Boyer-Moore algorithm
13. Write a program to implement modular arithmetic
14. Write a program to implement Set cover,
15. Write a program to implement vertex cover

OUTCOMES: After study of this subject student will be able to know
CO1: Various methods of calculating complexity
CO 2: Finding out the best method for different algorithms
CO3: About computational geometry, like Lower bound theory, modular arithmetic and CRT
CO4: Various Decision Problems like NP Complete, NP hard
CO5: Knowledge of Graph and its algorithm

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
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CO1	H	H	M		M			M				L	H	M	
CO2	H	H			H							L	H	M	M
CO3	M	H	L		M			M				M			M
CO4	H	L	M		M							L	M	H	
CO5	H	M	M		M			L				L	M	M	L

BCO 028B	COMPILER CONSTRUCTION	3-1-0 [4]

OBJECTIVE: At the end of the course, the student should be able to:

- Apply the principles in the theory of computation to the various stages in the design of compilers;
- Explain the stages involved in the translation process;
- Analyse problems related to the stages in the translation process;
- Design a compiler for a simple programming language; and
- Implement a compiler based on its design.

UNIT 1	Overview of compilation- The structure of a compiler and applications of compiler technology; Lexical analysis - The role of a lexical analyzer, specification of tokens, recognition of tokens, hand-written lexical analyzers, LEX, examples of LEX programs. Introduction to syntax analysis -Role of a parser, use of context-free grammars (CFG) in the specification of the syntax of programming languages, techniques for writing grammars for programming languages (removal left recursion, etc.), non- context-free constructs in programming languages, parse trees and ambiguity, examples of programming language grammars.
UNIT 2	Top-down parsing- FIRST & FOLLOW sets, LL(1) conditions, predictive parsing, recursive descent parsing, error recovery. LR-parsing - Handle pruning, shift-reduce parsing, viable prefixes, valid items, LR(0) automaton, LR-parsing algorithm, SLR(1), LR(1), and LALR(1) parsing. YACC, error recovery with YACC and examples of YACC specifications.
UNIT 3	Syntax-directed definitions (attribute grammars)-Synthesized and inherited attributes, examples of SDDs, evaluation orders for attributes of an SDD, Dependency graphs-attributed and L-attributed SDDs and their implementation using LR-parsers and Recursive Descent parsers respectively.
UNIT 4	Semantic analysis- Symbol tables and their data structures. Representation of "scope". Semantic analysis of expressions, assignment, and control-flow statements, declarations of variables and functions, function calls, etc., using S- and L-attributed SDDs (treatment of arrays and structures included). Semantic error recovery.
UNIT 5	Intermediate code generation - Different intermediate representations –quadruples, triples, trees, flow graphs, SSA forms, and their uses. Translation of expressions (including array references with subscripts) and assignment statements. Translation of control-flow statements – it- then-else, while-do, and switch. Short-circuit code and control-flow translation of Boolean expressions. Back patching. Examples to illustrate intermediate code generation for all constructs. Run-time environments: - Stack allocation of space and activation records. Access to non-local data on the stack in the case of procedures with and without nesting of procedures.

Course Outcome

At the end of this course students will have:

CO1 To apply the knowledge of lex tool &yacc tool to devleop a scanner & parser.
CO2 To design parser and Intermediate Code Generation in compiler.
CO3 To deal with different translators.
CO4 To learn the new code optimization techniques to improve the performance of a program in terms of speed & space.
CO5 To use the knowledge of patterns, tokens & regular expressions for solving a problem.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	L		H			L					H	M	
CO2		H				L							H		
CO3		L		H	L										M
CO4		H					H							H	
CO5		H		L		H									L

H = Highly Related; M = Medium L = Low

Text Books:
1. Compilers: Principles, Techniques, and Tools, by A.V. Aho, Monica Lam, Ravi Sethi, and J.D. Ullman, (2nded.), Addison-Wesley, 2007 (main text book, referred to as ALSU in lab assignments).
2. K.D. Cooper, and Linda Torczon, Engineering a Compiler, Morgan Kaufmann, 2004.

Reference Books:
1. K.C. Louden, Compiler Construction: Principles and Practice, Cengage Learning, 1997.
2. D. Brown, J. Levine, and T. Mason, LEX and YACC, O"Reilly Media, 1992.

BCO386A	**Microservices and design patterns**	3-1-0 [4]

OBJECTIVE:

- Define various Software Patterns.
- Explain Architectural Patterns.
- Illustrate Design Patterns.

UNIT 1	Software Architecture and its Stakeholders, Architectural Patterns and Styles, Monolithic Architecture, Strengths and Limitations, SOA Architecture, Domain-Driven Approach to Design and Implement Microservices, Strategic and Tactical Design, Domain, Bounded Context, Ubiquitous Language and Context Mapping, The Building Blocks of DDD, Strengths and Limitations of DDD, How Domain Driven Design Applies to Microservices, Designing Services Applying DDD Concepts, Service Communication, The API Gateway,Case Studies One Detail Case Study , RainyDay Grocer, UBER, Multiple Case Studies
UNIT 2	Software architecture: Overview, Stakeholders, Stakeholders' Areas of Concern, Software Architecture: Definition, Architecture Description, ISO/IEC/IEEE 42010, Architecture Structural Description, Architecture Behavioral Description, Benefits, Architectural Patterns, Architectural Style Vs. Architectural Pattern
UNIT 3	Design Pattern: Overview, Design Pattern Discovery, Elements, Documenting Design Pattern, Design Pattern: Benefits, Criticisms, Design Pattern Classifications, Creational Patterns, Structural Pattern, Behavioral Patterns, Architectural Patterns Vs. Design Pattern, Anti Patterns, Anti Pattern Vs. Bad Habit, God Object, Anti Patterns in Object Oriented Programming (OOP),Architectural Patterns, Layered Pattern, Layers, Use Cases, Layered Pattern: Advantages, Layered Pattern: Disadvantages, Event-driven Pattern: Definition, Components, Use Cases, Advantages & Disadvantages
UNIT 4	Microkernel Pattern: Definition, Components, Use Cases, Advantages & Disadvantages , Microservices (MS): Definition, MS: Architecture, MS Principles: Single Responsibility, MS Principles: Loose Coupling, Domain Driven Design, Principles: Service Discovery, Fault Tolerance/Circuit Breaker, Automation, Use Cases, Advantages & Disadvantages, Space– Based Architecture, Use Cases, Advantages & Disadvantages
UNIT 5	Creational Design Patterns, Factory pattern, Builder Pattern, Prototype Pattern, Singleton Pattern, Structural Design Patterns, Adapter Pattern, Bridge Pattern, Composite Pattern, Decorator Pattern, Facade Pattern, Flyweight Pattern, Proxy Pattern, Behavioural Design Patterns, Command Pattern, Iterator Pattern,

	Mediator Pattern, Memento Pattern, Observer Pattern, Observer Pattern, template pattern, Visitor Pattern

Course OUTCOME (CO):

CO1: Understand Domain driven approach to design and implementation.
CO2: Lean about software architecture
CO3: Analyse the design patterns
CO4: Understand the Microkernel Patterns
CO5: Understand creational design patterns

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	L	L	L	L	L	L			L	L	L	L	L	L	L
CO2	L	L	L	L	L	L			L			L	L	L	L
CO3	L	L	L	L	L	L						L	L	L	L
CO4	L	L	L	L	L		L					L	L	L	M
CO5	L	L	L	L	L	M			L			L	L	L	M

H = Highly Related; M = Medium; L = Low

Text Books:

1. Building Microservices: Designing Fine-Grained Systems 1st Edition, Sam Newman, O'Reilly

Reference Books:

2. Microservices in Action, Morgan Bruce, Manning
3. Microservice Architecture: Aligning Principles, Practices, and Culture, Mike Amundsen and Ronnie Mitra, O'Reilly

| BCO387A | **Microservices and design patterns Lab** | 3-1-0 [4] |

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	L	L			L	L	L	L	L	L	L
CO2	L	L	L	L	L	L			L			L	L	L	L
CO3	L	L	L	L	L	L						L	L	L	L
CO4	L	L	L	L	L		L					L	L	L	M
CO5	L	L	L	L	L	M			L			L	L	L	M

H = Highly Related; M = Medium; L = Low

Text Books:

1. Building Microservices: Designing Fine-Grained Systems 1st Edition, Sam Newman, O'Reilly

Reference Books:

2. Microservices in Action, Morgan Bruce, Manning
3. Microservice Architecture: Aligning Principles, Practices, and Culture, Mike Amundsen and Ronnie Mitra, O'Reilly

BCO388A	**Monitoring**	3-0-0 [3]

OBJECTIVE:

Explain the concepts of DevOps and monitoring
• Elaborate End-User monitoring, its benefits and tools
• Illustrate Infrastructure monitoring with reactive and proactive monitoring
• Discuss Application monitoring and Log monitoring
• Demonstrate monitoring techniques

UNIT 1	Introduction to monitoring, Goals of monitoring, DevOps approach to monitoring, Network operations center, Role of NOC in DevOps world, Telemetry and metrics, Types of monitoring: end user, infrastructure, application, log monitoring and analysis
UNIT 2	Overview, Objectives of end user monitoring, Types of end user monitoring, Real user monitoring, Synthetic transaction monitoring, Server-side monitoring, Benefits of end user monitoring, Tool's overview
UNIT 3	Overview of infrastructure monitoring, Monitoring components and metrics, Agent vs agentless monitoring, Reactive monitoring vs proactive monitoring, Cloud vs on premise, Network and security monitoring, Infrastructure monitoring challenges, Tool's overview
UNIT 4	Overview, How to Measure Application Performance, Key Functionalities, Application vs infrastructure monitoring, Monitoring components and metrics, Dependency monitoring, Tools overview
UNIT 5	Overview, Objectives of log monitoring, Metrics, Log monitoring vs analysis, Log analysis techniques, Purpose and benefits of log analysis, Log analysis best practices, Purpose and Benefits of Log Analysis, Best Practices, Tools overview; Monitoring Techniques: Visualization – Dashboards, Alerts, Alert triage process, DevOps dashboard with Hygieia, AI in monitoring – AIOps, Tools overview

Course OUTCOME (CO):

CO1: Understand the essentials of system monitoing
CO2: Understand the objectives of end user monitoring
CO3: Understand infrastructure monitoring
CO4: Learn essentials of Application monitoring
CO5: Learn more log monitoring & Analysis

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	L		L			L	L			M	H	M
CO2	M	H	H	H	H	L						L	M	H	H
CO3	M	H	H	H	H						L	L	M	H	H
CO4	M	H	H	H	H		L				L	L	M	H	H
CO5	M	M	M	M	H	L			L			L	M	H	H

H = Highly Related; M = Medium; L = Low

Textbooks:

1. Nagios: System and Network Monitoring, Wolfgang Barth, NoStarch Press

Reference Books:

2. Nagios Core Administration Cookbook – Second Edition, Tom Ryder, Packt

| BCO007C | COMPUTER GRAPHICS | 3-0-0 [3] |

OBJECTIVE:
- To provide students with a foundation in graphical applications programming
- To introduce students with fundamental concepts and theory of computer graphics
- To give basics of application programming interface (API) implementation based on graphics pipeline approach

UNIT 1	**Basic of Computer Graphics:** Basic of Computer Graphics, Applications of computer graphics, Display devices, Random and Raster scan systems, Graphics input devices, Graphics software and standards
UNIT 2	**...aphics Primitives:** Points, lines, circles and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan-line polygon filling, inside-outside test, boundary and flood-fill, character generation, line attributes, area-fill attributes, character attributers. Aliasing, and introduction to Anti Aliasing (No anti aliasing algorithm).
UNIT 3	**Two Dimensional Graphics:** Transformations (translation, rotation, scaling), matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping, line clipping (cohen-sutherland, liang bersky, NLN), polygon clipping
UNIT 4	**Three Dimensional Graphics**: 3D display methods, polygon surfaces, tables, equations, meshes, curved lies and surfaces, quadric surfaces, spline representation, cubic spline interpolation methods, Bazier curves and surfaces, B-spline curves and surfaces.3D scaling, rotation and translation, composite transformation, viewing pipeline and coordinates, parallel and perspective transformation, view volume and general (parallel and perspective) projection transformations.
UNIT 5	**Three Dimensional Graphics:** 3D display methods, polygon surfaces, tables, equations, meshes, curved lies and surfaces, quadric surfaces, spline representation, cubic spline interpolation methods, Bazier curves and surfaces, B-spline curves and surfaces.3D scaling, rotation and translation, composite transformation, viewing pipeline and coordinates, parallel and perspective transformation, view volume and general (parallel and perspective) projection transformations.

Course Outcome (CO):

At the ends of this course studentswill have:

CO1: Understand the basics of computer graphics, different graphics systems and applications of computer graphics
CO2: Apply and compare the algorithms for drawing 2D images
CO3: Analyze and apply clipping algorithms and transformation on 2D images
CO4: Explore projections and visible surface detection techniques for display of 3D scene on 2D screen
CO5: Understand visible-surface determination and hidden surface elimination for creating computer graphics applications

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H			M	L								M		
CO2			M	L					L		L			L	
CO3			L		L						M	L	L		M
CO4			H							L					L
CO5	H	M		L					M				M	L	

H = Highly Related; M = Medium L = Low

Text Books:
1. Donald Hearn and Pauline Baker, Computer Graphics with OpenGL (third edition), Prentice Hall, 2003

Reference Books:
1.F. S. Hill Jr. and S. M. Kelley, Computer Graphics using OpenGL (third edition), Prentice Hall, 2006
2. Peter Shirley and Steve Marschner, Computer Graphics(first edition), A. K. Peters, 2010
3. Edward Angel, Interactive Computer Graphics. A Top-Down Approach Using OpenGL (fifth Edition), PearsonEducation, 2008

BCO 031B	Compiler Design Lab	0:0:2 [1]

List Of Experiments

1 Familiarization with LEX by writing simple specifications for tokens such as identifiers, numbers, comments in C/C++, etc. All LEX specifications must be compiled andexecuted with appropriate inputs. At least ten such exercises must be completed in two labclasses.

2 LEX specification for tokens of the small language in ALSU"s book

3 Complete the specifications in (2) above to make a complete lexical analyzer. (1 lab class)

4 Familiarization with YACC by writing simple specifications for desk calculator, variable declarations in C (only numbers and array). All YACC specifications must be compiled and executed with appropriate inputs. Note that this exercise also requires LEX specifications o the tokens involved. (2 lab classes)

5 YACC specifications for the syntax of the small language in ALSU"s book (appendix A)(1 lab class)

6 Adding error recovery to (5) above to make a complete parser. (1 lab class)

7 S-attributed specification of the semantics of the small language in ALSU"s book

8 Adding semantic error recovery to the semantic analyzer in (7) above to make a complete semantic analyzer. (1 lab class)

9 Intermediate code generation for the constructs of the small language in ALSU"s book (appendix A) to be incorporated into the semantic analyzer of (8) above. Students doing this last assignment may be awarded bonus marks. (3 lab classes)

10 Write a programme to parse using Brute force technique of Top-down parsing.

11 Write a program for generating for various intermediate code forms
i) Three address code ii) Polish notation

12 Develop an operator precedence parser (Construct parse table also)

13 Develop a recursive descent parser

14 Develop a lexical analyser to recognize a few patterns.

BCO 015B	COMPUTERGRAPHICS LAB	0-0-2 [1]

List of Experiments

1   Write a Program to Show basic Transformation with OpenGL
2   Write a Menu Driven Program with OpenGL
3   Write a Program to draw a line using Bresenham's Algorithm with OpenGL
4   Write a Program to implement midpoint algorithm to draw circle
5   Write a Program to implement midpoint algorithm to draw ellipse
6   Program to implement 2d scaling about an arbitrary axis.
7   Write a program to implement DDA line Algorithm
8   Program to implement 2d rotation about an arbitrary axis.
9   Program to implement translation of a line and triangle.
10   Program to implement Cohen Sutherland line clipping.
11   Program to implement Sutherland Hodgeman polygon clipping.
12   Program to draw Bezier curve.
13   Program to draw b-spline curve.
14   Program to implement a line using slope intercept formula.
15   Write a program to implement Bresenham 's Algorithm

Course Outcome (CO):

At the ends of this course studentswill have:

CO1: Understand the structure of modern computer graphics system
CO2: Understand the basic principles of implementing computer graphics primitives.
CO3: Familiarity with key algorithms for modeling and rendering graphical data
CO4: Develop design and problem solving skills with application to computer graphics
CO5: Understand visible-surface determination and hidden surface elimination for creating computer graphics applications

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H			M	L								M		
CO2			M	L					L		L			L	
CO3			L		L						M	L	L		M
CO4			H							L					L
CO5	H		M		M			H				L	L	L	

H = Highly Related; M = Medium L = Low

CSE Track

BCO 069A	Advance Programming in Java Lab	0-0-2

Exp.No. **Name of the Experiment**

1   Design a registration page using HTML.

2   **Implementing JDBC**

Program 2(A)Write a program by using JDBC to execute insert, select and update query by using PreparedStatement and display the results.

Program 2(B) Write a program by using JDBC to execute an update query by using PreparedStatement and display the results.

Program 2(C) Write a program and execute ResultSetMetaData Interface by using JDBC.

3   **Implementing Servlet**

Program 3(A) Write a program and execute a simple servlet demonstrating servlet lifecycle.

Program 3(B) Write a program and execute a servlet program that receives input from html page.

Program 3(C) Write a program and execute ServletRequest and ServletResponse Interfaces with methods.

Program 3(D) Write a program and execute HttpServlet Class doGet() and doPost() Methods.

Program 3(E) Write a program to store the user information into Cookies. Write another program to display the above stored information by retrieving from Cookies.

4   **Implementing JSP,JSP Custom Tags and Directives**

Program4(A) Write a program to connect HTML page,JSP page and mysql database.Program 4(B) Write a program and implement custom tags in JSP

Program 4(C) Write a program and implement JSP directives.

5   **Implementing JavaBean**

Program 5 Write a program and implement Javabeans using JSP page.

6   **Implementing JSP Standard ActionElements**

Program 6 Write a program and implement JSP StandardActionElements.

7   **Implementing JSP Scripting Elements**

Program 7:Write a program and execute JSP Scriptlets,Declarations and Expressions.

8   **Learning session management**

Program 8(A):Write program and execute session management using URL rewriting

Program 8(B) :Write program and execute session management using Hidden Fields.

Program 8(C): Write program and execute session management using Cookie

Program 8(D): Write a program and execute session management using Session Objects.

9   **Remote Method Invocation (RMI)**

Program 9(A):Write a program and execute Remote Method Invocation

10   **Configure web.xml**

Program 10:Write a code to deploy web.xml file

11   **Performing Client-Server Communication and Networking**

Program 11(A): WAP to implement Client-Server Program
Program 11(B): WAP to implement InetAddress.
Program 11(C): WAP for Sending Email in java
12. **Implementing Multithreading**
Program 12: WAP to implement multithreading(three threads using single run method).

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes												Program specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			H	L	H		L			M	H			H	
CO2		L	H		H	L		L					M	H	
CO3			H	M					L	L		M		H	
CO4				M	H			M			L			H	M
CO5		L			H	M			M					H	

CSE Track
Department Elective 5

BCO615A	**QUANTUM COMPUTING**	**Total Credits: 3**

Course Objectives:

1. To introduce the basic principles of quantum mechanics, linear algebra, and Dirac notation relevant to quantum computing.
2. To explain quantum entanglement, quantum algorithms, and quantum channels with foundational understanding.
3. To provide exposure to quantum cryptography and quantum communication protocols.
4. To familiarize students with practical quantum computing using IBM Quantum and associated simulators for basic quantum programming and analysis.

UNIT 1	**Fundamentals of Quantum Mechanics:** Introduction to quantum mechanics and linear algebra concepts for quantum computing, including quantum states in Hilbert space, Dirac notation, Bloch sphere, density operators, superposition and measurement postulates. Covers uncertainty principle, no-cloning theorem, and basics of quantum dynamics with unitary transformations and Schrödinger equation applications.
UNIT 2	**Quantum Correlations:** Study of quantum correlations and entanglement, Bell's theorem and Bell inequalities, and Schmidt decomposition. Includes applications like superdense coding, quantum teleportation, and entanglement swapping, emphasizing their role in quantum networks and information processing.
UNIT 3	**Quantum Cryptography**: Introduction to quantum cryptography and its distinction from classical methods, focusing on QKD protocols such as BB84 and E91. Covers security analysis, eavesdropping, no-cloning implications, and applications of QKD in secure communications and cryptographic infrastructures.
UNIT 4	**Quantum Gates and Algorithms**: Overview of quantum gates such as Pauli, Hadamard, phase, T-gate, CNOT, and Toffoli, along with universal gate sets and quantum circuits. Introduces key algorithms like Deutsch–Jozsa, Grover's search, and Shor's factoring, highlighting quantum speedup and computational complexity.
UNIT 5	**Quantum Programming:** Hands-on quantum programming using IBM Quantum (IBMQ) and Qiskit simulators, constructing and analyzing quantum circuits, performing quantum measurements, and visualizing states. Includes implementing basic algorithms, error mitigation concepts, and executing circuits on real IBM quantum hardware.

Course Outcomes
Upon successful completion of this course, the student will be able to:

CO1: Understand fundamental quantum mechanical principles and their application to quantum information processing.
CO2: Analyze quantum entanglement, correlations and their role in quantum communication protocols.
CO3: Apply quantum cryptography techniques for secure key distribution and evaluate their security properties.
CO4: Design and interpret basic quantum circuits and algorithms demonstrating quantum speedup.
CO5: Implement and test quantum programs using IBM Quantum tools and analyze the effect of noise and errors on computation.

Textbooks

1. Phillip Kaye, Raymond Laflamme, et al., *An Introduction to Quantum Computing*, Oxford University Press, 2007.
2. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2020.
3. David McMahon, *Quantum Computing Explained*, Wiley-Interscience, IEEE Computer Society, 2008.

References

1. Michael A. Nielsen & Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 2013.
2. Eleanor G. Rieffel & Wolfgang H. Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2014.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	L	L	L	L	L	M	L	M	H	M	H
CO2	M	H	M	L	L	L	L	L	L	M	L	M	H	M	M
CO3	M	M	H	M	L	L	L	L	L	M	L	M	M	H	M
CO4	M	H	H	M	M	L	L	L	L	H	L	M	H	H	M
CO5	L	M	H	H	H	L	L	L	L	H	L	M	H	H	L

H = Highly Related; M = Medium L = Low

CSE Track
Department Elective 6

BCO 029B	DATA MINING &WAREHOUSING	3:0:0 [3]

OBJECTIVE:

- To compare and contrast different conceptions of data mining.
- To explain the role of finding associations in commercial market basket data.
- To characterize the kinds of patterns that can be discovered by association rule mining.
- To describe how to extend a relational system to find patterns using association rules.
- To evaluate methodological issues underlying the effective application of data mining.

UNIT 1	Introduction: Basic concepts of data mining, including motivation and definition; different types of data repositories; data mining functionalities; concept of interesting patterns; data mining tasks; current trends, major issues, and ethics in data mining
UNIT 2	Data: Types of data and data quality; Data Preprocessing: data cleaning, data integration and transformation, data reduction, discretization, and concept hierarchy generation; Exploring Data: summary statistics, visualization, multidimensional data analysis
UNIT 3	Association and Correlation Analysis: Basic concepts: frequent patterns, association rules - support and confidence; Frequent itemset generation - Apriori algorithm, FP-Growth algorithm; Rule generation, Applications of Association rules; Correlation analysis
UNIT 4	Clustering Algorithms and Cluster Analysis: Concept of clustering, measures of similarity, Clustering algorithms: Partitioning methods - k-means and k-medoids, CLARANS, Hierarchical methods - agglomerative and divisive clustering, BIRCH, Density-based methods - Subspace clustering, DBSCAN; Graph-based clustering - MST clustering; Cluster evaluation; Outlier detection and analysis.
UNIT 5	Data Mining Algorithms: Partitioned Algorithms, Hierarchical Algorithms, Density-Based Algorithms, Grid-Based Algorithms, Web Content Mining, Web Structure Mining, Web Usage Mining, Spatial Mining, Multimedia Data Mining, Text Mining. Case Study.

OUTCOMES: At the end of the course, the student should be able to:

- Compare and contrast different conceptions of data mining.
- Explain the role of finding associations in commercial market basket data.

- Characterize the kinds of patterns that can be discovered by association rule mining.
- Describe how to extend a relational system to find patterns using association rules.
- Evaluate methodological issues underlying the effective application of data mining.
- **MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

Course Outcomes	Program OutComes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M										M		M
CO2	M		M		M								H		
CO3	H	M		L			I						H	M	
CO4	M		H	M		M								H	
CO5	M	H											M		

- H = Highly Related; M = Medium L = Low

Text Books:

1. Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Introduction to Data Mining. Pearson (2005), India.ISBN 978-8131714720

2. Jiawei Han and MichelineKamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 3rd edition (July 2011), 744 pages. ISBN 978-0123814791

Reference Books:

1. T. Hastie, R. Tibshirani, and J. H. Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction.Springer, 2nd Edition, 2009.768 pages. ISBN 978-0387848570

2. C. M. Bishop, Pattern Recognition and Machine Learning.Springer, 1st edition, 2006.738 pages. ISBN 978-0387310732

3. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 3rd edition (January 2011).664 pages. ISBN 978-0123748560.

CSE Track
Department Elective 7

| BCO215B | Web development using WordPress | 3-0-1 [3] |

Web development using WordPress

Course objective:-Student will be able to design and develop websites using WordPress tool.

UNIT 1	**Introduction to CMS:** Introduction to Content Management Systems, Main Features of CMS, Web Content Management System, Component Content Management System, Enterprise Content Management System, Introduction of Blogs. Installing WordPress with a Web Host's "1-Click Install", Manually Installing WordPress
UNIT 2	**Introduction to WordPress:** Introduction to WordPress, Setting up WordPress, Setting Up Database, Overview of Working of WordPress, Dashboard, Exporting and Importing of Site Content, Backup of Site data and files, Upgrading WordPress, Settings: General, Writing, Reading, Discussion, Media, Privacy, Permalinks, Configuring and Managing Accounts, Adding Content: Post, Pages, Setup and use of Categories, Tags, Internal Linking
UNIT 3	**Advance Features for WordPress:** Working with media: using Media Library, Audio and Video Files, Managing Comments, Fighting Spam with Akismet, Syndication: Setup and Display of RSS Feed, Setup of Subscriptions, use of Google FeedBurner with WordPress, Widgets and Plug-ins: Use of Widgets and Plug-ins, Differences, Upgrade of Plug-ins. Adding an Image Gallery, Editing an Existing Image Gallery, Adding Video Embedding Responsive Videos, Uploading a Video File,
UNIT 4	**Customization with WordPress** Introduction to WordPress Themes, Customized WordPress Theme: Default Theme, New Theme, Theme Editor, Set up of Menus, Post Thumbnails, Customization of Themes: Custom CSS, addition of Frames, Getting Fancy with Themes: Customization of Themes with CSS, addition of Favicon, Editing Function files, Advanced Theme Development: Anatomy of WordPress theme, Building new Theme, Template Files, Template Tags, Use of Loop, Custom Post Types and Custom Taxonomies, One Installation and Multiple blogs: Setup and Administration of Blog Network, Customization of WordPress: Integration of Third Party Services, Third Party Comment System, AD Integration, Web Fonts, Tools and Tricks
UNIT 5	**WordPress Security, Performance & Deployment** Website Security (SSL, Backups, Anti-malware Plugins), Performance Optimization (Caching, Image Optimization, CDN), SEO for WordPress (Yoast SEO, RankMath), Migrating Websites (Local to Live Server), Career Pathways: Freelancing, Agencies, and Personal Branding.

Course Outcomes

CO1:- To be able to understand concepts of content management system, its benefits.

CO2:- Understand installation and configuring word press for web development

CO3:- To be able to work with video and audio files with their plug-ins in websites

CO4:- To be able to create websites more attractive by using themes and CSS, increasing usability by adding hyperlinks.

CO5:Able to create interactive web sites

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M	L	M							L	L		
CO2	L		M		M									L	M
CO3		L		M	H				M		M		M	M	M
CO4		M	L	M	H				M		M	M	M	H	H
CO5	H	H	L	M	M			L	M		M	M	H	M	L

H = Highly Related; M = Medium L = Low

References:

1. Building Web Apps with WordPress: WordPress as an Application Framework 2nd Edition by Brian Messenlehner, Jason Coleman

2. WordPress for Beginners 2020: A Visual Step-by-Step Guide to Mastering WordPress (Webmaster Series) by Dr. Andy Williams

3. WordPress 5 Complete - Seventh Edition by Karol Krol

Cyber Security Track

Information Security
Department Elective 1

BCO 186A	Principle of Cryptography	3-0-0 [3]

OBJECTIVE:
- To gain knowledge about the mathematics of the cryptographic algorithms.
- To get an insight into the working of different existing cryptographic algorithms.
- To learn how to use cryptographic algorithms in security.

UNIT 1	Algebra: Group, cyclic group, cyclic subgroup, field, probability. Number Theory: Fermat's theorem , Cauchy 's theorem, Chinese remainder theorem, primality testing algorithm, Euclid's algorithm for integers, quadratic residues, Legendre symbol, Jacobi symbol etc..
UNIT 2	Cryptography and cryptanalysis, Classical Cryptography, substitution cipher, different type of attack: CMA,CPA,CCA etc, Shannon perfect secrecy, OTP, Pseudo random bit generators, stream ciphers and RC4.
UNIT 3	Block ciphers: Modes of operation, DES and its variants, AES, linear and differential cryptanalysis.
UNIT 4	One-way function , trapdoor one-way function, Public key cryptography, RSA cryptosystem, Diffie-Hellman key exchange algorithm, Elgamal Cryptosystem.
UNIT 5	Cryptographic hash functions, secure hash algorithm, Message authentication, digital signature, RSA digital signature, Elgamal digital signature.

**Course Outcome*:*

CO1:Able to understand various mathematical concepts used is Information Security.
CO2: Blending the existing cryptographic algorithms with the existing communication protocols
CO3: Analyzing and application of cryptography for secure eCommerce and other secret transactions
CO4. Evaluate security mechanisms using rigorous approaches by key ciphers and Cryptosystem.
CO5. Evaluate security mechanisms using rigorous approaches by Digital Signature and Hash functions.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H											M	H	M	
CO2	H	H		L							L		H	M	
CO3	H	M	H		H						M		H		L
CO4	H	M	N		M						M	L	H	M	L
CO5	H	M	M		H						M	L	H		L

H = Highly Related; M = Medium L = Low

Textbook:
1. Stinson. D. Cryptography: Theory and Practice, third edition, Chapman & Hall/CRC, 2010.

Reference Books:
1. W. Stallings, Cryptography and Network Security Principles and practice, 5/e, Pearson Education Asia, 2012.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, second edition, Tata McGraw Hill, 2011
3. Thomas Koshy, Elementary Number Theory with applications, Elsevier India, 2005.

Cyber Security
Department Elective 2

BCO 187A	INFORMATION SECURITY	3-0-1 [4]

Objective:
- To explain the objectives of information security
- To analyse the trade-offs inherent in security
- To describe the enhancements made to IPv4 by IPSec
- To understand the basic categories of threats to computers and networks
- To discuss issues for creating security policy for a large organization

UNIT 1	Information Security: Introduction, History of Information security, What is Security, CNSS Security Model, Components of Information System, Balancing Information Security and Access, Approaches to Information Security Implementation, The Security Systems Development Life Cycle.
UNIT 2	Cryptography: Concepts and Techniques, symmetric and asymmetric key cryptography, steganography, Symmetric key Ciphers: DES structure, DES Analysis, Security of DES, variants of DES
UNIT 3	Message Authentication and Hash Functions: Authentication requirements and functions, MAC and Hash Funtions, MAC Algorithms: Secure Hash Algorithm, Whirlpool, HMAC, Digital signatures, X.509, Kerberos
UNIT 4	Security at layers(Network, Transport, Application): IPSec, Secure Socket Layer(SSL), Transport Layer Security(TLS), Secure Electronic Transaction(SET), Pretty Good Privacy(PGP), S/MIME
UNIT 5	Inruders, Virus and Firewalls: Intruders, Intrusion detection, password management, Virus and related threats, Countermeasures, Firewall design principles, Types of firewalls

OUTCOMES: At the end of the course, the student should be able to:

CO1: Explain the objectives of information security and analyze the importance of information Security in real world.

CO2: Analyse the trade-offs inherent in security and designing and analysis of different encryption Algorithms.

CO3: Implementation of MAC and Hash functions, security at different layers of a network

CO4: Understand the basic categories of threats to computers and networks and explore different types of intruders and viruses.

CO5: Discuss issues for creating security policy for a large organization

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H					M					M			M
CO2	H	H	H	M								M		M	
CO3	H			L									H		
CO4	L				H						M			L	
CO5	M				H	H	H	M		L	M				M

H = Highly Related; M = Medium   L=Low

Text Books –
1. Stalling Williams: Cryptography and Network Security: Principles and Practices, 4th Edition, Pearson Education, 2006.
2. Kaufman Charlie et.al; Network Security: Private Communication in a Public World, 2nd Ed., PHI/Pearson.
Reference Books:
1. Pieprzyk Josef and et.al; Fundamentals of Computer Security, Springer-Verlag, 2008.
2. Trappe & Washington, Introduction to Cryptography, 2nd Ed. Pearson.

Cyber Security
Department Elective 3

BCO 188A	Cyber Forensic & investigation	3-0-0 (3)

Objective:

- To study the fundamentals of Computer Forensics

• To learn, analyze and validate Forensics Data
• To study the tools and tactics associated with Cyber Forensics

UNIT 1	File systems, Microsoft file structure, Examining NTFS disks, Microsoft BitLocker, Third Party Disk Encryption Tools, Windows Registry, Start-up Tasks, Virtual Machines, Macintosh file structure and boot process, UNIX and Linux disk structures and boot processes. Other Disk structures (CD, SCSI, IDE and SATA devices)
UNIT 2	Commercial Forensic Tools (Encase, FTK), Advanced Features of forensic tools (search, encryption and decryption, data carving), windows registry, memory analysis, advanced file system analysis (deleted and hidden data, metadata, temporary file, unknown\executable file analysis), applied decryption.
UNIT 3	Graphic files: recognition, lossless and lossy data compression, locating and recovering graphic files, Identifying unknown file formats.
UNIT 4	Virtual Machines, Network Forensics, Network tools, E-mail Investigation, E-mail forensics tools, Mobile Device Forensic.
UNIT 5	Computer Investigation,Evidence acquisition, Processing crime and Incidence scene, Preserving, Analysis, Digital forensic investigation procedures, Report writing, Ethics

OUTCOMES: At the end of the course, the student should be able to:
CO1: Understand the fundamentals of Computer Forensics
CO2: Learn the issues of Data Acquisition and Data Recovery
CO3: Explore networking in cyber forensics
CO4: Learn to analyze and validate forensics data
CO5: Be familiar with forensic tools and case studies

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M		H									H		
CO2	H	H			M							H	H	L	
CO3	H	H		H									M		
CO4	H	M	H		M	L		M				M		M	H
CO5	M		H		H						L				H

H = Highly Related; M = Medium   L=Low

Text Books –
1. Computer Evidence - Collection and Preservation.Brown, C.L.T. Course Technology CENGAGE Learning.
2. Guide to Computer Forensics And Investigations Nelson, Bill ; Phillips, Amelia; Enfinger, Frank; Steuat, Christopher Thomson Course Technology.
3. Scene of the Cybercrime. Shinder, Debra Littlejohn and Tittel, Syngress

Reference Books:
1. Computer Forensics – Computer Crime Scene Investigation.Vacca, John R. Charles River Media
2. Bunting, Steve and William Wei. EnCase Computer Forensics: The Official EnCE: EnCase Certifed Examiner Study Guide. Sybex, 2006
3. Prosise, Chris, Kevin Mandia, and Matt Pepe. Incident Response: Computer Forensics. McGraw-Hill,
4. Casey, Eoghan, ed. Handbook of Computer Crime Investigation, Forensic Tools and Technology, Academic press
5. Carrier, Brian. File System Forensic Analysis. Addison-Wesley Professional

Cyber Security
Department Elective 4

BCO 189A	**Web and Android Security**	3-0-1 [4]

OBJECTIVES:
- o Introduce the concept of web application security concerns and its related issues.
- o To familiarize the students with various types of analysis techniques ,attacks and tools.
- o To introduce the various android application architecture and Security concerns.
- o To introduce the various types of mobile attacks.

UNIT 1	Web applications: Introduction to web applications, Web application hacking, Overview of browsers, extensions, and platforms.Attacks, detection evasion techniques, and countermeasures for the most popular web platforms, including IIS, Apache, PHP, and ASP.NET Attacks and countermeasures for common web authentication mechanisms, including password-based, multifactor (e.g., CAPTCHA), and online authentication services like Windows Live ID.
UNIT 2	Advanced session analysis, hijacking, and fixation techniques, cross-site scripting, SQL injection, classic categories of malicious input, Overlong input (like buffer overflows), canonicalization attacks (like the infamous dot-dot-slash), and meta characters (including angle brackets, quotes, single quote, double dashes, percent, asterisk, underscore, newline, ampersand, pipe, and semicolon), beginner-to-advanced SQL injection tools and techniques, stealth-encoding techniques and input validation/ output-encoding countermeasures.
UNIT 3	Introduction to Android Applications and Mobile App Security: History of Android, Understanding Android Hardware and Software Architecture, Understanding Android Security Model. Understanding Android Permission Model for Application Security, Sandboxing, Codesigning, Encryption, rooting Devices, Understanding APK Understanding Directories and Files on an APK 9
UNIT 4:	Mobile Application Attacks 1: Setting up Mobile App PentestingEnvironment,Interact with the Devices, Starting with Drozer,UnderstandingAndroidManifest.xml,Configuring, Burp and Traffic Interception,Traffic Interception Bypass, Weak Server Side Controls,Insecure Data Storage,Insufficient Transport Layer Protection,Unintended Data Leakage,Poor Authentication & Authorization 10
UNIT 5	Mobile Application Attacks 2: Broken Cryptography,Client Side Injections,Security Decisions via Untrusted Input,Improper Session Handling,Lack of Binary Protection,ExploitingDebuggableApplications,DeveloperBackdoor,Location spoofing to download location restricted apps,Configuring Live Device for Penetration Testing,Mitigation Approach for all Vulnerabilities.

OUTCOMES:-

Upon completion of this course, the student will be able to:

CO1:Learn web application security concerns and its related issues.
CO2: Develop the Secure web applicationwith helpvarious of analysis techniques and knowledge of different attacks and tools.
CO3: Understand android application architecture and Security issues.
CO4: Know about various types of mobile attacks and to deal with these attacks and develop the secure application
CO5: Able to under the concepts testing, debugging .

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H		M									H		L
CO2	H	H	H		M	L				L		L	H	M	
CO3	H			L	M		L		L				H		M
CO4	H		H			L				M		L		M	
CO5	H	M	H		M	L				M		L	H	M	

Text Books:
1. Hacking Exposed Web Applications, 3rd edition, JOEL SCAMBRAY, VINCENT LIU, CALEB SIMA
2. The Web Application Hacker's Handbook Discovering and Exploiting Security Flaws By DafyddStuttard, Marcus Pinto
3. Mobile device security: A comprehensive guide to securing your information in a moving world. Boca Raton, FL: Auerbach Publications - Fried, S.

Reference Books:
1. Rich Bowen, Ken Coar, "Apache Cookbook", O'Reilly
2. Open Web Application Security Project. A Guide to Building Secure Web Applications and Web Services. http://www.owasp.org/index.php/Category:OWASP_Guide_Project
3. 2 The web application hacker's handbook: Discovering and exploiting security flaws (2nd ed.). Indianapolis, IN: Wiley, John & Sons - Stuttard, D. & Pinto, M.
4. Mobile application security. New York: McGraw-Hill Companies - Dwivedi, H., Clark, C., &Thiel, D.

WAP Lab

- Setting up Mobile App PentestingEnvironment,interact with the Devices, Starting with Drozer

- Configuring, Burp and Traffic Interceptionof Mobile Applications between client and server

- Configuring Live Device for Penetration Testing,Mitigation Approach for all Vulnerabilities.

- Performing static Analysis of Mobile Application using MOBSF

- Perform the jailbreak/Root the Android phone and get admin level Privilege by using tools such as Superoneclick, superboot.

- PerformingCross-application scripting error in Android Browser which leads to hacking the devices.

- Detect application communication vulnerabilities and perform exploitation usingComDroid.

- Perform Jailbreaking on iOS Devices.

- Unlock the iPhone using tools such as iphonesimfree and anySIM.

- Perform a method to send Malicious Payload to the victims iPhone and check whether you can take over the control the victim's phone.

- Perform Man-in-the-Middle attack by intercepting the Wireless parameter of iPhone on wireless network.

- Perform social engineering Attack method and send the malicious link and SMS tricks which contains Malicious web page.

- Develop Backdoor,Location spoofing to download location restricted apps.

- Performing dynamic analysis to find API/Web services vulnerabilities.

- Performing reverse engineering on android applications

- Performing network communication attacks in Android and iOS.

- Performing authentication and session management attacks.

Cyber Security
Department Elective 5

BCO 190A	ETHICAL HACKING	3-0-1 [4]

OBJECTIVES:
Students undergoing this course are exposed to

- Ethical Hacking ethically penetrates into network systems using various tools to test the strength of a network.
- Ethical Hacking course shows how to test, scan, hack and secure networks and systems.
- Get in-depth theoretical knowledge and rich practical experience in hacking test networks.

UNIT 1	Ethical Hacking: Introduction, Networking & Basics, Foot Printing, Google Hacking, Scanning, Windows Hacking, Linux Hacking, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering,
UNIT 2	Introduction to Computer Systems and Networks , information systems and networks (including wireless networks) and their role in industry business and society, System and Network Vulnerability and Threats to Security , various types of attack and the various types of attackers in the context of the vulnerabilities associated with computer and information systems and networks
UNIT 3	Physical Security, Steganography, Cryptography, Wireless Hacking, Firewall & Honeypots, IDS & IPS, Vulnerability, Penetration Testing, Session Hijacking, Hacking Web Servers, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobile Phone Hacking
UNIT 4:	An introduction to basic ethical hacking tools and usage of these tools in a professional environment in a form of project
UNIT 5	An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking. Ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking.

OUTCOMES:-

Upon completion of this course, the student will be able to:

CO1: Understanding the basics of networking with the introduction on the system attacks

CO2 Describes attacks in terms of industry, society and information systems

CO3 Describes various types of securities and vulnerabilities

CO4 Demonstration of the ethical hacking tools

CO5 Summarizing the legal and professional responsibilities of ethical hacking

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H			M						L	M		H	H	
CO2	M			M				M		L	M	H	H	H	
CO3	H	M			H			M			M	H	M		M
CO4	M										H				H
CO5	M							H					H		M

Text Books:

1 Hands-On Ethical Hacking and Network Defense – By Michael T. Simpson, Kent Backman, James Corley
2. Official Certified Ethical Hacker Review Guide – By Steven DeFino, Barry Kaufman, Nick Valenteen.
Reference Books:
1. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy (Syngress Basics Series) [Paperback]
2. Hands-On Ethical Hacking and Network Defense [Print Replica] [Kindle Edition]

Cyber Security
Department Elective 6

BCO 191A	Application of AI in Cyber Security	3-0-0

OBJECTIVE:
- To study various AI terminologies in Cyber security
- Understand the various threats and attacks in cyber world
- To be familiar with different types of attacks and AI techniques to detect them
- Study and Compare real-world attacks and AI to solve them
- To understand ethical challenges and enforcements of laws in Cyber attacks

UNIT 1	Introduction of AI in Cyber Security: AI, Machine learning, and Deep learning within cyber security, What AI and machine learning can do for cyber security, How AI is used in cyber security, Examples of machine learning in cyber security, Use of Artificial Intelligence in Cyber Security, The Future of Cyber security, Impact of AI on Cyber

		security, How They Will Shape the Future.AI systems' support to cyber security, Major techniques in the use of AI for system robustness, resilience, and response,
UNIT 2		Cyber security for AI : Classification of AI Attacks based on attack motivation, Integrity Attack, Availability Attack, Replication Attack, Confidentiality Attack , Classification of AI attacks based on target ,Classification of AI attacks based on attacker capabilities ,Handling AI Attack, Social Media Attacks , Secure AI , Available Software Resources. Case Study of Cybercrime: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, E-mail spoofing instances, The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.
UNIT 3		AI Techniques for Cyber Security : Introduction, Malware Detection and Analysis, Intrusion Detection Systems (IDS) , Generative Adversarial Networks, Attack Detection , Trustworthiness of data, Artificial Intelligence and Hardware Security, Consideration for adoption of AI , Typical use cases.
UNIT 4		Applications from real world: Study of some applications AI-powered threat detection, Detection of sophisticated cyber-attacks, Reducing Threat Response Time, AI-based Antivirus Software, Fighting AI Threats, Email Monitoring ,Using machine learning to analyze mobile endpoints, to enhance human analysis and automate repetitive security tasks.
UNIT 5		Ethics and Laws in Applications of AI in Cyber world :Ethical considerations related to AI in cyber security, Standards on Cyber Security Using AI ,Current and future AI laws: accountability, audit ability, and regulatory enforcement, Existing legal frameworks in cyber security and major policy issues, Risk-assessment policies and suitability testing, privacy and data governance ,**Pitfalls of AI in cyber law.**

Course Outcome:

CO1. Understand role of AI in Cyber Security
CO2. Understand various threats and attacks in cyber world
CO3. Compare and analyze types of attacks and AI techniques to detect them
CO4. Able to understand the real world application requirement and develop it.
CO5. Understand ethical challenges and enforcements of laws for Cyber Security

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M										H			
CO2	M	M										H			
CO3	H	H										H	L	M	
CO4	H	M	H					M				H	M	L	
CO5	M	M						M				H	M		

H = Highly Related; M = Medium; L = Low

Text Book:

1. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018

Cyber Security
Department Elective 7

BCO 192A	Block chain and Cryptocurrency Technology	3-0-1 [4]

OBJECTIVES:
- This course is to understand Blockchain and its main application cryptocurrency.
- Students will learn how this system works and how can they utilize and what application can be build.

UNIT 1	Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. ,Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof
UNIT 2	Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.
UNIT 3	Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate
UNIT 4:	Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Name coin Cryptocurrency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy.
UNIT 5	Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.

OUTCOMES:-

Upon completion of this course, the student will be able to:

CO1: Learn basic concepts of block-chains
CO2: Understanding the crypto-currency technology
CO3: Know the block chain architecture
CO4: Study the block chain applications
 CO5: Learn the regulatory frameworks

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		L		L		M								
CO2	L	L											L		
CO3	M				L		M	M							
CO4	M		1					M					L	M	
CO5							M								L

Reference Books:
- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
- Wattenhofer, The Science of the Blockchain
- Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
- Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
- DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
- Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts

Tutorial & Practical

- Naive Blockchain construction,
- Memory Hard algorithm –
- Hashcash implementation,
- Direct Acyclic Graph,
- Play with Go-Ethereum,
- Smart Contract Construction,
- Toy application using Blockchain,
- Mining puzzles

AI & ML Track

AI &ML
Department Elective 1

BCO 019A	ARTIFICIAL INTELLIGENCE	3:0:0

Course Objective:

- To explain the basic principles of artificial intelligence

- To apply logic and structured concepts in knowledge representation and discuss the applications of artificial intelligence
- To implement and analyze Uninformed and Informed Search Strategies
- To implement and apply various game playing Algorithms to different problems
- Understand and represent various types of logics and their forms
- To Understand and various Learning techniques and analyze concept of ANN

UNIT 1	**Introduction**- What is intelligence? Foundations of artificial intelligence (AI), Task of artificial intelligence, Techniques of artificial intelligence, Problem Solving Formulating problems, problem types, states and operators, state space. Knowledge Representation- Role of Knowledge, Declarative Knowledge, Procedural Knowledge, Knowledge representation Techniques; conceptual graphs; structured representations; frames, scripts; issues in knowledge representation
UNIT 2	**Uninformed & Informed Search Strategies**- Breath First Search, Depth First Search, Depth Limited Search, Heuristic Functions, Best First Search, Hill Climbing Algorithm, Problems and solutions of Hill Climbing, Iterative Deepening (IDA), A* algorithm, AO* Algorithm
UNIT 3	**Game playing**- Introduction, Types of games, Minimax game algorithm, Alpha Beta cut-off procedure , Jug problem, Chess problem, Tiles problem
UNIT 4	**Logics-** Propositional logics, First Order Predicate Logics (FOPL), Syntax of First Order Predicate Logics, Properties of Wff, Clausal Forms, Conversion to clausal forms
UNIT 5	**Learning-** Overview of different forms of learning, Supervised base learning, Unsupervised based learning, Introduction to Neural networks:- basic, comparison of human brain and machine, biological neuron, general neuron model, Basic Architecture of Neural Networks, Single Computational Layer: The Perception, Choice of Activation functions, Number of Output Nodes and Loss Functions, applications and advantages of neural networks. Brief introduction to single layer and multiplayer networks

Course Outcomes: Upon the end of this course, student will be:

CO1: Familiar with the basic principles of artificial intelligence

CO2: To implement and analyse uninformed and informed Search algorithms

CO3: Able to represent and apply various logics and structured concepts in knowledge representation

CO4: To implement and apply various game playing algorithms to different problems

CO5: To Understand various Learning techniques and concept of ANN

 COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	L	M	H	L			M		L	H	L		
CO2	H	H	H	M	H	L			H	M	M	H	M		
CO3	H	M	M	H	H	L	L	L	M	M	M	H	M	M	H
CO4	H	M	M	H	H	L	L	L	H	M	M	H	H	M	H
CO5	H	L		L	M	L			M		L	H	L		M

H = Highly Related; M = Medium L = Low

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence – A Modern Approach, Pearson Education Press, 2001.

2. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, McGraw Hill, 2008.

3. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

Reference Books:

1. George F. Luger, Artificial Intelligence, Pearson Education, 2001.

2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kauffman, 2002.

AI &ML
Department Elective 2

BCO086B	MACHINE LEARNING	3-0-1 [4]

Course Objectives

- To understand the basic concepts of learning and decision trees.
- To understand the neural networks and genetic algorithms
- To understand the Bayesian techniques
- To understand the instant based learning
- To understand the analytical learning and reinforced learning

UNIT 1	INTRODUCTION, CONCEPT LEARNING AND SUPERVISED LEARNING ALGORITHMS: Introduction, Types of learning, Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm , Linear Regression Model, Naïve Bayes

	Classifier, Decision Tree, K Nearest Neighbor, Logistic Regression, Support Vector Machine, Random Forest Algorithm.
UNIT 2	UNSUPERVISED LEARNING ALGORITHM: Clustering- K-means Clustering, Hierarchical Clustering, Probabilistic Clustering, Apriori Algorithm, Association Rule Mining, Gaussian Mixture Model, Expectation Maximization. ENSEMBLE LEARNING-Bagging, Boosting and Stacking
UNIT 3	REGULARIZATION- Overfitting, Underfitting, Bias-Variance trade off, Cost Function, Regularized Linear Regression and Regularized Logistic Regression, Model Selection and train/Validation/Test Sets, VC Dimension. STATISTICAL LEARNING- Feature Extraction, Principal Component Analysis, Singular Value Decomposition, Feature Selection and subset selection.
UNIT 4	NEURAL NETWORKS AND GENETIC ALGORITHMS Neural Network Representation – Problems – Perceptron – Multilayer Networks and Back Propagation Algorithms – Gradient Descent.
UNIT 5	ANALYTICAL LEARNING AND REINFORCED LEARNING Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning- Markov Decision Processes (MDP), Introduction to Natural Language Processing and Recommended System- Collaborative and Content based Filtering.

Course Outcome:
CO1. Choose the learning techniques with this basic knowledge.
CO2. Apply effectively neural networks and genetic algorithms for appropriate applications
CO3. Apply Bayesian techniques and derive effectively learning rules.
CO4. Choose and differentiate reinforcement and analytical learning techniques
CO5. Able to understand the concepts of analytical learning and reinforced learning
MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M											M	M	
CO2	H	H	H	H	H								M	M	
CO3	H	H			M									M	
CO4	H	H	H	H	M									M	
CO5	M	H		M									L	M	

H = Highly Related; M = Medium ;L = Low

Required Texts:

1. Machine Learning, Tom Mitchell, McGraw Hill, 1997, ISBN 0-07-042807-:
2. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

REFERENCES:

1. EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.

BCO 089 B	MACHINE LEARNING LAB	0-0-2 [2]

Course Outcomes

CO1. To implement regression and various learning algorithms
CO2. Implement various classifiers and amalyze those classifiers base on confusion matrix
CO3. pattern recognition and machine learning theories
CO4. To design neural network and test network for different dataset
CO5. To apply the ML theories to different applications like face

List of Experiments

Lab 1. Implement the CANDIDATE – ELIMINATION algorithm. Show how it is used to learn from training examples.

Lab 2. Write a program to implement Linear Regression and Logistic Regression

Lab 3. Implement the ID3 algorithm for learning Boolean–valued functions for classifying the training examples by searching through the space of a Decision Tree.

Lab 4. Design and implement Naïve Bayes Algorithm for learning and classifying TEXT DOCUMENTS.

Lab 5. Implement K-Nearest Neighbor algorithm to classify the iris data set. Calculate the score also.

Lab 6. Write a program to implement Support Vector Machine. Also discuss the confusion matrix and score of model.

Lab 7. Apply EM algorithm to cluster a set of data and also apply K-Means algorithm on the same data set to compare two algorithms.

Lab 8. Build an Artificial Neural Network by implementing Back-Propagation algorithm and test the same using appropriate data set.

Lab 9. Implement the Non-Parametric Locally Weighted Regression Algorithm in order to fit data points. Select appropriate data set for your experiment and draw graph.

Lab 10.   Build a Face detection system to recognize faces in a frame or image. You can use OpenCV for this task.

AI &ML
Department Elective 3

BCO618A	Generative AI and Explainable AI	3-0-0

Objective

- To provide conceptual understanding of Generative AI and Explainable AI.
- To explore how to build generative AI systems and apply prompt engineering techniques.
- To understand model interpretability, post hoc explanations, and concept-based interpretability.
- To equip students with the ability to explain, evaluate, and justify decisions made by AI systems.
- To explore ethical challenges and fairness concerns in generative and explainable AI systems.

UNIT 1	**Foundations of Generative and Explainable AI:** Definition and scope of Generative AI and Explainable AI. Motivation for interpretability in machine learning. Applications and impact across domains (healthcare, education, finance, creative arts, etc.). Human factors in explainability and transparency. Ethical implications, bias, and challenges in both paradigms.
UNIT 2	**Language Models and Generative Architectures:** Introduction to language modeling: Traditional vs Deep Learning-based. Overview of RNNs, LSTMs, and Transformers. GPT architecture: Pre-training, Fine-tuning, and Applications. GPT variants and their use cases. Role of LangChain and its components in developing generative pipelines. Prompt Engineering: strategies and best practices.
UNIT 3	**Interpreting AI Models:** Model interpretability: myths and scientific foundations. Feature attribution methods: LIME, SHAP, and limitations. Post hoc explanations and counterfactual analysis. The disagreement problem and model-agnostic interpretability. Tools: OpenXAI, interpretable dashboards.
UNIT 4	**Concept-Based & Generative Model Explainability:** Concept-based explanations and deep visual representations. Interpreting generative models and diffusion models. Explainable Active Learning (XAL). Data attribution and equitable valuation of data. Interactivity and transparency in generative applications.
UNIT 5	**Fairness, Ethics, and Societal Impact:** Fairness through explainability. Robustness, Privacy, Unlearning, and the "Right to be Forgotten". Mechanistic interpretability and compiled transformers. Reasoning and understanding in LLMs. Real-world case studies from NLP, image generation, recommendation systems.

Course Outcome (CO):

At the end of this course students will have:

- CO1: Understand and apply Generative AI models including GPT and LangChain frameworks.
- CO2: Design effective prompts and content generation pipelines using LLMs.
- CO3: Employ interpretability techniques like SHAP, LIME, and counterfactual explanations for black-box models.
- CO4: Critically evaluate the trade-offs between accuracy, complexity, and explainability.
- CO5: Identify and address ethical, social, and fairness concerns in the deployment of AI systems.
- CO6: Apply explainability and generative techniques to real-world data problems with hands-on experience.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		H		M						L				
CO2		H		H								M	M		
CO3								H	M	L				H	
CO4	L		L		L	M									L
CO5	H				H	M		M			H		M		

H = Highly Related; M = Medium L = Low

Text Books:

- Generative Deep Learning by David Foster, 2nd Edition, O'Reilly.
- Neural Network Methods for Natural Language Processing by Goldberg, Morgan & Claypool Publishers.
- Michael Munn, David Pitman, Explainable AI for Practitioners, O'Reilly Media, Inc. , 2022.

Reference :

- Christoph Molnar, Interpretable Machine Learning, A Guide for Making Black Box Models Explainable, Leanpub , 2023.
- Denis Rothman, Hands-On Explainable AI (XAI) with Python: Interpret, visualize, explain, and integrate reliable AI for fair, secure, and trustworthy AI apps, Packt Publishing Limited , 2020.
- Leonida Gianfagna, Antonio Di Cecco, Explainable AI with Python, Springer , 2021

AI &ML
Department Elective 4

BCO 194A	NEURAL NETWORKS	3-0-1

Course Objectives

- The main objective of this course is to provide the student with the basic understanding of neural networks fundamentals,
- Program the related algorithms and Design the required and related systems
- To evaluate the performance of neural architectures in comparison to other machine learning method

UNIT1	**Introduction to Artificial Neural Network :** Introduction and ANN Structure, Biological neurons and artificial neurons, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear separability, Type of network architecture, Activation functions, Basic Learning rules, Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures.
UNIT2	**Mathematical Foundations and Learning Mechanisms**.Re-visiting vector and matrix algebra, State-space concepts, Concepts of optimization, Error-correction learning. Memorybased learning, Hebbian learning. Competitive learning
UNIT3	**Single Layer Perceptrons**: Structure and learning of perceptrons, Pattern classifier, introduction and Bayes' classifiers, Perceptron as a pattern classifier, Perceptron convergence. Limitations of a perceptrons.
UNIT4	**Feed forward Networks:** Multilayer Neural Network, Gradient Descent learning, Back propagation, Empirical Risk Minimization, regularization, Radial Basis Neural Network bias-variance trade off, regularization - over fitting - inductive bias regularization - drop out – generalization
UNIT 5	**Radial Basis Function Networks**: Pattern separability and interpolation, Regularization Theory Regularization and RBF networks, RBF network design and training. Approximation properties of RBF.

Text Books

1. Simon Haykin, "Neural Networks, A Comprehensive Foundation", 2nd Edition, Addison Wesley Longman, 2001.
2. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006
3. CharuC.Aggarwal "Neural Networks and Deep learning" Springer International Publishing, 2018
4. Satish Kumar, "Neural Networks, A Classroom Approach", Tata McGraw -Hill, 2007.

Course Outcomes

CO1. Explain & Demonstrate the basic concepts in Neural Networks and applications
CO2. Define foundations and learning mechanisms and state-space concepts
CO3. Identify structure and learning of perceptions
CO4. Explain Feed forward, multi-layer feed forward networks and Back propagation algorithms
CO5. Analyze Radial Basis Function Networks, Theory Regularization and RBF network

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			M							M			
CO2	M	L										M	M	M	
CO3	H	M	M		M							H			
CO4	H	M	M	M	M							H			
CO5	H	M	M	M	M							H	M	M	

ARTIFICIAL NEURAL NETWORK LAB	0-0-2

Course Objectives:

At the end of the course

- The students should be able to design and implement machine learning solutions
- Understand classification, regression, and clustering problems;
- Able to evaluate and interpret the results of the algorithms.

List of Experiments

Lab 1. Create a custom feed-forward network .It consists of the following sections:

Constructing Layers , Connecting Layers , Setting Transfer Functions, Weights and Biases , Training Functions & Parameters , Performance Functions , Train Parameters

Lab 2. Write a program to plot various membership functions.

Lab 3. Generate AND, NOT function using McCulloch-Pitts neural net program.

Lab 4. Generate XOR function using McCulloch-Pitts neural net.

Lab 5. Write a program for Perceptron net for an AND function with bipolar inputs and targets

Lab 6. Write a program of Perceptron Training Algorithm

Lab 7. Write a program of Back Propagation Algorithm.

Lab 8. Implement ANN and compare , regularization, overfitting, underfitting and drop out

Lab 9. Write a for Hebb Net to classify two dimensional input patterns in bipolar with their given targets

Lab 10. Write a program to implement Hebb's rule

Course Outcomes

CO1. Explain & Demonstrate the basic concepts in Neural Networks and applications

CO2. Define foundations and learning mechanisms and state-space concepts

CO3. Identify structure and learning of perceptions

CO4. Explain Feed forward, multi-layer feed forward networks and Back propagation algorithms

CO5. Analyze Radial Basis Function Networks, Theory Regularization and RBF network

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			M							M			
CO2	M	L										M	M	M	
CO3	H	M	M		M							H			
CO4	H	M	M	M	M							H			
CO5	H	M	M	M	M							H	M	M	

AI &ML
Department Elective 5

BCO616A	LARGE LANGUAGE MODELS	Total Credits: 3

Course Objectives:

1. To introduce students to the fundamentals of neural networks and transformer architectures forming the basis of large language models (LLMs).
2. To understand pre-training, fine-tuning, and inference processes of LLMs, and their real-world applications
3. To explore prompt engineering, evaluation methods, and alignment techniques for safe and ethical usage.
4. To study the impact and future trends of LLMs in domains such as healthcare, finance, education, and software development.

UNIT 1	**Introduction to Large Language Models:** Overview of Natural Language Processing (NLP), From Statistical Models to Deep Learning: RNNs, LSTMs, Attention Mechanism, Evolution of Transformers: BERT, GPT, T5, and beyond, Characteristics of LLMs: Scale, Context Windows, Emergent Abilities, Applications and Impact in Industry (Chatbots, Coding Assistants, Search, Content Generation).
UNIT 2	**Transformer Architecture and Training:** Attention Mechanism (Self-Attention, Multi-Head Attention), Positional Encoding, Feed-Forward Layers, Residual Connections, Pre-training Objectives: Masked Language Modeling, Causal Language Modeling, Tokenization Methods: BPE, SentencePiece, Hardware and Parallelization for LLM Training (GPUs, TPUs, Distributed Training).
UNIT 3	**Fine-Tuning and Adaptation Techniques**: Transfer Learning and Domain Adaptation, Instruction Tuning and Reinforcement Learning with Human Feedback (RLHF), Parameter-Efficient Fine-Tuning (LoRA, Prefix Tuning, Adapters), Prompt Engineering: Zero-Shot, Few-Shot, Chain-of-Thought Prompting, Evaluation Metrics: Perplexity, BLEU, ROUGE, Human Evaluation.
UNIT 4	**Applications and Case Studies**: LLMs for Code Generation (Copilot, Code Llama), Conversational AI (ChatGPT, Claude), Knowledge Retrieval and RAG (Retrieval-Augmented Generation), Multimodal LLMs (Text-to-Image, Speech-to-Text, Video Understanding), Enterprise Use Cases: Healthcare, Finance, Legal, and Education.
UNIT 5	**Challenges, Ethics, and Future Trends:** Bias, Fairness, and Hallucination in LLMs, Privacy, Security, and Safe Deployment, Energy Efficiency and Model Compression, Open Source vs Proprietary Models (LLaMA, Mistral, GPT-4, Gemini), Future Directions: Agentic AI, AutoGPT, Continual Learning, and Personalized Models

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO1: Understand the evolution and fundamentals of LLM architectures and their training principles.
CO2: Analyze pre-training and fine-tuning strategies for adapting LLMs to specific tasks.
CO3: Design effective prompts and evaluate LLM outputs for accuracy and safety.
CO4: Apply LLMs in real-world use cases like chatbots, coding, and multimodal applications.
CO5: Assess ethical considerations and emerging trends in LLM research and applications.

Suggested Books

1. **"Attention Is All You Need"** – Vaswani et al., 2017 (Transformer Paper)
2. **"Deep Learning for Natural Language Processing"** – Palash Goyal et al.
3. **"Transformers for Natural Language Processing"** – Denis Rothman
4. **Hugging Face Course:** https://huggingface.co/course
5. **OpenAI Blog** (https://openai.com/research) and **Anthropic Research Papers**
6. **"Hands-On Large Language Models"** – Ankur Patel, Ajay Uppili Arasanipalai (O'Reilly, 2024)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M		L	M							M	H	M	M
CO2	M	H	M	M	H							M	H	H	M
CO3	M	H	H	M	H	L		M		M		M	H	H	H
CO4	H	M	H	M	H	M	L	L	M	M	L	M	H	H	H
CO5	M	M	L	M	M	H	M	H		M		H	M	M	H

H = Highly Related; M = Medium L = Low

BCO617A	**LARGE LANGUAGE MODELS LAB**	**Total Credits: 1**

List of Experiments

Students are required to perform any ten experiments out of the following list of experiments.

1	**Tokenization Techniques:** Implement Byte Pair Encoding (BPE) and SentencePiece tokenization on a sample dataset and analyze vocabulary size vs. performance.
2	**Word Embeddings Visualization:** Train Word2Vec/Glove embeddings and visualize semantic similarity using PCA or t-SNE.
3	**Attention Mechanism Demo:** Implement self-attention on a small sequence and visualize attention weights.
4	**Mini Transformer Model:** Build a simple transformer model (encoder-decoder) for sequence-to-sequence tasks like translation.
5	**Pre-trained LLM Usage:** Use Hugging Face Transformers to load GPT-2 or BERT and generate text on custom prompts.
6	**Fine-Tuning Small LLM:** Fine-tune DistilBERT or GPT-2 on a domain-specific dataset (e.g., news or product reviews).
7	**Prompt Engineering Techniques:** Compare zero-shot, few-shot, and chain-of-thought prompting using OpenAI or Hugging Face APIs.
8	**Retrieval-Augmented Generation (RAG):** Implement document retrieval + LLM pipeline to answer questions from a custom corpus.
9	**LLM Evaluation Metrics:** Evaluate model outputs using BLEU, ROUGE, and perplexity on generated text.
10	**Bias Detection in LLMs:** Analyze outputs of a pre-trained LLM for potential bias using predefined prompts.
11	**LoRA Fine-Tuning:** Implement Low-Rank Adaptation (LoRA) on a small transformer model for efficient fine-tuning.
12	**Multi-Modal LLM Demo:** Use CLIP or LLaVA to generate image captions and compare with text-only models.
13	**Model Compression:** Apply quantization or pruning on a small LLM and evaluate inference speed and accuracy trade-offs.
14	**Safety and Alignment Testing:** Evaluate model responses for harmful content and propose prompt-level mitigations.
15	**Deploying LLM on Cloud:** Host a fine-tuned model using Hugging Face Spaces or Azure ML endpoint.
16	**AutoGPT/Agentic Demo:** Create a simple multi-step autonomous agent using LLM APIs to complete a defined goal.

Course Outcomes-

While graduating, students of the **Large Language Models Lab** program would be able to:

CO1: *Demonstrate understanding of LLM components (tokenization, attention, transformer blocks) through hands-on experiments.*
CO2: *Fine-tune and evaluate pre-trained LLMs for specific tasks using modern tools and frameworks.*
CO3: *Apply prompt engineering, RAG, and parameter-efficient methods to optimize performance.*
CO4: *Analyze ethical and safety aspects in LLM outputs and propose mitigation strategies.*
CO5: *Deploy and integrate LLM-based applications in real-world scenarios using cloud and open-source platforms.*

. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M		L	M							M	H	M	M
CO2	M	H	M	H	H							M	H	H	M
CO3	M	H	H	M	H	L		M		M		M	H	H	H
CO4	M	M	L	M	H	H	M	H		M		H	M	M	H
CO5	H	M	H	M	H	M	L	L	M	M	L	M	H	H	H

H = Highly Related; M = Medium L = Low

AIML
Department Elective 6

BCO 196A	DEEP LEARNING -PRINCIPLE & PRACTICE	3-0-0

Course Objectives

- To understand the concepts of deep Learning neural networks
- Familiar with the fundamental principles, theory and approaches for learning with deep neural networks
- Discuss Convolution Neural Network models to Applications
- Analyse performance of deep networks.
- Understanding Deep Learning applications and tools in different fields

UNIT1	**Deep Learning Fundamentals and Strategies**: Introduction to deep learning-History of Deep Learning- Perspectives and issues in deep learning – Deep Neural Networks - Unsupervised deep learning - Deep reinforcement learning - Deep learning strategies. Comparisons between architecture of different types of deep learning models,
UNIT2	**Introduction to Convolution Neural Networks**: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications. Case studies: Alex net, VGGNet, GoogLeNet
UNIT3	**Introduction to Recurrent Neural Networks**: Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, Optimization in deep learning: Gradient Descent (GD), Momentum Based GD, RNN application
UNIT4	**Autoencoders:** Undercomplete auto encoders, regularized auto encoders, sparse auto encoders, denoising auto encoders, representational power, layer, size, and depth of auto encoders, stochastic encoders and decoders
UNIT 5	**Deep Learning Applications and Tools**: deep learning in Image Processing, Natural Language Processing, Speech Recognition, Video Analytics Tools like NVIDIA , Tensor Flow, Caffe, Theano, Torch.

Text Books
1. CharuC.Aggarwal "Neural Networks and Deep learning" Springer International Publishing, 2018
2. 4.Ian Goodfellow, Deep Learning, MIT Press, 2016.
3. Jeff Heaton, Deep Learning and Neural Networks, Heaton Research Inc, 2015.
4. Mindy L Hall, Deep Learning, VDM Verlag, 2011
5. Li Deng (Author), Dong Yu, Deep Learning: Methods and Applications (Foundations and Trends in Signal Processing), Now Publishers Inc, 2009.

Course Outcomes

CO1. Describe the Feed forward and Deep networks.
CO2. Discuss & Apply Convolution Neural Network models to applications
CO3. Analyse various deep networks and analyze their performances
CO4. Able to understand the concepts of auto encoders.
CO5. Understanding Deep Learning applications and tools in various areas

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L										M			
CO2	M	L			H							M			
CO3	H	M	M	M	H							H	M	H	
CO4	H	M	L	H								H		M	
CO5	H	M	M	M	M							H	M	M	

AI &ML
Department Elective 8

BCO 197A	APPLICATION OF AI IN INDUSTRY	3-0-0

Course Objectives

- Able to apply the concept of Artificial intelligence in various sectors
- Familiarize with applications of Artificial intelligence in banking Applications .
- Appreciate the various applications in Communication and Education Industry.
- Identify the applications in Health care and Government sectors.
- Recognize the applications in Manufacturing industry and Transportations.

Module 1:	**AI in Banking :** Use of AI in banking and finance, Fraud detection, , Risk modeling and investment banks, Customer data management, Decreased customer experience and loyalty, Personalized marketing, Role of machine learning: Challenges of banking sector and securities, Widely used machine learning algorithms in banking and security, Fraud prevention and detection systems, Rule based and machine learning based approach in fraud detection, Anomaly detection: Ways to expose suspicious transactions in banks, Advanced fraud detection systems, Risk management systems, Current challenges and opportunities: Banking and security domain.
Module 2:	**AI in Communication, Media & Healthcare:** Usage of AI in media and entertainment industry, Machine learning techniques for customer sentiment analysis, Real-time analytics in communication, Real time analytics and social media, Recommendations engines. The most important applications of machine learning in healthcare, Role of machine learning in drug discovery, Medical image analysis, Why deep learning for medical image analysis and Predictive medicine: Prognosis and diagnostics accuracy, Predictive medicine
Module 3:	**AI in Education & Manufacturing:** Advantages of AI in education, learning analytics, Academic analytics, Action research, Educational data mining, Personalized adaptive learning, Learning analytics process, Case study: Application of ML in predicting students' performance. Applications in manufacturing industry, Deep learning for smart manufacturing, Machine learning for quality control in manufacturing, Case study, Construction of CNN, Experimental results, Efficiency of CNN for defect detection, Comparative experiments, Machine learning for fault assessment, Machinery failure prevention technology.

Module 4:	**AI in Government Administration:** Type of government problems appropriate for AI applications, AI for citizen services use cases, Answering questions, Routing requests, Translation, Drafting documents, Chat bots for communication between citizen and government, Media richness theory, Chatbots in the public sector, Case study, Data management services, Knowledge processing services, Application services.
Module 5:	**AI in Transportation & Energy Sector:** Applications of ML and artificial intelligence in transportation, Incident detection, Predictive models, Application of AI in aviation and public transportation, Aviation, Shared mobility, Buses, Intelligent urban mobility, Autonomous vehicles, Autonomous transportation, Artificial intelligence use cases in logistics, Back office AI, Cognitive customs, Predictive logistics, Predictive risk management, Seeing thinking and speaking logistics operations, ML powered customer experience, Limitations of AI techniques in transportation, AI in Smart grid technologies, Key characteristics of smart grid, Machine learning applications in smart grid, Machine learning techniques for renewable energy generation, Forecasting etc Case studies

TEXT BOOK

1. David Beyer, Artificial Intelligence and Machine Learning in Industry,: O'Reilly Media, Inc.,ISBN: 9781491959336
2. Doug Hudgeon, Richard Nichol,Machine Learning for Business **, D**ecember 2019 , ISBN 9781617295836
3. Application of machine learning in industries (IBM ICE Publications).
4. Andreas François Vermeulen, "Industrial Machine Learning", Apress, Berkeley, CA,2020

Course Outcomes

CO1. Familiarize, compare and analyze the role of AI in banking applications
CO2. Analyze the applications in Media and Health care Industry
CO3. Appreciate the various applications in manufacturing industry and Education sectors.
CO4. Identify the problems in public sectors and role of AI in the solutions
CO5. Recognize the applications and challenges in Transportation and Energy Sectors

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M			H							H	M	M	
CO2	H	H			H	M						H	M	M	
CO3	H	H			H	M						H	M	M	
CO4	H	H			H							H	M	M	
CO5	H	H			H							H	M	M	

Cloud Computing

Cloud Computing
Department Elective 1

BCO 198A	Introduction to Cloud Computing: Course Outlines	3-0-0

Course Objective:

1. To familiarize the philosophy, power, practical use of cloud.
2. To introduce fundamental principles, technology, and techniques of CC
3. To Discuss common problems that can be best solved with/in cloud
4. To Eliminate misconceptions about cloud computing

UNIT I	CLOUD COMPUTING FUNDAMENTALS: Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications
UNIT II	CLOUD APPLICATIONS: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages
UNIT III	MANAGEMENT OF CLOUD SERVICES: Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)
UNIT IV	APPLICATION DEVELOPMENT: Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.
UNIT V	CLOUD IT MODEL: Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO)

Outcomes:

At the end of the course, the student should be able to:

CO1: Identify the philosophy, power, and practical use of cloud.

CO2: Present fundamental principles, technology, and techniques tobuild cloud applications.

CO3: Solve and manage common problems that can be encountered during setup of cloud computing infrastructure.

CO4: Build understanding of development environment for cloud based services.

CO5: Analyse cloud IT model requirements to improve QoS.

Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	H			L									H	
CO2	H	M													
CO3				H							L	M	H	H	H
CO4			H		M						L		H		H
CO5				H								M	M	M	M

H = Highly Related; M = Medium L = Low

TEXT BOOK:

1. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.

REFRENCE BOOK:

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.

 2. Dimitris N. Chorafas, "Cloud Computing Strategies" CRC Press; 1 edition [ISBN: 1439834539],2010.

Cloud Computing
Department Elective 2

BCO 199A	Introduction to IT Infrastructure: Course Outlines	3-0-2

Course Objective:

The course enables students to understand the Database, Application and Middleware along with System Server hardware and Directory Services.

Module 1:	**IT Infrastructure & Management – Basics**: Various infrastructures – Server, Storage, network, Firewall, Security, Information Technology And System Maintenance overview, Backup and Restore, Defragment, Disk Management, Booting system, Securing system from virus or unauthorized
Module 2:	**Users and Access Policy Management:** Deploying & Configuring Network Connectivity in Windows Server 2008, Active Directory,Group policy , Application Server and Services, troubleshooting group policies, ApplicationAvailability , Implement application accessibility , application deployment , terminal Services, Server Virtualization , File and Print Servers
Module 3:	**Remote & Network Access Protection:** Certification services, Network policy server , Remote Access Accounting , Network accessprotection certificate authority , configuring and monitoring CS , CA health , LUN , VDS,Storage manager for SANs , multipath I/O , cluster tools , shadow copies of shared folders ,webadmin tools , remote backup of system , System centre & data protection manager, intrusiondetection systems.
Module 4:	**Internetwork Implementation & Maintenance:** Security services, Wireless Technology, IPV6, WAN, Threats, Monitoring & customizingAccess lists for various industry specific scenarios , Testing & Troubleshooting NAT,Introduction to Wireless Technology, Basics of IPv6, Configuring Routers with IPv6, WANbasics, WAN connection types, WAN, protocols, Frame Relay, Fiber Networks andmaintenance, Introduction to Mail Servers, basic concepts of exchange.
Module 5:	**Network Firewall administration:** Smart portal features , DNS implementation , IPv6 reporting , Firewall – 1 / VPN – 1 features ,cooperative Enforcement , AMT support , Internal URL Web Filtering , Internal Antivirus,Scanning , Edge support for CLM, smart centre installation , Dedicated Server Installation , Atour of dashboard , VPN, communities , New in smart dashboard NGX , first security policy,Useful control on dashboard, check point software, Managing Connectra and InterspectGateways.
	Suggested Practical List: (Implement using Python/Java)

- Deploying & Configuring Network Connectivity in Windows Servers / Linux Servers
- Configuration and Customization of Access Control List and Active Directory
- Setup and configure terminal Services, Server Virtualization, File and Print Servers on Open Source
- Setup and maintenance of Storage – RAID levels, Backup policies
- Setup and Maintenance of Remote Back Up systems & policies
- Hands on various Remote & Network Access Protection mechanism
- Monitoring & customizing NAT for various industry specific scenarios, Testing & Troubleshooting NAT
- VPN Server Installation & Configuration
- Simulations on Fiber Networks and maintenance related activities
- Implementation of WAN & Configuring Routers with IPv6
- Setup & Configure E-Mail Servers, Passive Mail server, exchange servers with proper Mailbox Server Roles
- Setup of Network Firewall, Rule Management and overall admiration of organization
- Hands on Internal URL Web Filtering

Outcome:

At the end of the course, the student should be able to:

CO1: Build understanding of Application and Middleware along with System Server hardware and Directory Services.

CO2: Present good knowledge of IT infrastructure, services and its policy management.

CO3: Identify and Troubleshootinternetwork securities issues.

CO4: Solve common problems that can be encountered during setup of server, storage, network and firewall.

CO5: Apply knowledge to setup and configure terminal services, servers, storage, network and firewalls.

Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			H		M									M	L
CO2	M	H										M	H	M	M
CO3		H						M					H	H	
CO4	H								L			H		H	H
CO5	H										M	H	H		H

H = Highly Related; M = Medium L = Low

Text Books:
1. Introduction to IT infrastructure Landscape (IBM ICE Publication)
2. Fundamentals of Computer Organization and Architecture By Mostafa AB−EL−BARR and Hesham EL−REWNI
3. Windows Server Administration By Ian McLean and Orin Thomas-Microsoft PressPublisher
4. CCNA Todd Lammle- Wiley Publishing Inc

Reference:
1. 70-662 MCTS exchage 2010 microsoft press
2. Checkpoint NGX R65 by : Ralph Bonell
3. Firewalls for dummies, Brain Komar, Ronald Beekelaar,JoernWettern, for Firewall Security

Cloud Computing
Department Elective 3

BCO 200A	Cloud Architecture: Course Outlines	3-0-0

Course Objective:

This course gives students an insight into the different cloud computing architecture, framework, working along with service centric issues, Security management issues, and virtualization issues and their solutions.

Module 1:	Understanding cloud computing architectures: Introduction to Cloud Computing architecture–Types, Benefits and Drawbacks –Architecture for Cloud Service Models, Architecture for Cloud Development Models.
Module 2:	Cloud Architecture Technology and Architectural Requirements: The Business Case for Clouds - Hardware and Infrastructure – Accessing the cloud – Cloud Storage – Standards- Software as a Service – Discovering Cloud Services Development tools. Three Layered Architectural Requirement - Provider Requirements
Module 3:	Service Centric Issues - Interoperability - QoS - Fault Tolerance - Data Management Storage and Processing - Virtualization Management - Scalability - Load Balancing - Cloud Deployment for Enterprises - User Requirement - Comparative Analysis of Requirement.
Module 4:	Security Management in Cloud: Security Management Standards - Security Management in the Cloud Availability Management - SaaS Availability Management - PaaS Availability Management - IaaS Availability Management - Access Control - Security Vulnerability, Patch, and Configuration Management – Privacy in Cloud- The Key Privacy Concerns in the Cloud - Security in Cloud Computing.
Module 5:	Virtualization: Objectives - Benefits - Virtualization Technologies - Data Storage Virtualization – Storage Virtualization – Improving Availability using Virtualization - Improving Performance using Virtualization- Improving Capacity using Virtualization.

Outcomes:

At the end of the course, the student should be able to:

CO1: Understand cloud computing architecture, types, services, drawbacks and benefits.

CO2: Formulate cloud architectural requirements.

CO3: Analyse service and deployment centric issues to maintain Quality of Service parameters.

CO4: Build understanding of key privacy concerns in cloud security management.

CO5: Apply virtualization technology to improve availability, performance and capacity of IT infrastructure.

Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				H								M			L
CO2		H											H	L	
CO3				H										H	H
CO4					M	M						H	H		
CO5	H								L		L				

H = Highly Related; M = Medium L = Low

Text books:

1. David S Linthicum, "Cloud Computing and SOA Convergence in your Enterprise A Step by Step Guide", Addison Wesley Information Technology Series.
2. Anthony T Velte, Toby J.Velte, Robert Elsenpeter, "Cloud computing A Practical Approach ", Tata McGraw Hill Publication

References:

1. Tim Mather, Subra Kumara swamy, Shahed Latif, "Cloud Security and Privacy –
2. An Enterprise Perspective on Risks and Compliance" , O'Reilly Publications, First Edition
3. Michael Miller, "Cloud Computing – Web-Based Applications that Change the Way You Work and Collaborate Online", Pearson Education, New Delhi, 2009.
4. Cloud Computing Specialist Certification Kit – Virtualization Study Guide.

Cloud Computing
Department Elective 4

BCO 201A	Cloud Application Development: Course Outlines	3-0-2

Course Objective:
1. To familiarize the eco-system of cloud based applications.
2. To introduce fundamental principles, technology, and techniques of designing code for the cloud applications.

UNIT I	CLOUD BASED APPLICATIONS: Introduction, Contrast traditional software development and development for the cloud. Public v private cloud apps. Understanding Cloud ecosystems – what is SaaS/PaaS, popular APIs, mobile
UNIT II	DESIGNING CODE FOR THE CLOUD: Class and Method design to make best use of the Cloud infrastructure; Web Browsers and the Presentation Layer- Understanding Web browsers attributes and differences. Building blocks of the presentation layer: HTML, HTML5, CSS, Silverlight, and Flash.
UNIT III	WEB DEVELOPMENT TECHNIQUES AND FRAMEWORKS: Building Ajax controls, introduction to Javascript using JQuery, working with JSON, XML, REST. Application development Frameworks e.g. Ruby on Rails , .Net, Java API's or JSF; Deployment Environments – Platform As A Service (PAAS) ,Amazon, vmForce, Google App Engine, Azure, Heroku, AppForce
UNIT IV	USE CASE 1: BUILDING AN APPLICATION USING THE LAMP STACK Setting up a LAMP development environment. Building a simple Web app demonstrating an understanding of the presentation layer and connectivity with persistence.
UNIT V	USE CASE 2: DEVELOPING AND DEPLOYING AN APPLICATION IN THE CLOUD Building on the experience of the first project students will study the design, development, testing and deployment of an application in the cloud using a development framework and deployment platform
	Suggested Practical work
	• Build a simple Web app demonstrating an understanding of the presentation layer and connectivity with persistence using LAMP stack. • Development, test and deploy an application in the cloud using a development framework and deployment platform.

Outcomes:

At the end of the course, the student should be able to:

CO1: Understand the eco-system of cloud based applications.

CO2: Present fundamental principles, technology, and techniques of designing code for cloud based application.

CO3: Hands on with web development tools, techniques and frameworks.

CO4: Build applications using LAMP Stack.

CO5:Design, develop, test and deploying applications in the cloud.

Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	H													L
CO2			H	M	L								M	L	M
CO3			M	L	H	L			M		L		H	H	H
CO4			H	M	H	L		L	M		H	H	H		H
CO5			H	H	H	M		L	M	L	H	H	H	H	H

H = Highly Related; M = Medium L = Low

Text

1. Chris Hay, Brian Prince, "Azure in Action" Manning Publications [ISBN: 978- 1935182481],2010

Reference:

1.. Henry Li, "Introducing Windows Azure" Apress; 1 edition [ISBN: 978-1-4302- 2469-3],2009.

2. Eugenio Pace, Dominic Betts, Scott Densmore, Ryan Dunn, Masashi Narumoto, MatiasWoloski, "Developing Applications for the Cloud on the Microsoft Windows Azure Platform" Microsoft Press; 1 edition [ISBN: 9780735656062],2010.

3. Eugene Ciurana, "Developing with Google App Engine" Apress; 1 edition [ISBN: 978-1430218319],2009.

4. Charles Severance, "Using Google App Engine" O'Reilly Media; 1 edition, [ISBN: 978-0596800697], 2009.

5. George Reese, "Cloud application architectures", O'Reilly Sebastopol, CA [ISBN: 978-0596156367] 2009.

6. Dan Sanderson, "Programming Google App Engine" O'Reilly Media; 1 edition [ISBN: 978-0596522728],2009.

7. Paul J. Deitel, Harvey M. Deitel, "Ajax, rich Internet applications, and web development for programmers", Prentice Hall Upper Saddle River, NJ [ISBN: 978-0-13-158738-0], 2008.

Cloud Computing
Department Elective 5

BCO 202A	**Cloud Computing Tools and Techniques: Course Outlines**	3-0-2 4

Course Objective:

This course gives students an insight into the basics of cloud computing along with virtualization, cloud computing is one of the fastest growing domain from a while now. It will provide the students basic understanding about cloud and Hands on virtualization and Simulation tools.

Unit I	**Introduction to Virtualization**:Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations Types of hardware virtualization: Full virtualization - partial virtualization - para virtualization Desktop virtualization: Software virtualization – Memory virtualization - Storage virtualization – Data virtualization – Network virtualization
Unit II	**Hypervisors and Virtual machines:**Server Virtualization: Understanding Server Virtualization, types of server virtualization, Virtual machine basics, types of virtual machines, hypervisor concepts and types, **Virtualization Solutions**: Understanding Microsoft's Virtualization solutions: Microsoft's Infrastructure Optimization Model, Virtualization and the Infrastructure Optimization Model, Benefits of Virtualization, Achieving the Benefits of Datacenter Virtualization, Achieving the Benefits of Client Virtualization, Achieving the Benefits of Cloud Virtualization.
Unit III	**Migrating into a Cloud:**Introduction, Challenges while migrating to Cloud, Broad approaches to migrating into the cloudwhy migrate -deciding on cloud migration, the Seven-step model of migration into a cloud, Migration Risks and Mitigation, Enterprise cloud computing paradigm, relevant Deployment Models for Enterprise Cloud Computing, Adoption and Consumption Strategies, issues for enterprise applications on the cloud.
Unit IV	**Cloud Simulators- CloudSim and GreenCloud:** Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture(User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud.
Unit V	**Introduction to VMWare Simulator:**Basics of VMWare, advantages of VMware virtualization, using Vmware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.
	Suggested Practical List: (Implement using CloudSim and VMW Simulator
	• **Create virtual machines with different configuration of virtual computing resources** • **Create Snapshots of virtual machines on different time stamps** • **Create clones of virtual machines with different configuration of Full and Linked Clone** • **Create alarms for different instances and events**

- **Perform migration operations.**
- **Apply various security setting on Virtual machines.**
- **Hands on practices on VMware HOL.**

Outcomes:

At the end of the course, the student should be able to:

CO1: understand need, types and techniques of virtualization.

CO2: optimize the virtualized infrastructure.

CO3: analyse the need and challenges in adoption and consumption of cloud resources.

CO4: hands on of CloudSimandGreenCloud simulator.

CO5: perform basic operations on VMWare Simulator.

Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		H										H		M	
CO2	M		H										M	L	
CO3				H							L		M	H	M
CO4					H						H	H	H		M
CO5	H				H				M		L		H		H

H = Highly Related; M = Medium L = Low

Text & References:

Text:

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter,TATA McGraw- Hill , New Delhi – 2010
2. Cloud Computing: Web-Based Applications That Change the Way You Work and CollaborateOnline - Michael Miller - Que 2008

References:

1. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011

Cloud Computing
Department Elective 6

BCO 203A	Cloud Security and Management: Course Outlines	3-0-0

Course Objective:

1. Introduce a thorough understanding of cloud security concepts and how these can be applied in the cloud computing.
2. Discuss and understand the legal and compliance issues for cloud provider and compliance for the cloud consumer.

Unit I	**Cloud Computing and Security Fundamentals** :What Cloud Computing Isn't ,Alternative Views ,Essential Characteristics ,On-Demand Self-Service ,Broad Network Access ,Location-Independent Resource Pooling ,Rapid Elasticity ,Measured Service, Architectural Influences ,High-Performance Computing ,Utility and Enterprise Grid Computing ,Autonomic Computing ,Service Consolidation, Horizontal Scaling ,Web Services ,High-Scalability Architecture, Technological Influences ,Universal Connectivity, Commoditization, Excess Capacity ,Open-Source Software ,Virtualization ,Operational Influences
Unit II	**Cloud Computing Software Security Fundamentals:** Cloud Information Security Objectives: Confidentiality, Integrity, and Availability, Cloud Security Services: Authentication, Authorization, Auditing, Accountability, Relevant Cloud Security Design Principles: Least Privilege, Separation of Duties, Defense in Depth, Fail Safe, Economy of Mechanism, Complete Mediation, Open Design, Least Common Mechanism, Psychological Acceptability, Weakest Link, Leveraging Existing Components Secure Cloud Software Requirements: Secure Development Practices, Handling Data, Code Practices, Language Options, Input Validation and Content Injection, Physical Security of the System.Approaches to Cloud Software Requirements Engineering: A Resource Perspective on Cloud Software Security Requirements, Goal-Oriented Software Security Requirements, Monitoring Internal and External Requirements.
Unit III	**Cloud Security Policy Implementation and Decomposition**: Implementation Issues, Decomposing Critical Security Issues into Secure Cloud Software Requirements, NIST Security PrinciplesSecure Cloud Software Testing: Testing for Security Quality Assurance, Conformance Testing, Functional Testing, Performance Testing, Security Testing, Cloud Penetration Testing: Legal and Ethical Implications, The Three Pre-Test Phases, Penetration Testing Tools and Techniques, Regression Testing, Cloud Computing and Business Continuity Planning/Disaster Recovery: Definitions, General Principles and Practices , Disaster Recovery Planning, Business Continuity Planning ,Using the Cloud for BCP/DRP
Unit IV	**Cloud Computing Risk Issues**, The CIA Triad: Confidentiality,Integrity,Availability,Other Important Concepts Privacy and Compliance Risks:The Payment Card Industry Data Security Standard (PCI DSS),Information Privacy and Privacy Laws Threats to Infrastructure: Data, and Access Control, CommonThreats and Vulnerabilities, Logon Abuse, Inappropriate System Use,Eavesdropping,Network Intrusion, Denial-of-Service (DoS) Attacks, Session Hijacking Attacks, Fragmentation AttacksCloud Access Control Issues:Database Integrity Issues Cloud Service Provider Risks:Back-Door,Spoofing,Man-in-the-Middle,Replay,TCP Hijacking, SocialEngineering, DumpsterDiving, PasswordGuessing, Trojan Horses and Malware
Unit V	**Cloud Computing Security Challenges**Security Policy Implementation, Policy Types, Senior Management Statement of Policy ,Regulatory Policies, Advisory Policies

	,Informative Policies ,Computer Security Incident Response Team (CSIRT), Virtualization Security Management, Virtual Threats, Hypervisor Risks ,Increased Denial of Service Risk, VM Security Recommendations, Best Practice Security Techniques, VM-Specific Security Techniques, Hardening the Virtual Machine, Securing VM Remote Access

Outcomes:

At the end of the course, the student should be able to:

CO1: Compare modern security concepts as they are applied to cloud computing

CO2: Analyse the security of virtual systems.

CO3: Evaluate the security issues related to multi-tenancy,

CO4: Appraise compliance issues that arise from cloud computing

CO5: Implement security policies to improve QoS.

Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H														L
CO2				H									H	L	
CO3					M							L		H	H
CO4			H										H		
CO5		H				M		M	M			M		H	

H = Highly Related; M = Medium L = Low

Text Book:

1. Cloud Security: A Comprehensive guide to secure cloud computing by Ronald L. Krutz and Russell Dean Vines

References:

1. Cloud Management and Security: Author(s):Imad M. Abbadi, First published:13 June 2014 Print ISBN:9781118817094 |Online ISBN:9781118817087 |DOI:10.1002/9781118817087 © 2014 John Wiley & Sons, Ltd

Cloud Computing
Department Elective 7

BCO 101A	Salesforce-Technical Aspirants: Course Outlines	3-0-2 4

Course Objective:
1. Supplement the student skillset with Salesforce skills and differentiate in the job market.
2. Benefit from the knowledge and experience of the Trailblazer Community.
3. Build Student skills and personal brand in the Salesforce Ecosystem.
4. Establish the student as a skilled Salesforce Developer

Unit I	**Introduction to Trailhead** :Trailhead Basics, Trailhead Playground Management, Salesforce Platform Basics, CRMfor Lightning Experience, Data Modeling, Build a Lemonade StandApp, Picklist Administration, Formulas & Validations, Data Management, Reports & Dashboards for Lightning Experience, Build a Data Model for a Recruiting App, Trailblazer Community Groups, Create Reportsand Dashboards \for Sales and Marketing Managers
Unit II	**Lightning App Builder:**Lightning Experience Customization, Lightning App Builder, Salesforce MobileAppCustomization, Customize theUser Interface for a Recruiting App, Lightning Flow, Accounts & Contacts for Lightning Experience, Leads & Opportunities for Lightning Experience, Service Cloud for Lightning Experience, App Customization, Specialist Super badge
Unit III	**Identity & User Management:** Identity Basics, User Management, User Authentication, Data Security, Keep Data Secure in a Recruiting App, Automate Business Processes for a Recruiting App, Security Specialist
Unit IV	**Introduction to Process Builder:** Quick Start: Process Builder, Screen Flow Distribution, Platform Development Basics, Process Automation Specialist
Unit V	**Apex Programming:**Developer Console Basics, Apex Basics & Database, Apex Triggers, Apex Testing, Asynchronous Apex, Visualforce Basics, Apex Integration Services, Apex Specialist,Lightning Platform API Basics, Apex Metadata API, Salesforce Connect, Trail – Major Project, Salesforce Project

Outcomes:

At the end of the course, the student should be able to:

CO1: showcase their skillset with Salesforce skills and differentiate in the job market.

CO2: build knowledge and experience of the Trailblazer Community.

CO3: develop skills and personal brand in the Salesforce Ecosystem.

CO4: interpretation of project process flow using process builder.

CO5: hands on with Apex Programming to develop Salesforce project.

Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			M		H			M				M	H	H	M
CO2	H				H								H	M	M
CO3		H											H	M	H
CO4				H								M	M	H	H

CO5				H			M	M	H	H	H

H = Highly Related; M = Medium L = Low

Textbooks:

Advanced Apex Programming for Salesforce.com and Force.com by Dan Appleman, Desaware Publishing; 3rd edition

Reference Websites:

https://trailblazercommunity.force.com/help/s/become-job-ready-developeredition

Data Science Track

Data Science

Department Elective 1

BCO019A	ARTIFICIAL INTELLIGENCE	3:0:0

Course Objective:

- To explain the basic principles of artificial intelligence
- To apply logic and structured concepts in knowledge representation and discuss the applications of artificial intelligence
- To implement and analyze Uninformed and Informed Search Strategies
- To implement and apply various game playing Algorithms to different problems
- Understand and represent various types of logics and their forms
- To Understand and various Learning techniques and analyze concept of ANN

UNIT 1	**Introduction**- What is intelligence? Foundations of artificial intelligence (AI), Task of artificial intelligence, Techniques of artificial intelligence, Problem Solving Formulating problems, problem types, states and operators, state space. **Knowledge Representation**- Role of Knowledge, Declarative Knowledge, Procedural Knowledge, Knowledge representation Techniques; conceptual graphs; structured representations; frames, scripts; issues in knowledge representation
UNIT 2	**Uninformed & Informed Search Strategies**- Breath First Search, Depth First Search, Depth Limited Search, Heuristic Functions, Best First Search, Hill Climbing Algorithm, Problems and solutions of Hill Climbing, Iterative Deepening (IDA), A* algorithm, AO* Algorithm
UNIT 3	**Game playing**- Introduction, Types of games, Minimax game algorithm, Alpha Beta cut-off procedure , Jug problem, Chess problem, Tiles problem
UNIT 4	**Logics-** Propositional logics, First Order Predicate Logics (FOPL), Syntax of First Order Predicate Logics, Properties of Wff, Clausal Forms, Conversion to clausal forms
UNIT 5	**Learning-** Overview of different forms of learning, Supervised base learning, Unsupervised based learning, Introduction to Neural networks:- basic, comparison of human brain and machine, biological neuron, general neuron model, Basic Architecture of Neural Networks, Single Computational Layer: The Perception, Choice of Activation functions, Number of Output Nodes and Loss Functions, applications and advantages of neural networks. Brief introduction to single layer and multiplayer networks

Course Outcomes: Upon the end of this course, student will be:

CO1: Familiar with the basic principles of artificial intelligence

CO2: To implement and analyzeuninformed and informed Search algorithms

CO3: Able to represent and apply various logics and structured concepts in knowledge representation

CO4: To implement and apply various game playing algorithms to different problems

CO5: To Understand various Learning techniques and concept of ANN

 COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	L	M	H	L			M		L	H	L		
CO2	H	H	H	M	H	L			H	M	M	H	M		
CO3	H	M	M	H	H	L	L	L	M	M	M	H	M	M	H
CO4	H	M	M	H	H	L	L	L	H	M	M	H	H	M	H
CO5	H	L		L	M	L			M		L	H	L		M

H = Highly Related; M = Medium L = Low

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence – A Modern Approach, Pearson Education Press, 2001.

2. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, McGraw Hill, 2008.

3. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

Reference Books:

1. George F. Luger, Artificial Intelligence, Pearson Education, 2001.

2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kauffman, 2002.

Data Science

Department Elective 2

BCO210A	Foundation of data Science & Machine learning	3-0-1

Prerequisite : Students are expected to have some background in mathematics and to have the rudiments of programming in Python.

Course Objective : This course introduces the methods for you the mathematical intuition behind a number of core/common machine learning algorithms. There is a significant practical aspect too, in which student will learn to use the methods and evaluate their performance on real world data. However, the UNIT is not purely about learning to use machine learning libraries. It is about learning how and why they work too.

Syllabus

UNIT 1	**Introduction:** What is Data Science? Big Data and Data Science – Datafication - Current landscape of perspectives - Skill sets needed; Matrices - Matrices to represent relations between data, and necessary linear algebraic operations on matrices -Approximately representing matrices by decompositions (SVD and PCA); Statistics: Descriptive Statistics: distributions and probability - Statistical Inference: Populations and samples - Statistical modeling - probability distributions - fitting a model - Hypothesis Testing - Intro to R/ Python.
UNIT 2	**Data preprocessing:** Data cleaning - data integration - Data Reduction Data Transformation and Data Discretization.Evaluation of classification methods – Confusion matrix, Students T-tests and ROC curves-Exploratory Data Analysis - Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA - The Data Science Process.
UNIT 3	**Basic Machine Learning Algorithms:** Association Rule mining - Linear Regression-Logistic Regression - Classifiers - k-Nearest Neighbors (k-NN), k-means -Decision tree - Naive Bayes- Ensemble Methods - Random Forest. Feature Generation and Feature Selection - Feature Selection algorithms - Filters; Wrappers; Decision Trees; Random Forests.
UNIT 4	**Clustering:** Choosing distance metrics - Different clustering approaches - hierarchical agglomerative clustering, k-means (Lloyd's algorithm), - DBSCAN - Relative merits of each method - clustering tendency and quality.
UNIT 5	**Data Visualization:** Basic principles, ideas and tools for data visualization.

Course Outcomes: By the end of the course, students will have :
CO1. Basic understanding of supervised learning (regression and classi_cation)
CO2. Basic understanding of unsupervised learning (clustering and dimensionality reduction).
CO3. Able to apply methodologies in each of these problem domains; to assess the suitability of approaches to a constrained set of tasks;
CO4. Employ common techniques to evaluate a methodology's performance.
CO5. Make use of Data sets in implementing the machine learning algorithms and Implement the machine learning concepts and algorithms in any suitable language

of choice.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		L										L		L
CO2		L			L						L			L	
CO3	L		M										L		
CO4		L			M						L			L	
CO5	M		L		H								M		

H = Highly Related; M = Medium L = Low

TEXTBOOKS
1.Cathy O'Neil and Rachel Schutt, " Doing Data Science, Straight Talk From The Frontline", O'Reilly, 2014.
2.Jiawei Han, Micheline Kamber and Jian Pei, " Data Mining: Concepts and Techniques", Third Edition. ISBN 0123814790, 2011.
3.Mohammed J. Zaki and Wagner Miera Jr, "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2014.
4.Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization , O'Reilly, 2016.
5.Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015.
6.Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.

Data Science & Machine learning Lab

Description (If any):

1. The programs can be implemented in either JAVA or Python.

2. For Problems 1 to 6 and 10, programs are to be developed without using the builtin classes or APIs ofJava/Python.

3. Data sets can be taken from standard repositories

Lab Experiments:

1. Implement and demonstratethe FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithmto output a description of the set of all hypotheses consistent with the training examples.

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Course outcomes: The students should be able to:

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

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

3. Applyappropriate data sets to the Machine Learning algorithms.

4. Identify and apply Machine Learning algorithms to solve real worldproblems.

Data Science

Department Elective 3

BCO 211A	Data Analytics	3-0-0

Prerequisite :Nill

Course Objectives:

1.This course introduces the methods for data preparation and data understanding.

2.It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.

3.Supports to Summarize the insurers use of predictive analytics, data science and Data Visualization

UNIT:1	**Introduction To Exploratory Data Analysis:** Data Analytics lifecycle,Exploratory Data Analysis(EDA) Definition, Motivation, Stepsindataexploration, The basic data types Data Type Portability.
UNIT:2	**Preprocessing-Traditional Methods And Maximum Likelihood Estimation :**Introduction to Missing data, Traditional methods for dealing with missing data, Maximum Likelihood Estimation – Basics, Missing data handling, Improving the accuracy of analysis **Preprocessing Bayesian Estimation :** Introduction to Bayesian Estimation ,Multiple Imputation-Imputation Phase, Analysis and Pooling Phase, Practical Issues in Multiple Imputation, Models for Missing Notation Random Data
UNIT: 3	**Data Summarization & Visualization** Statistical data elaboration, 1-D Statistical data analysis, 2-D Statistical data Analysis, ND Statistical data analysis
UNIT: 4	**Outlier Analysis** Introduction, Extreme Value Analysis, Clustering based, Distance Based and Density Based outlier analysis, Outlier Detection in Categorical Data
UNIT:5	**Feature Subset Selection** : Feature selection algorithms: filter methods, wrapper methods and embedded methods, Forward selection backward elimination, Relief, greedy selection, genetic algorithms for features election **Dimensionality Reduction** : Introduction, Principal Component Analysis(PCA), Kernel PCA, Canonical Correlation Analysis, Factor Analysis, Multi dimensional scaling, Correspondence Analysis

Course Outcome:

CO1.Handle missing data in the real-world data sets by choosing appropriate methods.

CO2.Summarize the data using basic statistics. Visualize the data using basic graphs and plots.
CO3.Identify the outliers if any in the data set.

CO4.Choose appropriate feature selection and dimensionality reduction

CO5.Techniques for handling multi-dimensional data

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L											L			L
CO2		L			M							L		L	
CO3	L					L						M			
CO4		L			M							L		L	
CO5						L						L			

*H = Highly Related; M = Medium L = Low

Text Book(s)

1. Trevor Hastie Robert Tibshirani Jerome Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction, 2nd Edn, Springer, 2014

2. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.

3. Jiawei Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011.

4. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.

Reference Books

1. Charu C. Aggarwal ,"Data Mining The Text book", Springer, 2015.

2. Craig K. Enders, "Applied Missing Data Analysis", The Guilford Press, 2010.

3. Inge Koch, "Analysis of Multivariate and High dimensional data", Cambridge University Press, 2014.

4. Michael Jambu, "Exploratory and multivariate data analysis", Academic Press Inc. , 1990.

5. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC press, 2015

Data Science

Department Elective 4

BCO 230 A	Big Data Analytics using R	3-0-2

Pre- requisites : Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.

COURSE OBJECTIVES :

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop
3. Provide HDFS Concepts and Interfacing with HDFS
4. Understand Map Reduce Jobs
5. Provide hands on Hodoop Eco System
6. Apply analytics on Structured, Unstructured Data.
7. Exposure to Data Analytics with R.

UNIT 1	**INTRODUCTION TO BIG DATA AND HADOOP :** Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.
UNIT 2	**HDFS(Hadoop Distributed File System)** The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.
UNIT 2I	**Map Reduce** Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.
UNIT 4	**Hadoop Eco System** **Pig :** Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. **Hive :** Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. **Hbase :** HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. **Big SQL :** Introduction
UNIT 5	**Data Analytics with R** Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

COURSE OUTCOMES:

The students will be able to:

CO1 Identify Big Data and its Business Implications.

CO2 List the components of Hadoop and Hadoop Eco-System

CO3 Access and Process Data on Distributed File System

CO4 Manage Job Execution in Hadoop Environment and Develop Big Data Solutions using Hadoop Eco System

CO5 Analyse Infosphere BigInsights Big Data Recommendations and Apply Machine Learning Techniques using R.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		*L*										L	*M*		L
CO2	*L*				M								L	L	
CO3		*L*			L							*L*	*M*		
CO4	*L*				M							*L*	*M*	L	
CO5		*L*				*L*							*M*		

*H = Highly Related; M = Medium L = Low

Text Books

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, SubhasiniChellappan, "Big Data Analytics" Wiley 2015.

References

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
4. Anand Rajaraman and Jefrey David Ulman, "Mining of Massive Datasets", Cambridge University Press,2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
6. Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007
7. Pete Warden, "Big Data Glossary", O'Reily, 2011.
8. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
9. ArvindSathi, "BigDataAnalytics: Disruptive Technologies for Changing the Game", MC Press, 2012
10. Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012.

List of Experiments

1. Implement the following Data structures in Java

i) Linked Lists ii) Stacks iii) Queues iv) Set v) Map

2. Perform setting up and Installing Hadoop in its three operating modes:

a) Standalone, Pseudo distributed, Fully distributed.

3. Implement the following file management tasks in Hadoop:

• Adding files and directories

• Retrieving files

• Deleting files

(Hint: A typical Hadoop workflow creates data files (such as log files)

elsewhere and copies them into HDFS using one of the above command line utilities.)

4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

5. Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.

6. Implement Matrix Multiplication with Hadoop Map Reduce.

7. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

8. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions,

and indexes.

9. Solve some real life big data problems.

Data Science

Department Elective 5

BCO 212A	Data mining and Predictive Modelling	3-0-2

Course Objectives:

1. To provide comprehensive knowledge on developing and applying machine learning algorithms for massive real-world datasets in distributed frameworks.

2. To demonstrate the use of big data analytics tools like Spark and Mahout for mining massive datasets.

3. To impart in depth knowledge on Deep Learning and Extreme Learning concepts.

UNIT:1	**MapReduce Based Machine Learning** K-Means, PLANET, Parallel SVM, Association Rule Mining in MapReduce, Inverted Index,Page Ranking, Expectation Maximization, Bayesian Networks **Classification and Regression models with Spark and Mahout** Linear support vector machines - Naive Bayes model- Decision Trees - Least square regression-Decision trees for regression.
UNIT:2	**Clustering in Spark and Mahout** : Hierarchical Clustering in a Euclidean and Non-Euclidean Space - The Algorithm of Bradley, Fayyad, and Reina - A variant of K-means algorithm - Processing Data in BFR Algorithm CURE algorithm - Clustering models with Spark - Spectral clustering using Mahout
UNIT:3	**Mining Social-Network Graphs** : Clustering of Social-Network Graphs - Direct Discovery of CommUNITies - Partitioning of Graphs Finding Overlapping CommUNITies - Counting Triangles using MapReduce Neighborhood Properties of Graphs
UNIT:4	**Semi-Supervised Learning :** Introduction to Semi-Supervised Learning, Semi-Supervised Clustering, Transductive Support Vector Machines
UNIT:5	**Deep Learning** : Introduction, Deep Neural Networks, Deep Belief Networks, Auto Encoders, Recurrent Networks **Extreme Learning :** Extreme Learning Machines (ELM), ELM auto encoder, Extreme Support Vector Regression

Course Outcome:

CO1.Identify right machine learning / mining algorithm for handling massive data

CO2.Apply classification and regression models with Spark and Mahout

CO3. Implement clustering models using Spark and Mahout

CO4.Mine social Network graphs using MapReduce

CO5.Apply semi supervised learning for clustering and classification and eep learning to solve real-life problem

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L				M								*M*		L
CO2		L			H						L			L	
CO3	L				M	L							*M*		
CO4		L			M						L			L	
CO5					H	L									

H = Highly Related; M = Medium L = Low

Text Book(s)

1.Jure Leskovec, AnandRajaraman, Je_ Ullman, "Mining of Massive Datasets", Standford Press,2011.

2. Nick Pentreath, "Machine Learning with Spark", Packt Publishing,

3. Olivier Chapelle, Bernhard Scholkopf, Alexander Zien "Semi-Supervised Learning", The MIT Press,2006.

Reference Books

1. Ron Bekkerman, Mikhail Bilenko, John Langford "Scaling Up Machine Learning: Parallel and Distributed Approaches", Cambridge University Press, 2012.

2. Jimmy Lin, Chris Dyer, "Data-Intensive Text Processing with MapReduce", Morgan Claypool Publishers, 2010.

3. Hennessy, J.L. and Patterson, D.A., 2011. Computer architecture: a quantitative approach. Elsevier.

4. ChandramaniTiwary "Learning Apache Mahout", Packt Publishing, 2015.

5. Fuchen Sun, Kar-Ann Toh, Manuel Grana Romay, KezhiMao,"Extreme Learning Machines2013: Algorithms and Applications", Springer, 2014.

Data mining and Predictive Modelling LAB	0-0-2

1. K-means implementation in MapReduce

2. Association Rule Mining with MapReduc

3. Decision trees in Spark

4. Nave bayes classification using Spark

5. Advanced text processing with Spark

6. Clustering models with Spark

7. Building a recommendation engine with Spark

8. Representing social-network data using Graphs

9. Implementing Semi-supervised Clustering

10. Deep Learning using H2O

11. Predictive analysis using H2O tool

12. SVM Classification using Mahout

13. Spectral clustering using Mahout

14. Building a recommendation engine with Sparkling water

Data Science

Department Elective 6

BCO614A	MongoDB	3-0-0

Course Objective:
1. To understand the fundamentals and need for NoSQL databases in modern applications.
2. To gain hands-on experience with MongoDB, including CRUD operations and indexing.
3. To design and model efficient schemas using MongoDB's document-oriented approach.
4. To explore advanced MongoDB features such as replication, sharding, and consistency.
5. To develop secure, scalable applications using MongoDB and associated tools.

UNIT 1	**Introduction to NoSQL and MongoDB :**Overview of NoSQL databases and need for non-relational models;Introduction to MongoDB architecture;NoSQL concepts, MongoDB vs RDBMS**;**MongoDB Document model: embedding vs referencing **;**core storage concepts
UNIT 2	**MongoDB Basics – CRUD, Querying & Indexing:**Basic CRUD operations: insert, find, update, delete**;**Querying documents, use of operators, projection**;**Database and collection creation**;**Query operators and BSON basics**;**Introduction to indexing and fundamentals of aggregation framework **;**Index basics, types (single field, compound, text, TTL)**;**Performance tuning and use cases
UNIT 3	Schema design practices: normalization vs denormalization;Embedded documents vs referencing;Modeling for scalability and access patterns (srtmun.ac.in);Aggregation pipeline stages: $match, $group, $sort, $project, $lookup, etc.;Monitoring and diagnostics (explain, profiling, stats);Logging, configuration, maintenance tasks
UNIT 4	**Advanced Features – Replication, Sharding & Consistency :**Replication and high-availability via replica sets;Sharding concepts, shard key selection, distributed data**;**Transactions, consistency models, eventual vs strong consistency (srtmun.ac.in)**;**Sharding architecture, shard key selection, chunks**;**Shard balancing, tag-aware sharding, sharded replica sets**;**Replica sets, member roles, election process**;**Read/write concerns, failover, rollback, Oplog
UNIT 5	**Security, Authentication & Application Development :**Role-based access control, authentication, encryption, authorization **;** MongoDB drivers and APIs for application integration **;**Building sample applications using MongoDB (swayam-plus.swayam2.ac.in, srtmun.ac.in)**;**Backup and restore mechanisms (mongodump, mongoexport, Ops Manager, etc.)**;**Tools such as MongoDB Atlas, Ops Manager, MMS**;**Drivers and integrations

Course Outcomes:

 CO1: Understand the need for NoSQL and MongoDB's architecture and data model.

CO2: Perform CRUD operations, indexing, and query optimization in MongoDB.
CO3: Design and implement efficient schemas using best modeling practices.
CO4: Apply advanced MongoDB features like replication, sharding, and consistency handling.
CO5: Develop secure, real-world applications integrated with MongoDB tools and services.

Suggested Books:
Textbook:

1. MongoDB University Courses (MongoDB Inc.)
2. Swayam/NPTEL Online Course Material: NoSQL and MongoDB

Reference Books:

1. Kristina Chodorow, MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, 2019.
2. Kyle Banker, MongoDB in Action, 2nd Edition, Manning Publications, 2016.
3. Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015.

COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H												M		
CO2		H		M										M	
CO3			H										M		L
CO4	M					M								M	
CO5				H											M

H = Highly Related; M = Medium L = Low

Data Science
Department Elective 7

MCO 214A	Streaming Data Analytics	3-0-2

Pre-requisite : Nil

Course Objectives:

It introduces theoretical foundations, algorithms, methodologies, and Applications of streaming data and also provide practical knowledge for handling and analyzing streaming data.

UNIT:1	**Introduction :**Characteristics of the data streams, Challenges in mining data streams Requirements and principles for real time processing, Concept drift Incremental learning.
UNIT:2	**Data Streams :** Basic Streaming Methods, Counting the Number of Occurrence of the Elements in a Stream, Counting the Number of Distinct Values in a Stream, Bounds of Random Variables, Poisson Processes, Maintaining Simple Statistics from Data Streams, Sliding Windows, Data Synopsis, **Change Detection:** Tracking Drifting Concepts, Monitoring the Learning Process
UNIT:3	**Decision Trees** : The Very Fast Decision Tree Algorithm (VFDT), The Base Algorithm, Analysis of the VFDT Algorithm, Extensions to the Basic Algorithm: Processing Continuous Attributes, Functional Tree Leaves, Concept Drift. **Clustering from Data Streams :**Clustering Examples: Basic Concepts, Partitioning Clustering - The Leader Algorithm, Single Pass k-Means, Micro Clustering, Clustering Variables: A Hierarchical Approach
UNIT:4	**Frequent Pattern Mining :** Mining Frequent Itemsets from Data Streams- Landmark Windows, Mining Recent Frequent Itemsets, Frequent Itemsets at Multiple Time Granularities Sequence Pattern Mining- Reservoir Sampling for Sequential Pattern Mining over data streams
UNIT:5	**Evaluating Streaming Algorithms :** Evaluation Issues, Design of Evaluation Experiments, Evaluation Metrics, Error Estimators using a Single Algorithm and a Single Dataset, Comparative Assessment, The 0-1 loss function, Evaluation Methodology in Non-Stationary Environments, The Page-Hinkley Algorithm.

Course Outcome:

CO1. Recognize the characteristics of data streams that make it useful to solve real-world problems.

CO2. Identify and apply appropriate algorithms for analyzing the data streams for variety of problems.

CO3. Implement different algorithms for analyzing the data streams

CO4. Identify the metrics and procedures to evaluate a model

CO5:Able to understand the concept of streaming algorithims.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				L										L	
CO2	L					L					M		M		
CO3		L			L	L									L
CO4	L			L							M			L	
CO5	M	M		H		L					L		M	M	

H = Highly Related; M = Medium L = Low

Text Book(s) &Refrence Books

1. Joao Gama, "Knowledge Discovery from Data Streams", CRC Press, 2010.

2. David Luckham, "The Power of Events: An Introduction to Complex Event

Processing in Distributed Enterprise Systems", Addison Wesley, 2002.

3. Charu C. Aggarwal, "Data Streams: Models And Algorithms", Kluwer Academic

Publishers, 2007

	Streaming Data Analytics LAB	0-0-2

List of Experiments

1. Exploring one stream processing engine like storm or STREAM etc (2 classes)

2. Implementation of algorithms for example : VFDT, CVFDT(2 classes)

3. Implementation of Clustering

4. Implementation of Frequent pattern mining

5. Exploring one CEP engine like ESPER or DROOLS(2 classes)

6. Exercise with continuous queries Logical operations on single stream

7. Exercise with continuous queries Logical operations on multiple streams

8. Exercise with continuous queries temporal operators on single stream

9. Exercise with continuous queries temporal operators on multiple streams

using DL4J

Full Stack Track

Full Stack
Department Elective 1

BCO 216A	Software Reliability and testing	3-0-0 [3]

Course Objectives: This course makes students understand the concepts and theory related to software reliability and testing. Understand different reliability models and testing techniques used in designing test plans, developing test suites, and evaluating test suite coverage. Understand how software developers can integrate a testing framework into code development in order to incrementally develop and test code

Unit-1	Basic Ideas of Software Reliability, Hardware reliability vs. Software reliability, Reliability metrics, Failure and Faults – Prevention, Removal, Tolerance, Forecast, Dependability Concept – Failure Behaviour, Characteristics, Maintenance Policy, Reliability and Availability Modeling, Reliability Evaluation Testing methods, Limits, Starvation, Coverage, Filtering, Microscopic Model of Software Risk **Reliability Engineering Measures**: Reliability Definitions, System Mean Time to Failure, Failure Rate Function, Reliability Function for Common Distributions, Maintainability and Availability.
Unit-2	Computation of software reliability, Functional and Operational Profile, Operational Profiles – Difficulties, Customer Type, User Type, System Mode, Test Selection - Selecting Operations, Regression Test. **Software Reliability Modelling**: Introduction, Halstead's Software Metric, McCabe's Cyclomatic Complexity Metric, Error Seeding Models, Failure Rate Models, Curve Fitting Models, Markov Structure Models.
Unit-3	**Software Cost Models**: Introduction, A Software Cost Model With Risk Factor, A Generalized Software Cost Model, A Cost Model With Multiple Failure Errors, Applications. **Fault- Tolerant Software**: Introduction, Basic Fault- Tolerant Software Techniques, Self-Checking Duplex Scheme, Reliability Modeling, Reduction Of Common- Cause Failures.
Unit-4	**The purpose of Testing :** What we Do, Productivity and Quality in Software, Goals for Testing, Phases in a tester's Mental life, Test Design, Testing Isn't Everything, The Pesticide Paradox and the complexity Barrier. **Some Dichotomies :** Testing Versus Debugging , Function Versus Structure, The designer Versus the Tester, Modularity Versus Efficiency, Small Versus Large, The builder Versus the Buyer.
Unit-5	**A Model for Testing** : The Project, Overview, The Environmental, The Program, Bugs, Tests, Testing and Levels, The Role of Models. **Flowgraphs and Path Testing:** Path Testing Basics**,** Predicates, Path Predicates, and Achievable Paths, Path Sensitizing , Path Instrumentation, Complement and Application of Path Testing, Generalizations. **Transaction- Flow Testing:** Transactions Flows, Transactions – Flows Testing Techniques, Implementation Comments

COURSE OUTCOME: -

CO1 Understanding the fundamental concepts of Software Reliability
CO2 Able to understand the basics of Software Reliability Modeling.
CO3 Learning the concepts of Comparison Criteria
CO4 Understanding the concepts of Measurements in Software Engineering.
CO5 Understanding the importance of testing and its methods

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M	L								L	L		
CO2	L	M	M											L	L
CO3		L		M									M	M	M
CO4		M	L	M									L	M	
CO5	M	H	M	M	M							M		M	H

H = Highly Related; M = Medium L = Low

REFERENCES:

1. John D. Musa, Anthony Iannino and KazuhiraOkumoto, "Software Reliability, Measurement, Prediction, Application, Series in Software Engineering and Technology", McGraw Hill, 1987.

2. Norman E, Fenton and Share Lawrence Pfleeger, "Software metrics", Second Edition, Thomson, 2002.

3. John D. Musa, "Software Reliability Engineering", Tata McGraw Hill, 1999.

4. Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw-Hill International Editions

5. Ian Sommerville, Software engineering, Pearson education Asia

6. Software Testing Techniques, 2nd edition, Boris Beizer, 1990

7. Software Testing: Principles and Practices by Srinivasan Desikan

Full Stack
Department Elective 2

BCO 217A	**Multi-Platform Mobile Development**	3-0-1 [3]

Course Objective:-Students would be able To develop cross platform applications.

Unit-1	Xamarin platform: Introduction to Mobile Development:Differences between Starter vs. Indie vs. Business licenses, types of mobile apps that can be created with Xamarin Studio vs. Visual Studio on both Windows and OS X, Requirements for creating a Xamarin.iOS application
Unit-2	Cross-Platform: Best practices for developing mobile applications with Xamarin: Introduction to Portable Class Libraries, Differences and approaches to sharing source code files (File Linking vs. SAPs vs. PCLs), Techniques used to switch to the UI thread (platform-specific and cross-platform), Basic knowledge of Xamarin.Social component (what it supports), Basic knowledge of the Xamarin.Mobile component (what it supports), Differences between common design patterns used in mobile development (MVVM, IoC/DI, Singleton, etc.), Using the Nuget and Xamarin Component Store, Basic knowledge of .NET libraries you can use in Xamarin.iOS and Xamarin.Android. Using the async / await keywords
Unit-3	Memory Management, Techniques for Building Efficient Xamarin Applications: SGen vs. Bohm garbage collection (differences, why choose one over the other), which collector is used by default on each platform and how do you change it, Strong vs. Weak references in GC, Techniques to avoid circular references. Navigation, Fragments in Android: Navigation patterns used in Android, Navigation patterns used in iOS, How to add items to the Android, Options menu
Unit-4	Data in Mobile: Working with the File System: Advantages and restrictions to SQLite, ORM libraries used in the mobile world, How to abstract paths in Xamarin.Android and Xamarin.iOS, Isolated storage on Xamarin.Android, Xamarin.iOS and Windows Phone Web Services: Web Services in Xamarin: Common architecture and data formats used in Web Services, Approaches you can use to access a web service from a Xamarin application, Available bindings in WCF/SOAP for Xamarin
Unit-5	Backgrounding: Backgrounding: Starting and communicating with Android Services, Running a background task while suspended in iOS Xamarin.Forms: Introduction to Xamarin.Forms: Xamarin.Forms core types - Page types, Layout containers, etc, What is XAML, Basic binding features.

Course Outcomes: -

CO1: Get hands on with Xamarin Studio and Visual Studio.
CO2: Building apps for cross platform and basic knowledge of Xamarin. Social and Xamarin. Mobile components.
CO3: Students would be able to able to manage application memory using Garbage collection & Navigation libraries.
CO4: Demonstrate database of an app in Xamarin.Android&Xamarin.iOS and create web services in Xamarin.
CO5: Student will be able to implement background services in iOS&Xamarin.Forms.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L			M	H							M	L	M	
CO2		M	M	H	M								M		H
CO3	M	L	M	M										M	
CO4	L	M		M									L		M
CO5	M	M	H	H										L	

H = Highly Related; M = Medium L = Low

Text Books:

1. Professional Cross-Platform Mobile Development in C# By Scott Olson, John Hunter, Ben Horgen, Kenny Goers, Wiley
2. Xamarin Cross-platform Application Development By Jonathan Peppers, Packt Publishing Ltd.
Reference Book:
3. Mobile Design and Development: Practical concepts and techniques for creating mobile sites and web apps By Brian Fling, O'Reilly

Full Stack
Department Elective 3

BCO218 A	Mobile Analytics	3-0-1 [3]

Course Objectives

1. Having the knowledge on the Data Analysis.
2. Able to analyse mobile data using Analytics Software.
3. Able to develop a complete Platform for predicting the facts from structured data.

Unit-1	Overview, Web Analytics Vs Mobile Analytics, Social media Analytics Vs Mobile analytics, Need of mobile analytics, Basics of mobile computing - Smart phones, mobile browsers, Mobile applications, Bandwidth. transactions, sessions, handset types & operating systems, mobile operators & their services, WAP gateway or GGSN support, APNs or regional POPs support, Architecture components, mobile webservices, overview of mobile cloud.
Unit-2	Mobile as next customer experience frontier, Customers expectations, business impact & criticality, Core metrics for deeper behavior analysis, Integration of different channels - SMS, Instant messaging, chatting, apps, HTML5 enabled sites on browsers for unique experience, Multi-channel campaning optimization, considerations for best mobile services, Location based media & support.
Unit-3	Mobile Handset Analysis, Mobile Handset Screen Resolution - supported screen resolutions of mobile handsets browsing site in terms of page views, visits and visitors, Mobile Operator Analysis -operator names and countries of subscribers browsing your site in terms of page views, visits and visitors. The types of statistics & reports: • Bandwidth (total, average per visit, total per file type) • Transactions (average per visit, number of downloads, page view breakdown) • Sessions (entry page, average duration, click paths, referring search engine) • Subscribers (browser type, user agent, operating system) • Operating system (iOS, Android, Blackberry, etc) • Mobile applications (YouTube, Facebook, Twitter, etc) • Content categorization (Adult, Video, Social, Ad Networks, etc) • Handsets (make, model, screen resolution) • Mobile Operator (country of origin, operator name) • Geo Location (Visitor location tracking, country of origin, RDNS lookup) • Referrer tracking, Search term performance, Specific visitor behaviour, Page views per visit by referrer/advert, Time spent on site by referrer/advert
Unit-4	MAIL MARKETING- Logs users email address, Cold callers report.
Unit-5	DATA FUNCTIONALITIES- Page views per annum, Data recording timeframe, Data archiving timeframe, Historic comparison , Integration to client platforms through API, HTTPS Support.

Course Outcomes

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

CO1. Describe the need of Mobile Analytics
CO2. Describe effectively the area where mobile analytics is solely useful
CO3. Construct mobile analytics tools in apps and analyze the results
CO4. Design and use advance tools for Email Marketing
CO5: Understand the concept of data functionality.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L						L			M		M
CO2	L	L								L			M		L
CO3	L	L		M	M	L		L					L	M	M
CO4	L		M		H	L		L				L	M	M	H
CO5	L		M		H	L		L				L	M	M	H

Reference Books:

IBM Mobile Enterprise Redbooks, Available at
[https://www.redbooks.ibm.com/Redbooks.nsf/portals/mobile?Open&page=featured]

Full Stack
Department Elective 4

BCO 219 A	Mobile App development Using Android	3-0-0 [3]

Course Objectives

1. To enable students with the basic concepts of Mobile Application development.

2. To enable students to provide innovative business solutions with help of Mobile Application techniques and supporting technologies

3. To enable students acquire skills to Mobile application development using Android

Unit-1	Introduction to Android and Setup History & Background of Android, Environment Setup – Installation & Setup of SDK tools on Windows; Installing platforms and samples; Creating an Android Virtual Device (emulator) ; Installing Eclipse on a Windows machine; Installing the Android Development Tools; Preparing an Android device for development. Android Fundamentals , Overview of Android development; Understanding project creation and structure; Working with the AndroidManifest.xml file; Creating and managing activities; Using explicit intents; Using implicit intents; Creating and using resources; Understanding security and permissions; Debugging an app.
Unit-2	User Interface and Controls, Understanding units and layout; Using layout managers; Working with text controls; Building button controls; Building list controls; Building custom list layouts; Other interesting controls. Graphics and Styling, Creating and using styles; Creating and using themes; Creating icons; Creating Nine Patch drawable.
Unit-3	Supporting Multiple Screens, Understanding screen size and density; Providing alternate layouts. Animation And Graphics, Setting up frame-by-frame animation; Showing tween animation; Working in 2D graphics. Menus And Dialogs Setting up options menus; Building context menus; Building alert dialogs; Setting up progress dialogs; Creating custom dialogs.
Unit-4	Notifications And Toast, Displaying status bar notifications; Displaying toast notifications. Working With Media, Setting up audio playback; Establishing video playback; Accessing the camera and camera roll. Preferences And Data Storage Using shared preferences; Creating a preferences activity; Using the SQLite database; Setting up network access; Using Content Providers. Locations And Maps, Incorporating Google Maps; Using GPS to find the current location.
Unit-5	Creating A Home Screen Widget, Creating a simple home-screen widget; Creating a widget configuration activity. Publishing Android App, Preparing for publishing; Signing and building; Preparing the graphics; Publishing to the Android Market.

Course Outcomes

CO1. Understand the Mobile application development fundamentals
CO2. Understand various components and interfaces available to develop Mobile Application Using Android.
CO3. Understanding the importance of effectively developing the interactive UI in mobile platform to maximize the app usage.
CO4. Apply Mobile application development in the domain of Games and Graphics.
CO5.Able to create home screen using various Concepts.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L				M							M	L	L	L
CO2			L		M	L			L		L	M	L	L	M
CO3		M			M		M		M			M	L	L	M
CO4					M						H	M	L	L	M
CO5	H	M			M						H	M	L	L	M

Text Books

1. Professional Android 4 Application Development 3rd Edition – Reto Meier

2. Programming Android O' Rielly

Reference Books

https://developer.android.com/training/index.html

Full Stack
Department Elective 5

BCO 220 A	Mobile App development Using IOS	3-0-1 [3]

Course Objectives

• Develop iOS mobile app using Swift
• Design UI for iPhones and iPad screens
• Evaluate and integrate third-party APIs and libraries into mobile app
• Apply principles of effective UI design
• Understand the hardware and software constraints of developing for mobile platforms

Unit-1	Unit 1: Fundamentals: Overview of iOS and X-CODE: Installation, Create and manage project using XCode, Introduction to iPhone Architecture, Introduction to SWIFT, Developer Technology Overview: The Apple Developer Tool, Swift, Cocoa Touch, Model-View-Controller, Interface Builder, Overview of latest iOS features.
Unit-2	Swift Basics: Object oriented programming with swift, File structure in Swift, Swift Programming Basics: Data types, Constants, Variables, Operators, Decision making and Branching, Arrays, Functions, Enumerations. Introduction to iOS Playground.
Unit-3	iPhone Application Development: Exploring the iOS Framework with XCode, Cocoa Fundamentals, Tracking the iOS Application Life cycle, Understanding Interface Builder, Creating User Interface, Customizing the Interface Appearance using Layout, Views, Outlets and Actions, View Controllers and UI Controllers like Labels, Buttons, Sliders, Different Views, Gestures, etc. Connecting the code with Accelerometer, Location service, 3D touch, Push notifications
Unit-4	Understand the MVC Design pattern, MVC in XCode, Using Application Templates, User Input and Output: Handling Keyboard Input, Implementing Alert, Sounds and Vibrations, Using XCode debugger. Database Management and Web Services: Parsing JSON data, Parsing XML data, SqLite databases, Web Service APIs calls.
Unit-5	Submit App to Apple Store: Create Apple developer account, Submit App to Apple Store

Course Outcomes:
CO1. To be able to design iOS application.
CO2. To be able to develop an application using Swift Programming language
CO3. To be able to develop multi-screen application using XCode
CO4. To understand the need and be able to use Different UI Controllers.
CO5. To be able to upload iOS application on Apple's App Store.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			M		M						M	M	L	H	L
CO2		L	H		M						L			M	L
CO3		L	H		H				M		H		M	L	L
CO4				M	H				L	L	M			M	
CO5					H	M			L		L	M		M	

References:

1. iOS 10 Programming Fundamentals with Swift by Matt Neuburg - O'Reilly Media Pub
2. Building iPhone and iPad Electronic Projects - MikeWesterfield - O'Reilly Media Pub.
3. Head First iPhone and iPad Development, 2nd Edition - Dan Pilone, Tracey Pilone - O'Reilly Media
4. Beginning iPhone and iPad Web Apps - ChrisApers, Daniel Paterson - Apress Pub

Full Stack
Department Elective 6

BCO 221 A	Security in Mobile App Development	3-0-0 [3]

Course Objective:-Students will learn concepts of security parameters in mobile applications and meet the following security parameters like authentication, data integrity, confidentiality, authorization, and non-repudiation.

Unit-1	Software Development Life Cycle (SDLC)- Introduction, Software Engineering Paradigms, Software Process, Software Characteristics, Verification and Validation of Software, Software Development Lifecycle - Waterfall Model, Spiral Model, System Engineering, Business Process Engineering, Product Engineering, Agile Methodology
Unit-2	Information Security Concepts - Definition of Information Security, Evolution of Information Security; Basics Principles of Information Security; Critical Concepts of Information Security; Components of the Information System; Balancing Information Security and Access; Implementing IT Security, The system Development Life cycle, Security professional in the organization.
Unit-3	Building Security into Software Life Cycle - Understanding security requirements, building security into design of application, approach for secure coding and security testing
Unit-4	Web Application Security - Understanding web security vulnerabilities, attack types, controls and overview of OWASP
Unit-5	Secure SDLC in Mobile Application Development - Understanding mobile app SDLC challenges, security issues in mobile apps, security design aspects in mobile apps, approach to secure SDLC in mobile app development

Course Outcomes

CO1:- Understand software development life cycle and its models
CO2:- To be able to understand information security concepts
CO3:- To be able to implement security in SDLC
CO4:- Understand concepts of web application security and role of secure SDLC in mobile application development

CO5:Able to understand the concept of Secure SDLC in Mobile Application Development.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M	M	L								M	L		L
CO2	M	L	L								L	M		L	M
CO3		M		L								M	L	M	
CO4	L	M	M								H	M		L	H
CO5	H		M	M			1				H	M		L	H

References:

1. Information Security Risk Analysis - Thomas R. Peltier, Third Edition, Pub: Auerbach, 2012

2. Information security: Principles and Practice - Mark Stamp, 2nd Edition, Pub: John Wiley & Sons, Inc., 2011

3. Ian Sommerville, "Software engineering", Seventh Edition, Pearson Education Asia, 2007

4. Roger S. Pressman, "Software Engineering – A practitioner's Approach", Sixth Edition, McGraw-Hill International Edition, 2005

Full Stack
Department Elective 7

BCO215B	Web development using WordPress	3-0-1 [3]

Web development using WordPress

Course objective:-Student will be able to design and develop websites using WordPress tool.

UNIT 1	**Introduction to CMS:** Introduction to Content Management Systems, Main Features of CMS, Web Content Management System, Component Content Management System Enterprise Content Management System, Introduction of Blogs. Installing WordPress with a Web Host's "1-Click Install", Manually Installing WordPress
UNIT 2	**Introduction to WordPress:** Introduction to WordPress, Setting up WordPress, Setting Up Database, Overview of Working of WordPress, Dashboard, Exporting and Importing of Site Content, Backup of Site data and files, Upgrading WordPress, Settings: General, Writing, Reading, Discussion, Media, Privacy, Permalinks, Configuring and Managing Accounts, Adding Content: Post, Pages, Setup and use of Categories, Tags, Internal Linking
UNIT 3	**Advance Features for WordPress:** Working with media: using Media Library, Audio and Video Files, Managing Comments, Fighting Spam with Akismet, Syndication: Setup and Display of RSS Feed, Setup of Subscriptions, use of Google FeedBurner with WordPress, Widgets and Plug-ins: Use of Widgets and Plug-ins, Differences, Upgrade of Plug-ins. Adding an Image Gallery, Editing an Existing Image Gallery, Adding Video Embedding Responsive Videos, Uploading a Video File,
UNIT 4	**Customization with WordPress** Introduction to WordPress Themes, Customized WordPress Theme: Default Theme, New Theme, Theme Editor, Set up of Menus, Post Thumbnails, Customization of Themes: Custom CSS, addition of Frames, Getting Fancy with Themes: Customization of Themes with CSS, addition of Favicon, Editing Function files, Advanced Theme Development: Anatomy of WordPress theme,Building new Theme, Template Files, Template Tags, Use of Loop Custom Post Types and Custom Taxonomies, One Installation and Multiple blogs: Setup and Administration of Blog Network, Customization of WordPress: Integration of Third Party Services, Third Party Comment System, AD Integration, Web Fonts, Tools and Tricks
UNIT 5	**WordPress Security, Performance & Deployment** Website Security (SSL, Backups, Anti-malware Plugins), Performance Optimization (Caching, Image Optimization, CDN), SEO for WordPress (Yoast SEO, RankMath), Migrating Websites (Local to Live Server), Career Pathways: Freelancing, Agencies, and Personal Branding.

Course Outcomes

CO1:- To be able to understand concepts of content management system, its benefits.
CO2:- Understand installation and configuring word press for web development
CO3:- To be able to work with video and audio files with their plug-ins in websites
CO4:- To be able to create websites more attractive by using themes and CSS, increasing usability by adding hyperlinks.

CO5:Able to create interactive web sites

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M	L	M							L	L		
CO2	L		M		M									L	M
CO3		L		M	H				M		M		M	M	M
CO4		M	L	M	H				M		M	M	M	H	H
CO5	H	H	L	M	M			L	M		M	M	H	M	L

H = Highly Related; M = Medium L = Low

References:

1. Building Web Apps with WordPress: WordPress as an Application Framework 2nd Edition by Brian Messenlehner, Jason Coleman

2. WordPress for Beginners 2020: A Visual Step-by-Step Guide to Mastering WordPress (Webmaster Series) by Dr. Andy Williams

3. WordPress 5 Complete - Seventh Edition by Karol Krol

Course Outcomes

CO1:- To be able to understand concepts of content management system, its benefits.
CO2:- Understand installation and configuring word press for web development
CO3:- To be able to work with video and audio files with their plug-ins in websites
CO4:- To be able to create websites more attractive by using themes and CSS, increasing usability by adding hyperlinks.

CO5:Able to create interactive web sites

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M	L	M							L	L		
CO2	L		M		M									L	M
CO3		L		M	H				M		M		M	M	M
CO4	M	L	M	H				M		M	M	M	H	H	
CO5	H	H	L	M	M			L	M		M	M	H	M	L

H = Highly Related; M = Medium L = Low

References:

1. Building Web Apps with WordPress: WordPress as an Application Framework 2nd Edition by Brian Messenlehner, Jason Coleman

2. WordPress for Beginners 2020: A Visual Step-by-Step Guide to Mastering WordPress (Webmaster Series) by Dr. Andy Williams

3. WordPress 5 Complete - Seventh Edition by Karol Krol

Internet of things (IOT) Track

Internet of things (IOT)
Department Elective 1

BCO 223A	Open-Source Programming for IOT (Programming in SWIFT/RUST)	3-0-1 [2]

Course Objective:

UNIT-I	Introduction: Rust Programming Language: The Complete Course
UNIT-II	Basic Programming Concept: variables, datatypes, Function in rust, control flow
UNIT-III	Rust ownership Principle: Rust Ownership Model, Rust Ownership Model 2 - Memory Allocation, Rust Programming Language: The Complete Course, Rust Ownership Model 4 - References and Borrowing, Rust Ownership Model 5 - Data Races and Mutable References Rust Ownership Model 6 - Slices
UNIT-IV	Structuring Data: Using Structs, Initializing Structs - Field Init Shorthand, Tuple Structs, Examples of Struct - Area of Rectangle, Enum and Pattern Matching:Enums, Option Enum, Match statement and Enum
UNIT-V	Error handling in Rust, Unrecoverable errors with panic! Recoverable errors with Result enum, Shortcuts to Panic with Error: unwrap and expect Smart Pointers: Smart Pointers in Rust, Box<T> Smart Pointer, Deref trait, Drop trait, Rc<T> Smart Pointer, RefCell<T>

Course Outcome (CO)

At the end of this course students will have:

CO1: Create a Rust project, including proper Cargo configuration.
CO2: Translate a design into a working Rust program.
CO3: Explain and remedy type and lifetime errors encountered during Rust programming.
CO4: Construct reasonable types within programs, including parametric and lifetime-bounded types.
CO5: Use structs, enums and traits as intended in the construction of Rust programs.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		M	H	M	H				M		H		M	H	
CO2	L		M		H		L			M	M			H	M
CO3		M		H	M	L		L		M	H		M	H	
CO4			H	M			L		M		H		M	H	
CO5			H	M		L						M	H	H	

Textbook:

- *Programming Rust: Fast, Safe Systems Development*Jim Blandy and Jason OrendorffO'Reilly 2018

Internet of things (IOT)
Department Elective 2

BCO 090B	INTERNET OF THINGS	3-0-0 [3]

Course Objectives:

The objective of the course is to:

1. Introduction to IoT concepts.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.
5. Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

UNIT 1	**M2M to IoT**-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.
UNIT 2	**M2M to IoT – A Market Perspective**– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. **M2M to IoT-An Architectural Overview**– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.Sensor modules, nodes and systems.
UNIT 3	**M2M and IoT Technology Fundamentals-** Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management
UNIT 4	**IoT Architecture-State of the Art –** Introduction, State of the art, **Architecture Reference Model-** Introduction, Reference Model and architecture, IoT reference Model
UNIT 5	**IoT Reference Architecture-** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints-** Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.**Industrial Automation-** Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, **Commercial Building Automation-** Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future..

Course Outcome (CO) of **Internet of Things**

At the end of this course students will have:

CO1: To provide the basic understanding of IoT concepts
CO2: To equip our students with the market perspective of IoT and have the knowledge of architectural overview of IoT.
CO3:To be familiar with contemporary issues in IoT and Data and Knowledge Management and use of Devices in IoT Technology.
CO4: To be familiar with IoT tools and to enhance analytical skills to develop innovative solutions, automation.
CO5: Able to understand the real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H											L		
CO2				H				L		M					M
CO3			M			M								L	M
CO4				H	M				M				M		
CO5	H	M		H	M				M				M		

Textbook:

- Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",** 1st Edition, Academic Press, 2014.

Reference Books:

- Vijay Madisetti and ArshdeepBahga, **"Internet of Things (A Hands-on-Approach)",** 1stEdition, VPT, 2014.
- Francis daCosta, **"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",** 1st Edition, Apress Publications, 2013

Internet of things (IOT)
Department Elective 3

BCO 224A	Sensors and Actuator Devices	3-0-0

Course Objectives:
- Understand Internet of Things (IoT) sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules
- Market forecast for IoT devices with a focus on sensors
- Learn the Sensors and Actuators used in Automotive Industry and Security

UNIT-1	Introduction to sensors for IoT: Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device
UNIT-2	Sensors and actuator: Introduction to Sensors and Actuator- Sensor and Actuator Characteristics- Primary factors driving the deployment of sensor technology
UNIT-3	Seven generations of IoT sensors: Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics – Description & Characteristics–IoT Generation Roadmap
UNIT-4	Energy Harvesting Technologies: Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module– Sensing Module
UNIT-5	Sensors for Automotive Vehicle and Security applications: Tyre pressure monitoring systems - Two wheeler and Four wheeler security systems - Parking guide systems - Anti-lock braking system - Future safety technologies- Vehicle diagnostics and health monitoring, Sensor and Actuators in smart cities: Sensors in Home activity monitoring, human activity recognition, road traffic management,

Course Outcome:
CO1: Identify the IoT networking components with respect to sensors.
CO2: Build schematic for IoT solutions with sensors.
CO3: Design and develop IoT based sensor systems.
CO4: Select the appropriate sensors for various industrial applications
CO5: Evaluate the wireless sensor technologies for IoT.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		L										L		
CO2		M	H						M		H		M	M	
CO3			H	M	M				M		H			L	
CO4							M					H			L
CO5	H		L	M									L	M	

Text Book(s)

1. Timothy Chou,. Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020
2. Maggie Lin and Qiang Lin., Internet of Things Ecosystem: 2nd Edition,. January 19, 2021., independently published

Reference Books:

1. Patranabis, Sensors and Actuators, 2 nd edition, PHI, 2013
2. D. Patranabis, Sensors and Transducers, 1st edition, PHI Learning Private Limited,2013
3. Monk, Simon. Programming the Raspberry Pi: getting started with Python, 1st edition, McGraw-Hill Education, 2016.

Internet of things (IOT)
Department Elective 4

BCO 225A	Real Time Operating System	3-0-0

COURSE OBJECTIVES
- To introduce the characteristics of real-time systems & their different types and to discuss the characteristics and constraints of some commercial real-time operating systems.
- To discuss and analyze different task scheduling algorithms in uniprocessor and multi processor environments.
- To discuss the features and algorithms for real-time communications to take place in different network structures.
- To explain the characteristics of real-time databases and their applications in real world.

UNIT-1	REAL TIME SYSTEMS: Introduction- Issues in real time computing- Structure of a real time system- Task classes- Performance measures for real time systems- Task assignment and scheduling algorithms - Mode changes- Fault tolerant scheduling - Real Time Models.
UNIT-2	µC/OS- II RTOS CONCEPTS: Foreground/Background process- Resources - Tasks - Multitasking -Priorities - Schedulers -Kernel - Exclusion - Inter task communication-Interrupts - Clock ticks - µC/OS- II Kernel structure - µC/OS- II Initialisation - Starting µC/OS- II
UNIT-3	µC/OS- II RTOS FUNCTIONS: Task Management - Time management - Semaphore management - Mutual exclusion semaphore - Event Management –Message management - Memory management - Porting µC/OS- II – Comparison and Study of Various RTOS like QNX- VX Works-PSOS
UNIT-4	EMBEDDED LINUX: - Features - Embedded Linux Distributions - Architecture of Embedded Linux - Linux Kernel Architecture – User Space -Root File System - Linux Start-Up Sequence - GNU Cross Platform Tool chain - Porting Traditional RTOS Applications to Linux.
UNIT-5	REAL-TIME LINUX: Linux and Real-Time - Real-Time Programming in Linux - Hard Real-Time Linux - Building and Debugging - Building the Kernel- Integrated Development Environment - Kernel Debuggers - Embedded Drivers - Board support packages - Introduction to C linux.

COURSE OUTCOMES

After reading this subject, students will be able to:

CO1: Understand and develop real-time applications.
CO2: Develop efficient algorithms for real-time task scheduling in uniprocessor and multi processorenvironments.
CO3: Get an exposure to the different types of commercial real-time operating systems.
CO4: Identify the limitations of a non real-time operating system in running a real-time application.

CO5:Identify and address the important issues in real-time communications and will be able to use real-time databases.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H			M			L				L		H		L
CO2		M	L						M		H			M	
CO3			M		M									M	M
CO4	M		L									L			
CO5	M			L					L				M	L	

TEXT BOOKS:

1. Krishna C.M., Kang G. Shin, "Real Time Systems", Tata McGraw-Hill Edition, 2010.
2. Philip A.Laplante, "Real Time Systems Design and Analysis-An Engineers Handbook", II Edition-IEEE Press, IEEE ComputerSociety Press, 2001
3. Jean J Labrosse, "MicroC/OS-II The Real Time Kernel" II Edition,CMP Books, 2002.
4. P. Raghavan,Amol Lad, SriramNeelakandan, "Embedded LinuxSystem Design and Development", Auerbach Publications, Taylor& Francis Group, 2006.
5. Christopher Hallinan, "Embedded Linux Primer, A Practical, Real-World Approach", II Edition Pearson Education, Inc., 2011.

Internet of things (IOT)
Department Elective 5

BCO 226A	Wireless Ad-hoc and Sensor Networks	3-0-0

Course Objectives:

- Understand the design issues in ad hoc and sensor networks.
- Learn the different types of MAC protocols.
- Familiar with different types of adhoc routing protocols.
- Expose to the TCP issues in adhoc networks.
- Learn the architecture and protocols of wireless sensor networks

UNIT-1	INTRODUCTION: Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel MANET and WSN: Mobile Ad hoc Networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks
UNIT-2	MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS: Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocolsContention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11
UNIT-3	ROUTING PROTOCOLS IN WIRELESS AD-HOC NETWORKS: Issues in designing a routing protocol for Ad hoc networks- proactive routing, reactive routing (ondemand), hybrid routing TRANSPORT LAYER IN AD-HOC NETWORKS: Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.
UNIT-4	WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS: Issues in Designing in MAC protocol for WSN, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, T-MAC, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, BLUETOOTH, ZIGBEE, RFID
UNIT-5	WSN ROUTING, LOCALIZATION: Issues in Ad- Hoc and WSN routing protocols - Secure Ad hoc routing protocols – LEACH, PEGASIS, Direct Diffusion, Energy Efficient WSN Routing protocols, QoS WSN Routing Protocols -Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation

Course Outcome:

CO1: Understanding the concepts, network architectures and applications of ad hoc and wireless sensor networks
CO2: Understanding challenges in the layered architecture of Ad hoc wireless networks
CO3: Understanding the working of MAC and Routing Protocols for ad hoc and sensor networks
CO4: Analyze the protocol design issues of ad hoc and sensor networks
CO5: Design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues
CO6: Evaluate the QoS related performance measurements of ad hoc and sensor networks

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H											L		
CO2		H		H		L		M		L			H		
CO3	H			M			L			H				M	
CO4			M		H				M			L	L		H
CO5	H	M		L								L	M	L	
CO6	M			H		L				M				H	

Text Book(s)

1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.
2. Dargie, Waltenegus, and Christian Poellabauer. Fundamentals of wireless sensor networks: theory and practice. John Wiley & Sons, 2010.

Reference Books

1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
2. Feng Zhao and LeonidesGuibas, "Wireless Sensor Networks", Elsevier Publication – 2002.
3. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005
4. Kazem Sohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor NetworksTechnology, Protocols, and Applications", John Wiley, 2007. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003

Internet of things (IOT)
Department Elective 6

BCO 227A	IOT for Industry	3-0-1

Course Objectives:
- To develop knowledge in Industrial Internet of Things (IIoT) fundamentals.
- To gain conceptual understanding of networking and wireless communication protocols used in IIoT deployments
- To Understand the various Internet of Things (IoT) Protocols like COAP, MQTT.etc

UNIT-1	**Industrial IOT Introduction:** Introduction to IOT, What is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIOT
UNIT-2	**IoT Architecture:** IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT
UNIT-3	**Sensors and Protocols:** Introduction to sensors, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE, Modbus, SPI , I2C, IIOT protocols –COAP, MQTT, 6lowpan, lwm2m, AMPQ. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet
UNIT-4	**Privacy and Security:** Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, non-repudiation and availability
UNIT-5	**Application Design & Case Study:** Application Design & Case Study: Wireless Patient Monitor system, Wearable Fitness & Activity Monitor Application Design: Design of IOT based pulse oximeter, Reliability of IoT-Aware BPNM Healthcare process

Course Outcomes:
CO1. Develop conceptual design of Medical and Industrial IoT architecture.
CO2. Apply sensors and various protocols for industry standard solutions
CO3. Articulate privacy and security measures for industry standard solutions.
CO4. Study about Internet of Medical Things (IoMT) and its applications in Healthcare industry.
CO5. Design various applications using IoT in Healthcare Technologies.
CO6. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		L										L		
CO2		M	H						M		H		M	M	
CO3			H	M	M				M		H			L	
CO4							M					H			L
CO5	H		L	M									L	M	
CO6	H		L										L	H	

Text Book(s)

1. Veneri, Giacomo, and Antonio Capasso. Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1st edition, Packt Publishing Ltd, 2018.
2. Reis, Catarina I., and Marisa da Silva Maximiano, eds. Internet of Things and advanced application in healthcare, 1st edition, IGI Global, 2016.

Reference Books

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 1st Edition, Apress, 2017
2. Aboul Ella Hassanien, Nilanjan Dey and SureakaBoara, Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications, 1st edition, CRC Press, 2019.

Internet of things (IOT)
Department Elective 7

BCO 228A	Analytics for IOT	3-0-0

Course Objectives:

- Apply the fundamentals of machine learning and statistics to extract value from IoT data
- Understand different business use-cases for IoT data
- Understand different types of IoT data

UNIT-1	Introduction to IoT, applications, IoT architectures, introduction to analytics, IoT analytics challenges
UNIT-2	IoT devices, Networking basics, IoT networking connectivity protocols, IoT networking data messaging protocols, Analyzing data to infer protocol and device characteristics
UNIT-3	IoT Analytics for the Cloud: Introduction to elastic analytics, decouple key components, Cloud security and analytics, designing data processing for analytics, Applying big data technology to storage
UNIT-4	Exploring IoT Data: Exploring and visualizing data, Techniques to understand data quality, Basic *time* series analysis, Statistical analysis
UNIT-5	Data Science for IoT Analytics: Introduction to Machine Learning, Feature engineering with IoT data, Validation methods, Understanding the bias–variance tradeoff, Use cases for deep learning with IoT data Strategies to Organize Data for Analytics: Linked Analytical Datasets, Managing data lakes, data retention strategy

Course Outcomes:

CO1: Implement the architectural components and protocols for application development

CO2: Identify data analytics and data visualization tools as per the problem characteristics collect, store and analyse IoT data

CO3: Engineers who would like to understand the methods used to analyze IoT data in large scale

CO4: Executives who would like to understand how to utilize IoT data to create business value

CO5:Able to understand the concepts of Data Science for IoT Analytics.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcome	Program Outcome												Program Specific Outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H			L								H	L	
CO2				H				L		M			L		M
CO3			M			M								L	M
CO4				H	M				M				M		
CO5	M	M		H	M				M				M	M	

Text Books:

1. Minteer, Andrew, Analytics for the Internet of Things (IoT), Packt Publishing Ltd. Kai Hwang,
2. Min Chen, Big-Data Analytics for Cloud, IoT and Cognitive Computing, Wiley HwaiyuGeng,
3. Internet of Things and Data Analytics Handbook, Wiley John Soldatos, Building Blocks for IoT

Reference Books:

1. Analytics Internet-of-Things Analytics, RiverPublishers Gerardus Blokdyk, IoT Analytics A Complete Guide, 5starcooks