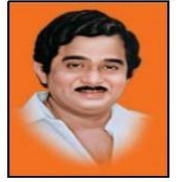


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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

COURSE STRUCTURE AND SYLLABUS

For UG – RM21

**B. Tech - COMPUTER SCIENCE AND ENGINEERING with Specialization ARTIFICIAL
INTELLIGENCE**

(Applicable for batches admitted from 2021-2022)



MVR COLLEGE OF ENGINEERING AND TECHNOLOGY, PARITALA

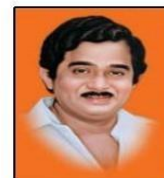
Paritala, Kanchikacherla, N.T.R Dist., AP—521180.



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I YEAR – I SEMESTER					
S.NO	SUBJECT NAME	L	T	P	CREDITS
1	Communicative English	3	0	0	3
2	Linear Algebra & Differential Equations	3	0	0	3
3	Applied Chemistry	3	0	0	3
4	Programming for Problem Solving using C	3	0	0	3
5	Engineering Graphics	3	0	0	3
6	English Communication Skills Lab	0	0	3	1.5
7	Applied Chemistry Lab	0	0	3	1.5
8	C Programming Lab	0	0	3	1.5
9	Constitution of India	2	0	0	0
Total Credits					19.5

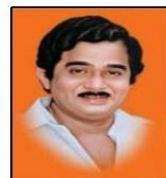
I YEAR-II SEMESTER					
S.NO	SUBJECT NAME	L	T	P	CREDITS
1	Applied Physics	3	0	0	3
2	Numerical Methods & Vector Calculus	3	0	0	3
3	Python Programming	3	0	0	3
4	Basic Electrical Engineering	3	0	0	3
5	Digital Logic Design	3	0	0	3
6	Applied Physics Lab	0	0	3	1.5
7	Applied Physics Virtual Lab	0	0	2	0
8	Python Programming Lab	0	0	3	1.5
9	Basic Electrical Engineering Lab	0	0	3	1.5
10	Environmental Studies	2	0	0	0
Total Credits					19.5



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II YEAR – I SEMESTER

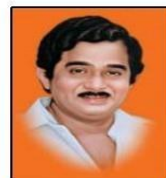
S.NO	SUBJECT NAME	L	T	P	CREDITS
1	Mathematics III	3	0	0	3
2	Mathematical Foundations of Computer Science	3	0	0	3
3	Introduction to Artificial Intelligence	3	0	0	3
4	Object Oriented Programming with Java	3	0	0	3
5	Database Management Systems	3	0	0	3
6	Introduction to Artificial Intelligence Lab	0	0	3	1.5
7	Object Oriented Programming with Java Lab	0	0	3	1.5
8	Database Management Systems Lab	0	0	3	1.5
9	Mobile App Development	0	0	3	2
10	Essence of Indian Traditional Knowledge	2	0	0	0
Total Credits					21.5



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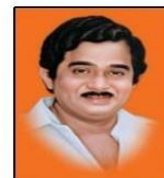
II YEAR – II SEMESTER					
S.NO	SUBJECT NAME	L	T	P	CREDITS
1	Probability and Statistics	3	0	0	3
2	Computer Organization	3	0	0	3
3	Data warehousing and Mining	3	0	0	3
4	Formal Languages and Automata Theory	3	0	0	3
5	Managerial Economics and Financial Accountancy	3	0	0	3
6	R Programming Lab	0	0	3	1.5
7	Data Mining using Python Lab	0	0	3	1.5
8	Web Application Development Lab	0	0	3	1.5
9	Natural Language Processing with Python	0	0	3	2
Total Credits					21.5



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III B. Tech – I Semester						
S.No	Course Code	courses	Hours per week			Credits
			L	T	P	
1	PC	Machine Learning	3	0	0	3
2	PC	Computer Networks	3	0	0	3
3	PC	Design and Analysis of Algorithms	3	0	0	3
4	Open Elective/ Job Oriented	Open Elective-I 1.Highway Engineering 2 Air Pollution Control 3.Remotesensing & GIS	3	0	0	3
5	PE	Professional Elective-I 1. Software Engineering 2. AI in Health Care 3. Data Visualization	3	0	0	3
6	PC	Computer Networks Lab	0	0	3	1.5
7	PC	Machine Learning Lab	0	0	3	1.5
8	SO	Skill Oriented Course - III 1. DevOps	0	0	4	2
9	MC	Employability Skills-I	2	0	0	0
10	PR	Summer Internship 2 Months(Mandatory) after second year(tobe evaluated during V semester	0	0	0	1.5
Total Credits-21.5						

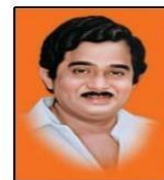
Industrial/Research Internship(Mandatory) 2 Months during summer vacation



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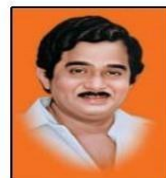
III B. Tech – II Semester						
S.No	Course Code	courses	Hours per week			Credits
			L	T	P	
1	PC	Deep Learning	3	0	0	3
2	PC	Big Data Analytics	3	0	0	3
3	PC	Cloud Computing	3	0	0	3
4	PE	Professional Elective-II 1. Software Project Management 2. Data Science 3. Distributed Systems	3	0	0	3
5	Open Elective/Job Oriented	Open Elective-II 1. Internet Of Things 2. Management Science	3	0	0	3
6	PC	Deep Learning with Tensor flow	0	0	3	1.5
7	PC	Big Data Analytics Lab	0	0	3	1.5
8	PC	Cloud Computing Lab	0	0	3	1.5
9	SO	Skill Oriented Course - IV Mean stack technologies-Module-I Html5, Javascript, Node.Js Express Js and type script	0	0	4	2
10	MC	Employability skills-II	2	0	0	0
Total Credits-21.5						



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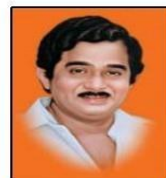
IV B. Tech – I Semester						
S.No	Course Code	courses	Hours per week			Credits
			L	T	P	
1	PE	Professional Elective-III 1. Reinforcement Learning 2. Quantum Computing 3. Social Network Analytics 4. Block Chain Technologies	3	0	0	3
2	PE	Professional Elective-IV 1. Virtual Reality Technologies & AR Development 2. High Performance Computing 3. Robotic Process Automation 4. Information Retrieval Systems	3	0	0	3
3	PE	Professional Elective-V 1. Artificial Neural Networks 2. Recommender Systems 3. AI Chat bots 4. Cyber Security	3	0	0	3
4	Open Elective /Job Oriented	Open Elective-III 1. Computer Graphics 2. Software Testing Methodologies 3. Expert Systems	3	0	0	3
5	SO	Mean stack technologies Module ii-Angular js and Mongo DB	0	0	4	2
6	Open Elective /Job Oriented	Open Elective-IV 1. Embedded System 2. Optimization Techniques 3. Human Computer Interaction	3	0	0	3
7	HS	Universal Human Values 2: Understanding Harmony	3	0	0	3
8	PR	Industrial/Research Internship 2 months(Mandatory) after third year evaluated during VII semester	0	0	0	3
Total Credits-23						



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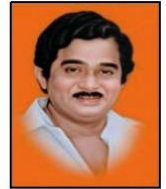
IV B. Tech –II Semester						
S.No	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1	Project	Major Project Work, Seminar, Internship	-	-	-	12
Total credits						12



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I Year - I Semester	REGULATION : RM_21	L	T	P	C
		3	0	0	3
COMMUNICATIVE-ENGLISH					

Introduction:

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/workplace contexts. The shift is from learning about the language to using the language. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

Course Objectives:

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Learning Outcomes: At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

Unit 1:

12 Hours

Lesson-1: A Drawer full of happiness from "Infotech English", Maruthi Publications.

Objective: To learn the value of togetherness of family and recollecting the previous Memories.

Outcome: The students will understand the comparison of present and past.

Grammar: Word Forms, Basic Sentence Structure and Word Order, yes and no type Questions,

Wh questions.

Writing: Punctuation, paragraph writing

Reading: Skimming, Scanning,

Speaking: Self Introduction, and introducing others.

Listening: Relevant tasks

Lesson-2: Deliverance by Premchand from “**The Individual Society**”, Pearson Publications. (Non-detailed)

Outcome: The students will understand the prejudice of caste system and realize how to Treat others equally.

Unit 2:

10 Hours

Lesson-1: Nehru’s letter to his daughter Indira on her birthday from “**Infotech English**”, Maruthi Publications.

Objective: To learn the human values and patriotism from elders.

Outcome: The students will learn to work hard and take the model of great freedom Fighters that dedicated themselves for the cause of our nation.

Grammar: Articles, Prepositions

Writing: Summarizing, paraphrasing,

Reading: Identifying ideas

Speaking: Discussions in pairs/small groups on specific topics.

Lesson-2: Bosom Friend by Hira Bansode from “**The Individual Society**”, Pearson Publications. (Non-detailed)

Outcome: The students will understand the human values well.

Unit 3:

08 Hours

Lesson-1: Stephen Hawking-Positivity ‘Benchmark’ from “**Infotech English**”, Maruthi Publications.

Objective: To make the learner understand the importance of being positive despite all odds

Outcome: The student will learn to move forward and follow despite all the disadvantages a Person might face.

Grammar: Verbs, Tenses, Concord Writing: Letter Writing

Reading: Reading between the lines Speaking: Complaining, Apologizing

Listening: Listening for global comprehension.

Lesson-2: A Shadow – RK Narayan (Non-detailed) from Modern Trailblazers of

Orient Black Swan.

Outcome: The learner will be in a position to appreciate the art of writing a short story.

Unit -4

10 Hours

Lesson -1: Work Brings Solace from “Sure Outcomes”, Orient Black Swan.

Objective: In this lesson, Abdul Kalam highlights the advantages of work.

Outcome: The student will understand the advantages of work. They will also learn how to overcome their problems and contribute to national development.

Grammar: Degrees of comparison Writing: Email Writing

Speaking: Describing Objects and Processes.

Lesson-2: Telephone Conversation-Wole Soyinka from “**The Individual Society**”, Pearson Publications. (Non-detailed)

Outcome: The students will understand the ill treatment meted out to Afro-Americans in the US and learn that any kind of discrimination is uncalled for.

Unit 5:

10 Hours

Lesson-1: Stay Hungry-Stay foolish from “**Infotech English**”, Maruthi Publications

Objective: In this lesson, students will understand the philosophy of connecting the dots backwards.

Outcome: The students will understand many life lessons that can be picked from the life of Steve Jobs

Grammar: Reported Speech

Writing: poster presentation

Reading: Reading

Comprehension Speaking: Presentation of a PPT

Lesson-2: Still I Rise by Maya Angelou from “**The Individual Society**”, Pearson Publications.(Non-detailed)

Outcome: The students learn about self-respect and confidence.

Text Books:

1. “Infotech English”, Maruthi Publications. (Detailed)
2. “Sure Outcomes”, Orient Black Swan.
3. “The Individual Society”, Pearson Publications.(Non-detailed)
4. Modern Trailblazers of Orient Black Swan

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students.Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking.HeinleyELT; 2ndEdition, 2018.

I Year - I Semester	REGULATION : RM-21	L	T	P	C
		3	0	0	3
LINEAR ALGEBRA & DIFFERENTIAL EQUATIONS					

COURSE OBJECTIVES:

- To instruct the concept of Matrices in solving simultaneous linear systems.
- Understanding of formation and solution of ordinary differential equations.
- Knowing the mathematical methods to solve applications of differential equations.
- To familiarize a variety of well-known sequences and series, with a developing intuition about the behavior of new ones.

COURSE OUT COMES : At the end of the course, the student will learn

- CO1: Apply the knowledge to solve linear system of equations.
- CO2: Illustrate the methods of computing Eigenvalues and Eigen vectors
- CO3: Able to solve the differential equations related to various engineering fields
- CO4: Determine the solutions of linear differential equations of higher order.
- CO5: Familiarize with functions of several variables which is useful in optimization

UNIT I:

Linear systems of equations : Rank of a matrix by reducing Echelon form and Normal form, Rank of a matrix, PAQ in normal form, Solving system of homogeneous and non-homogeneous linear equations, Gauss Elimination method, Gauss Jordan method. Application: Finding the current in electrical circuits.

UNIT II:

Eigen values and Eigen vectors: Eigen values and Eigen vectors and properties, Cayley- Hamilton theorem (without proof) **Applications** – Finding the inverse and power of a matrix by Cayley-Hamilton theorem, Reduction to Diagonal form, Quadratic forms and nature of the quadratic forms, Reduction of quadratic form to canonical forms by orthogonal transformation.

UNIT III:

Differential equations of first order and first degree Linear differential equations, Bernoulli's equations, Exact equations and equations reducible to exact form. **Applications:** Newton's Law of cooling– Law of natural growth and decay– Orthogonal trajectories– Electrical circuits.

UNIT IV:

Linear differential equations of higher order Solutions of Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients with non-homogeneous term of the type e^{ax} , $\sin ax$, $\cos ax$, x^n , $e^{ax}V(x)$ and $x^nV(x)$, Method of Variation of parameters. **Applications:** LCR circuit

UNIT V:

Partial differentiation: Introduction, Homogeneous function, Euler's theorem, Total derivative, Chain rule, Jacobian, Functional dependence, Taylor's and MacLaurin's series expansion of functions of two variables. Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India
2. N.P.BALI & Dr.MANISH GOYAL, A Text book of Engineering Mathematics, Lakshmi Publications, 9th Edition, 2014.

I Year - I Semester	REGULATION :RM21	L	T	P	C
		3	0	0	3
Applied Chemistry					

PURPOSE:

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Course Objectives:

- Importance of usage of Plastics in household appliances and composites(FRP)in aerospace and automotive industries.
- Outline the basics for the construction of electrochemical cells, batteries and fuel cell. Understand the mechanism of corrosion and how it can be prevented.
- Explain the preparation of Nanomaterials, Engineering applications of superconductors and liquid crystals.
- With the increase in demand for power and also with depleting sources of fossil fuels, the demand for alternative sources of fuels is increasing. Some of the prospective fuel sources are introduced and the study can create a better understanding on the Non –Conventional Energy Sources. Advanced instrumental techniques are introduced.
- Outline the basics of computational chemistry and molecular switches.

COURSE OUTCOMES :

CO1: Analyse the different types of composite plastic materials and interpret the mechanism of conduction in conducting polymers.

CO2: Utilize the theory of construction of electrodes, batteries and fuel cells in Redesigning new engineering products and categorize the reasons for Corrosion and study methods to control corrosion

CO3: Synthesize nanomaterials for modern advances of engineering technology. Analyze the applications of liquid crystals and superconductors.

CO4: Obtain the knowledge of Green chemistry and computational chemistry, molecular switches.

CO5: Familiarize various renewable energy sources that could be useful to alternate fossil fuels. Design models for energy by different natural sources Analyze the principles of different analytical instruments and their Applications

UNIT-I: POLYMER TECHNOLOGY

8hrs

Polymerization:-Introduction-Types of polymerization-addition and condensation polymerization with Examples – Physical and mechanical properties. **Plastics:-** Thermoplastics and Thermosetting plastics – Compounding - fabrication (compression, injection, Blown film and extrusion) - Preparation, properties and applications of PVC, Bakelite and Polycarbonates.

Elastomers:-Natural rubber-Draw backs-vulcanization–preparation, properties and applications(Buna S, Thiokol and polyurethanes) . **Composite Materials:** Fiberein forced plastics-aramid fibre reinforced plastics, conducting polymers, biodegradable Polymers.

UNIT-II: ELECTROCHEMICAL CELLS AND CORROSION

10hrs

Single electrode potential, Electro chemical series and uses of this series, Standard Hydrogen Electrode, Calomel electrodes.

Batteries (Dry Cell, Lithium ion and zinc air cell)Fuel cells(H_2-O_2 , CH_3OH-O_2)**Corrosion:-** Definition –

Theories of Corrosion (chemical & electrochemical) –galvanic corrosion, differential Aeration corrosion-Galvanic series, Factors influencing rate of corrosion-Corrosion control methods (Cathodicprotection)Protective coatings (Surface preparation, Cathodiccoatings, anodic Coatings, electroplating, electrolessplating (Nickel]) Paints (constituents and functions)

UNIT III: CHEMISTRY OF MATERIALS

10hrs

Nanomaterials:- Introduction , Sol-gel method , characterization by (Brunauer Emmet Teller(BET),(scanning electron microscopy[SEM]and (transmission electron microscopy[TEM]with example (TiO₂), Carbon Nano tubes and fullerenes(Types, preparation and applications).

Liquid crystals:-Introduction-types-applications.

Super conductors:-Type –I, Type II – Characteristics and applications

UNIT -IV :GREEN CHEMISTRY& ADVANCED CONCEPTS OF CHEMISTRY

8hrs

PART-A: GREEN CHEMISTRY:-Principles of Green chemistry- Methods for Green Synthesis- Aqueous Phase method-Phase transfer catalysis method -R₄M₄ Principles

PART-B: Molecular switches:Computational chemistry: Introduction to computational chemistry, molecular modeling and docking studies Characteristics of molecular motors and machines, Rotaxanes and Catenanes as artificial molecular machines, prototypes – linear motions in rotaxanes.

UNIT V: NON-CONVENTIONAL ENERGY SOURCES &SPECTROSCOPIC TECHNIQUES

10 hrs

PART-A: NON-CONVENTIONAL ENERGY RESOURCES:

Introduction, types of Renewable energy sources, solar energy – photovoltaic cell: design, working and its Importance. Hydropower includes setup a hydropower plant (schematic diagram)-Geothermal energy: Introduction-schematic diagram of a geothermal power plant-Tidal and wave power- OTEC

PART B: SPECTROSCOPIC TECHNIQUES:

UV spectroscopy- Basic principle-Instrumentation-Applications

IR spectroscopy- Basic principle-Instrumentation-Applications

NMR spectroscopy- Basic principle-Instrumentation-Applications

Text Books:

1. P.C. Jain and M. Jain “Engineering Chemistry”, 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, “Engineering Chemistry”, Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, “A Textbook of Engineering Chemistry”, S.Chand& Co, (2010).
4. Shashi Chawla, “Engineering Chemistry”, Dhanpat Rai Publicating

Standard Books:

1. Engineering Chemistry by Jain and Jain; DhanpatRaiPublicating Co.
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2015 edition.

Reference Books:

1. Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others, 2014 edition (second).
2. Engineering Chemistry by PrasanthRath, Cengage Learning, 2015 edition.
3. A text book of Engineering Chemistry by S. S. Dara; S.Chand & Co Ltd., Latest

I Year - I Semester	REGULATION: RM21	L	T	P	C
		3	0	0	3
PROGRAMMING FOR PROBLEM SOLVING USING –‘ C ‘					

Course Objectives:

- To learn the fundamentals of computers.
- To understand the various steps in program development.
- To learn the syntax and semantics of C programming language.
- To learn the usage of structured programming approach in solving problems.

Course Outcomes: The student will learn

- To write algorithms and to draw flowcharts for solving problems.
- To convert the algorithms/flowcharts to C programs.
- To code and test a given logic in C programming language.
- To decompose a problem into functions and to develop modular reusable code.
- To use arrays, pointers, strings and structures to write C programs.
- Searching and sorting problems.

UNIT - I: Introduction to Programming

Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming
 Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code, Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion, The main method and command line arguments

UNIT – II: Bitwise Operations

Bitwise operations: Bitwise AND, OR, XOR and NOT operators

Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do-while loops
 I/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr. Command line arguments

UNIT - III: Arrays, Strings, Structures and Pointers:

Arrays: one- and two-dimensional arrays, creating, accessing and manipulating elements of arrays
Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings

Structures: Defining structures, initializing structures, unions, Array of structures

Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self referential structures in linked list (no implementation)
 Enumeration data type

UNIT - IV: Function and Preprocessor:

Functions: Designing structured programs, Declaring a function, Signature of a function, and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, Preprocessor commands like include, define, undef, if, ifdef, ifndef passing pointers to functions, idea

of call by reference, Some C standard functions and libraries.

UNIT V: Strings and File handling:

Strings – Concepts, C Strings, String Input / Output functions, string manipulation functions, string /data conversion. Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions, Files: Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

TEXT BOOKS:

1. Byron Gottfried, Schaum’s Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
2. Hall of India
3. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
4. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
5. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

I Year – I Semester	REGULATION : RM21	L	T	P	C
		4	0	0	3
ENGINEERING GRAPHICS					

Course Objectives:

- To introduce the students to use drawing instruments and to draw polygons, Engg. Curves.
- To introduce the students to use orthographic projections, projections of points & simple lines.
- To make the students draw the projections of the lines inclined to both the planes.
- The objective is to make the students draw the projections of the plane inclined to both the Planes.
- The objective is to make the students draw the projections of the various types of Solids in Different positions inclined to one of the planes.
- The objective is to represent the object in 3D view through isometric views. The Student will be able to represent and convert the isometric view to orthographic view and vice versa.

Course Out comes:

CO1 Student’s ability to hand letter will improve, Student’s ability to perform basic sketching techniques will improve. Construct polygons, curves Student’s ability to use architectural and engineering scales will increase

CO2 Students will be able to draw orthographic projections and sections. Students are able to draw

lines .and project the line is inclined to both the planes

CO3 Students are able to draw planes

CO4 Develop the surfaces of geometrical solids

CO5 Visualize geometrical solids in 3D space through exercises in Orthographic Projections; interpret Orthographic, Isometric and Perspective views of objects.

UNIT – I :

Polygons: Constructing regular polygons by general methods, inscribing and describing Polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general methods. Scales: Plain scales, diagonal Scales and vernier scales.

UNIT - II :

Orthographic Projections: Horizontal plane, vertical plane, profile plane, importance of reference lines,

projections of points in various quadrants, projections of lines, lines parallel either to of the reference planes

(HP,VP or PP).Projections of straight lines inclined to both the Planes, determination of true lengths, angle of inclination and traces- HT, VT.

UNIT – III

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other

reference plane; inclined to both the reference planes.

UNIT- IV

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one plane.

UNIT – V

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer Aided Design, Drawing practice using Auto CAD, Creating 2D&3D drawings of objects using Auto CAD

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGraw-Hill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

I Year - I Semester	REGULATION: RM21	L	T	P	C
		0	0	3	1.5

ENGLISH COMMUNICATION SKILLS ‘ LAB ‘ SYLLABUS

Course Objectives:-

- To develop effective communication skills and build confidence.

- To enhance the general conversational skills in different socio-cultural contexts.
- To strengthen their public speaking skills.
- To instill courage to speak with anyone and make them competent enough to express themselves fluently.
- To enable the students to comprehend the speech of people belonging to different backgrounds and regions.
- To make the students understand the power of communication in personal & professional success.

Course outcomes: By the end of course, the student will be able to:

- Improve listening and speaking skills.
- Use functional English.
- Gain fluency in English Language.
- Learn effective communication skills and learn team dynamics.
- Face any interviews to get a suitable job.

Methodology:

1. The classes are to be learner-centered where the learners are exposed to much practice sessions of JAM, GDs and Interviews.
2. Integrated skill development methodology has to be adopted with focus on individual language skills as per the tasks/exercise.
3. The teacher is expected to use supplementary material wherever necessary and also generate activities/tasks as per the requirement.
4. The teacher is permitted to use lecture method when a completely new concept is introduced in the class

UNIT I: Phonetics: Sounds and Symbols (Vowels/Consonants Sounds)

UNIT II: Stress and Common Errors in Pronunciation.

UNIT III: Self-Introduction and JAM Session.

UNIT IV: Requests, Permissions and Directions.

UNIT V: Group Discussions and Interview Process.

TEXT BOOKS : “Infotech English”, Maruthi Publications. “Sure Outcomes”, Orient BlackSwan
References:

1. Exercises in Spoken English Part 1,2,3,4, CIEFL Oxford University Press.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan

I Year - I Semester	REGULATION : RM21				L	T	P	C
					3	0	0	3
APPLIED CHEMISTRY - LAB								

Purpose: Acquire some experimental skills.

Course Objectives:

*The experiments introduce volumetric analysis, Redox titrations and EDTA Titrations.

*A Few instrumental methods of chemical analysis.

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

CO: The student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, Volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na₂CO₃ solution.
2. Determination of alkalinity of a sample containing Na₂CO₃ and NaOH.
3. Determination of Mn⁺² using standard oxalic acid solution.
4. Determination of ferrous iron using standard K₂Cr₂O₇ solution.
5. Determination of Cu⁺² using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of P^H of the given sample.
8. Determination of concentration of acetic acid using sodium hydroxide (pH-metry method)
9. Determination of iso-electric point of amino acids using pH-metry method/conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of Mg⁺² present in an antacid.
13. Determination of CaCO₃ present in an egg shell.
14. Estimation of Vitamin C.
15. Preparation of nylon-6, 6 and Bakelite (demonstration only).

Of the above experiments at-least 10 assessment experiments should be completed

I Year - I Semester	REGULATION: RM21	L	T	P	C
		0	0	3	1.5
‘ C - PROGRAMMING - LAB ‘					

Course Objectives:

- Apply the principles of C language in problem solving.
- To design flowcharts, algorithms and knowing how to debug programs.
- To design & develop of C programs using arrays, strings pointers & functions.
- To review the file operations, preprocessor commands.

Course Outcomes:

By the end of the Lab, the student

- Gains Knowledge on various concepts of a C language.
- Able to draw flowcharts and write algorithms.
- Able to design and development of C problem solving skills.
- Able to design and develop modular programming skills.
- Able to trace and debug a program
- Able to implement file operations

Exercise 1:

1. Write a C program to print a block H using hash (*), where the H has a height of six characters and width of five and four characters.
2. Write a C program to compute the area of a circle with radius 10 inches.
3. Write a C program to print even numbers from 100 to 350.

Exercise 2:

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

Exercise 3:

1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number.

Exercise 4:

1. Write a program in C to display the n terms of even natural number and their sum.
2. Write a program in C to display the n terms of harmonic series and their sum. $1 + 1/2 + 1/3 + 1/4 + 1/5 \dots 1/n$ terms.
3. Write a C program to check whether a given number is an Armstrong number or not.

Exercise 5:

1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.
3. Write a program in C to sort elements of array in ascending order.

Exercise 6:

1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

Exercise 7:

1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

Exercise 8:

1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

Exercise 9:

1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

Exercise 10:

1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator.
2. Write a program in C to add two numbers using pointers.

Exercise 11:

1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

Exercise 12:

1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

Exercise 13:

1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.

Exercise 14:

1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc() function. Understand the difference between the above two programs
2. Write a program in C to convert decimal number to binary number using the function.

Exercise 15:

1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to generate 20 random numbers using arrays between 100 to 200.

Exercise 16:

1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to concatenate two files.

I Year – II Semester	REGULATION : RM21	L	T	P	C
		3	0	0	3
APPLIED PHYSICS					

Course Objective: Objective of the course is to impart

- *Knowledge* of fundamentals of Physics which helps them in the study of advanced topics of Engineering.
- *Develop* analytical capability and understand various Engineering concepts.

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

- *Impart knowledge* of Physical Optics phenomenon Polarization and identify these phenomena in natural processes.
- *Gain knowledge* of applications of lasers and optical fibers in various fields.
- *Classify* magnetic and dielectric materials and their Engineering applications.
- *Understand basic* quantum mechanics and free electron theories.
- *Obtain* the concept of holes and electrons in semiconductors.

UNIT-I- Wave Optics

(12hrs)

Interference: Introduction-Principle of Superposition – Coherent Sources – Interference in thin films (reflection geometry) – Colors in thin films-Newton’s rings-Determination of wave length and refractive index.**Diffraction:** Introduction- Fresnel and Fraunhofer diffraction - Fraunhofer Diffraction due to Single slit,double slit, N-slits (Qualitative) - Diffraction Grating – Resolving Power of Grating (Qualitative).**Polarization:** Introduction- Types of polarization-polarization by reflection, refraction and Double-Nicol’s prism – Half and Quarter wave plates.

Unit-II: Lasers and Fiber optics

(10hrs)

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein’s coefficients – Population inversion – Lasing action - Pumping Schemes – Ruby laser – He-Ne laser - Applications of lasers.

Fiber optics: Introduction –Principle of Optical Fiber-Construction- Acceptance Angle-Numerical Aperture-Classification of Optical Fibers based on refractive index profile and modes-Optical Fiber communication System.

UNIT III: Magnetic and Dielectric Materials

(08hrs)

Magnetic Materials: Introduction – Magnetic dipole moment – Magnetization – Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Bohr magneton – Classification of magnetic materials: Dia, para, Ferro, antiferro & Ferri – Domain concept of Ferromagnetism - Hysteresis – soft and hard magnetic materials .

Dielectric Materials: Introduction - Dielectric polarization – Dielectric Polarizability, Susceptibility and Dielectric constant-types of polarizations: Electronic and Ionic (Quantitative), Orientation polarizations (qualitative) – Lorentz Internal field – Clausius-Mossotti equation.

UNIT-IV- Quantum Mechanics, Free Electron Theory

(10 hrs)

Quantum Mechanics: Introduction- Matter waves-Dual nature of matter – Heisenberg’s Uncertainty Principle – Significance and properties of wave function – Schrodinger’s time independent and dependent wave equations– Particle in 3-Dimensional Potential Box.

Free Electron Theory: Introduction-Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory– Equation for electrical conductivity based on quantum free electron theory- Fermi-Dirac distribution- Density of States(3D),Fermi energy.

Unit – V: Band Theory of Solids and Semiconductors

(10 hrs)

Band theory of Solids: Introduction- Bloch's Theorem (Qualitative) - Kronig - Penney model (Qualitative) - E vs K diagram – v vs K diagram-effective mass of electron–concept of hole
Classification of crystalline solids.**Semiconductors:** Introduction– Intrinsic semi conductors - density of charge carriers - Electrical conductivity – Fermi level – extrinsic semiconductors - p-type & n-type - Density of charge carriers -Dependence of Fermi energy on carrier concentration and temperature – Drift and Diffusion currents – Einstein's equation-Hall effect- Hall coefficient - Applications of Hall effect.

Text Books:

1. "A Text book of Engineering Physics" by M.N.Avadhanulu, P.G.Kshirsagar -S.Chand Publications, 2019.
2. "Engineering Physics" by D.K.Bhattacharya and Poonam Tandon, Oxford press (2015).
3. "Engineering Physics" by R.K Gaur. and S.L Gupta., - Dhanpat Rai publishers,2012.

Reference Books

1. Applied Physics by P.K. Palanisamy, Scitech publications (2014).
2. Engineering Physics by M. Arumugam, Anuradha Publication (2014).
3. Physics for Engineers by M.R. Srinivasan, New Age international publishers (2009).

I Year - II Semester	REGULATION : RM21	L	T	P	C
		3	0	0	3
NUMERICAL METHODS AND VECTOR CALCULUS					

Course objectives:

- To understand the basic numerical methods to solve non linear algebraic equations.
- To demonstrate the use of different numerical techniques for carrying out numerical integration
- To Illustrate the types of Integration over the lines, surface and volumes

COURSE OUT COMES: At the end of the course, the student will learn

- CO1: Evaluate the approximate roots of polynomial and transcendental equations by different algorithms. Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals
- CO2: Discuss numerical integral techniques to different Engineering problems. Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations
- CO3: Calculate double integration techniques in evaluating areas bounded by region
- CO4: Interpret the physical meaning of different operators such as gradient, curl and divergence
- CO5: Estimate the work done against a field, circulation and flux using vector calculus

UNIT I: Iterative methods and Interpolation:

Introduction, Bisection method , Method of false position, Iteration method , Newton-Raphson method, Jacobi and Gauss-Seidel methods for solving system of equations numerically. Errors in polynomial interpolation , Finite differences , Forward differences , Backward differences , Central differences, Relations between operators, Newton's forward and backward formulae for interpolation , Interpolation with unequal intervals , Lagrange's interpolation formula .

UNIT II: Numerical integration, Solution of ordinary differential equations with initial conditions:

Numerical integration, Trapezoidal rule , Simpson's 1/3rd and 3/8th rule, Solution of initial value problems by Taylor's series ,Picard's method of successive approximations , Euler's method ,Modified Euler's method, Runge-Kutta method (fourth order).

UNIT III: Multiple integrals:

Double and Triple integrals, Change of order of integration in double integrals, Change of variables to polar coordinates. Applications: Finding Areas and Volumes.

UNIT IV: Vector Differentiation :

Gradient, Directional derivative, Divergence, Curl, Scalar Potential, Vector identities, Laplacian and second order operators.

UNIT V: Vector Integration:

Line integral , Work done , Area , Surface and volume integrals .Vector integral theorems: Greens, Stokes and

Gauss Divergence theorems (without proof).

Text Books:

1. **B. S. Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana**, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India
2. **N.P.BALI &Dr.MANISH GOYAL**, A Text book of Engineering Mathematics, Lakshmi Publications, 9th Edition, 2014.

I Year - II Semester	REGULATION: RM21	L	T	P	C
		3	0	0	3
PYTHON PROGRAMMING					

Course Objectives:

The Objectives of Python Programming are

- To learn about Python programming language syntax, semantics, and the runtime environment
- To be familiarized with universal computer programming concepts like data types, containers
- To be familiarized with general computer programming concepts like conditional execution, loops & functions
- To be familiarized with general coding techniques and object-oriented programming

Course Outcomes:

- Develop essential programming skills in computer programming concepts like data types, containers
- Apply the basics of programming in the Python language
- Solve coding tasks related conditional execution, loops
- Solve coding tasks related to the fundamental notions and techniques used in object-oriented programming

UNIT I

Introduction: Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output. Data Types, and Expression: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.

Repetition Structures: Introduction, while loop, for loop, Calculating a Running Total, Input validation Loops, Nested Loops.

UNIT II

Control Statement: Definite iteration for Loop Formatting Text for output, Selection if and if else Statement, Conditional Iteration, The While Loop ,Strings and Text Files: Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods Text Files.

UNIT III

List and Dictionaries: Lists, Defining Simple Functions, Dictionaries, Design with Function: Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function., Modules: Modules, Standard Modules, Packages.

UNIT IV

File Operations: Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and write lines(), Manipulating file pointer using seek, Programming using file operations .

Object Oriented Programming:

Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Programming using Oops support Design with Classes: Objects and Classes,Data modeling Examples, Case Study An ATM, Structuring Classes with Inheritanceand

UNIT V

Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Redefined Clean-up Actions.

Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI -Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources. Programming : Introduction to Programming Concepts with Scratch.

Text Books

- 1) Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage.
- 2) Python Programming: A Modern Approach, Vamsi Kurama, Pearson.

Reference Books:

- 1) Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press.
- 2) Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

e-Resources:

https://www.tutorialspoint.com/python3/python_tutorial.pdf

I Year - I Semester	REGULATION : RM21	L	T	P	C
		3	0	0	3
BASIC ELECTRICAL ENGINEERING - I					

Course Objectives:

- To understand the basic concepts on RLC circuits.
- To know the behavior of the steady state analysis RLC circuits.
- To know about basics of the magnetic circuits.
- To know about network theorems
- To understand the two port network parameters.

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

- Gain the knowledge on basic network elements.
- Will analyze the RLC circuit's behavior in detailed.
- Analyze the performance magnetic circuits.
- Analyze the network theorem using ac and dc networks.
- Gain the knowledge in characteristics of two port network parameters.

UNIT – I: Introduction to Electrical Circuits:

(10hrs)

Network elements classification, Electric charge and current, electric energy and potential, Resistance parameter – series and parallel combination, Inductance parameter – series and parallel Combination, Capacitance parameter - series and parallel combination- Star-Delta conversion-Types of energy sources- Source transformation-Kirchoff's laws-Mesh analysis and Nodal analysis problem solving with independent sources. Principal of Duality with examples

UNIT – II: A.C Fundamentals and Steady State Analysis

(10hrs)

Definitions of terms associated with periodic functions: Time period, Angular velocity and frequency, RMS value, Average value, Form factor and peak factor- problem solving, Phase angle, Phasor representation- Mathematical representation of sinusoidal Quantities Response to sinusoidal excitation - pure resistance, pure inductance, pure capacitance, impedance concept, phase angle, series R-L, R-C, R-L-C circuits.

UNIT – III: Magnetic Circuits:

(10hrs)

Introduction to magnetic circuits-Self inductance, Mutual inductance, Coefficient of coupling, analysis of coupled circuits-Dot rule of coupled circuits. **Resonance:** Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance

UNIT –IV: Network Theorems: (10hrs)

Thevinin’s theorem-Norton’s theorem-Milliman’s theorem- Reciprocity theorem- Superposition theorem- Maximum Power Transfer theorem- Problems using independent source for ac and dc sources

UNIT – V: Two-port networks: (10hrs)

Z-parameters-Y-parameters-ABCD parameters-H-parameters- Cascading of two port networks- series connection of two port networks-Problems on independent sources.

Text Books:

- Network Analysis by Sudhakar&Shyammohan s palli, TMH
- Network Analysis by K.Satya Prasad and S Sivanagaraju, Cengage Learning
- Electric Circuit Analysis by Hayt and Kimmarle, TMH
- Circuit theory by A.Chakrabarthy,dhanapathirai&co

Reference Books:

- Network lines and Fields by John. D. Ryder 2nd edition, Asia publishing house.
- Basic Circuit Analysis by DR Cunningham, Jaico Publishers.
- Network Analysis and Filter Design by Chadha, Umesh Publications..

I Year - II Semester		L	T	P	C
		3	0	0	3
DIGITAL LOGIC DESIGN					

Course objectives:

- To study the basic philosophy underlying the various number systems, negative number representation, binary arithmetic, theory of Boolean algebra and map method for minimization of switching functions.
- To introduce the basic tools for design of combinational and sequential digital logic.
- To learn simple digital circuits in preparation for computer engineering.

Course outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

- An ability to define different number systems, binary addition and subtraction, 2’s complement representation and operations with this representation.
- An ability to understand the different switching algebra theorems and apply them for logic functions.
- An ability to define the Karnaugh map for a few variables and perform an algorithmic reduction of logic functions.
- Students will be able to design various logic gates starting from simple ordinary gates to complex programmable logic devices & arrays.
- Students will be able to design various sequential circuits starting from flip-flop to registers and counters.

UNIT I: Digital Systems and Binary Numbers

Digital Systems, Binary Numbers, Octal and Hexadecimal Numbers, Complements of Numbers, Signed Binary Numbers, Arithmetic addition and subtraction, 4-bit codes: BCD, EXCESS 3, alphanumeric codes, 9’s complement, 2421, etc.

Concept of Boolean algebra: Basic Theorems and Properties of Boolean algebra, Boolean Functions, Canonical and Standard Forms, Minterms and Maxterms.

UNIT II: Logic Gates and Gate level Minimization: Basic logic operations, Digital Logic gates, The K-Map Method, Three-Variable K-Map, Four Variable K-Maps. Products of Sum Simplification,

Sum of Products Simplification, Don't – Care Conditions, NAND and NOR Implementation, Exclusive OR Function.

UNIT III: Combinational Logic Circuits:

Introduction, Analysis Procedure, Binary Adder–Subtractor, Binary Multiplier, Decoders, Encoders, Multiplexers, Demultiplexers, Priority Encoder, Code Converters, Magnitude Comparator, HDL Models of Combinational Circuits.

Realization of Switching Functions Using PROM, PAL and PLA.

UNIT IV: Synchronous Sequential Logic

Introduction to Sequential Circuits, Storage Elements: Latches, Flip-Flops, RS- Latch Using NAND and NOR Gates, Truth Tables. RS, JK, T and D Flip Flops, Truth and Excitation Tables, Conversion of Flip Flops.

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UNIT V: Registers and Counters

Registers, Shift Registers, Ripple Counters, Synchronous Counters, Ring Counter, Johnson Counter.

Text Books:

- 1) Digital Design, 5/e, M.Morris Mano, Michael D Ciletti, PEA.
- 2) Fundamentals of Logic Design, 5/e, Roth, Cengage.

Reference Books:

- 1) Digital Logic and Computer Design, M.Morris Mano, PEA.
- 2) Digital Logic Design, Leach, Malvino, Saha, TMH.
- 3) Modern Digital Electronics, R.P. Jain, TMH.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

	REGULATION : RM21	
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		REGULATION : RM-21			
I Year – II Semester	Applied Physics Lab	L	T	P	C
		0	0	3	1.5
(Any 10 of the following listed 15 experiments)					

Course Objective: Objective of the course is to impart

- Training Engineering graduates to handle instruments and their usage methods to improve the accuracy of measurements.

CO1: Outcomes: The student is exposed to different methods of chemical analysis and use of some Commonly employed instruments. They thus acquire some experimental skills.

CO2: Implement the basic principles of Mechanics to measure different physical parameters.

CO3: Enhance the knowledge of Usage of electronic devices in various applications.

SYLLABUS

1. Laser: Determination of wavelength using diffraction grating.
2. Study of variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method
3. Determination of velocity of sound – volume resonator.
4. To determine the energy gap of a semiconductor using p-n junction diode.
5. Determination of dielectric constant using charging and discharging method.
6. Determination of Acceleration due to Gravity and Radius of Gyration- Compound Pendulum.
7. Measurement of resistance of a semiconductor with varying temperature.
8. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum).
9. Determination of numerical aperture and acceptance angle of an optical fiber.
10. Determination of thickness of thin object by wedge method.
11. Determination of radius of curvature of given Plano convex lens by Newton's rings.
12. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction Grating in normal incidence configuration.
13. Determination of dispersive power of the prism.
14. Sonometer: Verification of laws of string.
15. Melde's experiment-Transverse and Longitudinal modes.

References:

1. S. Bala subramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.



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I Year – II Semester	APPLIED PHYSICS-VIRTUAL LAB	L	T	P	C
		0	0	2	0
(Any 05 of the following listed experiments)					

Course Objective: Objective of the course is to impart

- Training Engineering students to prepare a technical document and improving their writing skills.

Course Outcomes

- Physics Virtual laboratory curriculum in the form of assignment ensures an engineering graduate to prepare a /technical/mini-project/experimental report with scientific temper.

LIST OF EXPERIMENTS:

- Hall Effect
- Crystal Structure
- Hysteresis
- Brewster's angle
- Magnetic Levitation / SQUID
- Numerical Aperture of Optical fiber
- Photoelectric Effect
- Simple Harmonic Motion
- Damped Harmonic Motion
- LASER – Beam Divergence and Spot size
- B-H curve
- Michelson's interferometer
- Black body radiation

URL: www.vlab.co.in

		L	T	P	C
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I Year - II Semester	REGULATION: RM21	3	0	0	1.5
PYTHON PROGRAMMING - LAB					

Course Objectives: The Objectives of Python Programming are

- To learn about Python programming language syntax, semantics, and the runtime environment
- To be familiarized with universal computer programming concepts like data types, containers
- To be familiarized with general computer programming concepts like conditional execution, loops & functions
- To be familiarized with general coding techniques and object-oriented programming

Course Outcomes:

- Develop essential programming skills in computer programming concepts like data types, containers
- Apply the basics of programming in the Python language
- Solve coding tasks related conditional execution, loops
- Solve coding tasks related to the fundamental notions and techniques used in object- oriented programming

List of Experiments:

- 1) Write a program that asks the user for a weight in kilograms and converts it to pounds. There are 2.2 pounds in a kilogram.
- 2) Write a program that asks the user to enter three numbers (use three separate input statements). Create variables called total and average that hold the sum and average of the three numbers and print out the values of total and average.
- 3) Write a program that uses a *for* loop to print the numbers 8, 11, 14, 17, 20, . . . , 83, 86, 89.
- 4) Write a program that asks the user for their name and how many times to print it. The program should print out the user's name the specified number of times.
- 5) Use a *for* loop to print a triangle like the one below. Allow the user to specify how high the triangle should be.

```
*
**
***
****
```

- 6) Generate a random number between 1 and 10. Ask the user to guess the number and print a message based on whether they get it right or not.
- 7) Write a program that asks the user for two numbers and prints *Close* if the numbers are within .001 of each other and *Not close* otherwise.
- 8) Write a program that asks the user to enter a word and prints out whether that word contains any vowels.
- 9) Write a program that asks the user to enter two strings of the same length. The program should then check to see if the strings are of the same length. If they are not, the program should print an appropriate message and exit.
- 10) If they are of the samelength, the program should alternate the characters of the two strings. For example, if the user enters *abcde* and *ABCDE* the program should print out *AaBbCcDdEe*.
- 11) Write a program that asks the user for a large integer and inserts commas into it according to the standard American convention for commas in large numbers. For instance, if the user enters 1000000, the output should be 1,000,000.
- 12) In algebraic expressions, the symbol for multiplication is often left out, as in $3x+4y$ or $3(x+5)$. Computers prefer those expressions to include the multiplication symbol, like $3*x+4*y$ or $3*(x+5)$. Write a program that asks the user for an algebraic expression and then inserts multiplication symbols where appropriate.
- 13) Write a program that generates a list of 20 random numbers between 1 and 100.
 - (a) Print the list.
 - (b) Print the average of the elements in the list.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

- (c) Print the largest and smallest values in the list.
- (d) Print the second largest and second smallest entries in the list
- (e) Print how many even numbers are in the list.

- 14) Write a program that asks the user for an integer and creates a list that consists of the factors of that integer.
- 15) Write a program that generates 100 random integers that are either 0 or 1. Then find the longest run of zeros, the largest number of zeros in a row. For instance, the longest run of zeros in [1,0,1,1,0,0,0,0,1,0,0] is 4.
- 16) Write a program that removes any repeated items from a list so that each item appears at most once. For instance, the list [1,1,2,3,4,3,0,0] would become [1,2,3,4,0].
- 17) Write a program that asks the user to enter a length in feet. The program should then give the user the option to convert from feet into inches, yards, miles, millimeters, centimeters, meters, or kilometers. Say if the user enters a 1, then the program converts to inches, if they enter a 2, then the program converts to yards, etc. While this can be done with if statements, it is much shorter with lists and it is also easier to add new conversions if you use lists.
- 18) Write a function called *sum_digits* that is given an integer num and returns the sum of the digits of num.
- 19) Write a function called *first_diff* that is given two strings and returns the first location in which the strings differ. If the strings are identical, it should return -1.
- 20) Write a function called *number_of_factors* that takes an integer and returns how many factors the number has.
- 21) Write a function called *is_sorted* that is given a list and returns True if the list is sorted and False otherwise.
- 22) Write a function called *root* that is given a number x and an integer n and returns $x^{1/n}$. In the function definition, set the default value of n to 2.
- 23) Write a function called *primes* that is given a number n and returns a list of the first n primes. Let the default value of n be 100.
- 24) Write a function called *merge* that takes two already sorted lists of possibly different lengths, and merges them into a single sorted list.
 - (a) Do this using the sort method. (b) Do this without using the sort method.
 Write a program that asks the user for a word and finds all the smaller words that can be made from the letters of that word. The number of occurrences of a letter in a smaller word can't exceed the number of occurrences of the letter in the user's word.
- 25) Write a program that reads a file consisting of email addresses, each on its own line. Your program should print out a string consisting of those email addresses separated by semicolons.
- 26) Write a program that reads a list of temperatures from a file called *temps.txt*, converts those temperatures to Fahrenheit, and writes the results to a file called *ftemps.txt*.
- 27) Write a class called *Product*. The class should have fields called name, amount, and price, holding the product's name, the number of items of that product in stock, and the regular price of the product. There should be a method *get_price* that receives the number of items to be bought and returns a the cost of buying that many items, where the regular price is charged for orders of less than 10 items, a 10% discount is applied for orders of between 10 and 99 items, and a 20% discount is applied for orders of 100 or more items. There should also be a method called *make_purchase* that receives the number of items to be bought and decreases amount by that much.



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- 28) Write a class called Time whose only field is a time in seconds. It should have a method called *convert_to_minutes* that returns a string of minutes and seconds formatted as in the following example: if seconds is 230, the method should return '5:50'. It should also have a method called *convert_to_hours* that returns a string of hours, minutes, and seconds formatted analogously to the previous method.
- 29) Write a class called Converter. The user will pass a length and a unit when declaring an object from the class— for example, `c = Converter(9,'inches')`. The possible units are inches, feet, yards, miles, kilometers, meters, centimeters, and millimeters. For each of these units there should be a method that returns the length converted into those units. For example, using the Converter object created above, the user could call `c.feet()` and should get 0.75 as the result.
- 30) Write a Python class to implement `pow(x, n)`.



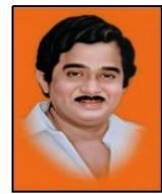
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II Year I Semester		L	T	P	C
		3	0	0	3

TRANSFORM TECHNIQUES
(Common to All Branches)

Course Objectives:

- To familiarize the techniques in partial differential equations
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

Course Outcomes:

At the end of the course, the student will be able to

- Interpret the physical meaning of different operators such as gradient, curl and divergence.
- Estimate the work done against a field, circulation and flux using vector calculus.
- Apply the Laplace transform for solving differential equations.
- Find or compute the Fourier series of periodic signals.
- Know and be able to apply integral expressions for the forwards and inverse Fourier transform to arrange of non-periodic waveforms.
- Identify solution methods for partial differential equations that model physical processes.

UNIT I: Vector calculus:

Vector Differentiation: Gradient – Directional derivative – Divergence – Curl – Scalar Potential. Vector Integration: Line integral – Work done – Area – Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof).

UNIT II: Laplace Transforms:

Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function – Inverse Laplace transforms – Convolution theorem (without proof).

Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

UNIT III: Fourier series and Fourier Transforms:

Fourier Series: Introduction – Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties – inverse transforms – Finite Fourier transforms.

UNIT IV: PDE of first order:

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

UNIT V: Second order PDE and Applications:

Second order PDE: Solutions of linear partial differential equations with constant coefficients – RHS term of the type e^{ax+by} , $\sin(ax+by)$, $\cos(ax+by)$, $x^m y^n$.

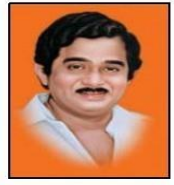
Applications of PDE: Method of separation of Variables – Solution of one-dimensional Wave, Heat and two-dimensional Laplace equation.



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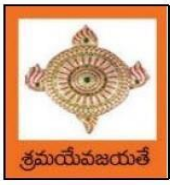
(Approved by AICTE, Affiliated to JNTUK, certified by ISO: 9001-2008, Accredited by NBA(CSE) and NAAC with 'A')

Text Books:

- 1) B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
- 2) B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

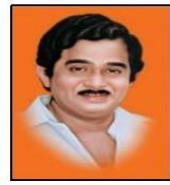
- 1) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
- 2) Dean. G. Duffy, Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.
- 3) Peter O' Neil, Advanced Engineering Mathematics, Cengage.
- 4) Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – I Semester	L	T	P	C
	3	0	0	3
MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE				

Course Objectives:

This course is designed to:

- To introduce the students to the topics and techniques of discrete methods and combinatorial reasoning
- To introduce a wide variety of applications. The algorithmic approach to the solution of problems is fundamental in discrete mathematics, and this approach reinforces the close ties between this discipline and the area of computer science

Course Outcomes:

At the end of the course student will be able to

- Demonstrate skills in solving mathematical problems
- Comprehend mathematical principles and logic
- Demonstrate knowledge of mathematical modeling and proficiency in using mathematical software
- Manipulate and analyze data numerically and/or graphically using appropriate Software
- Communicate effectively mathematical ideas/results verbally or in writing

UNIT I

Mathematical Logic: Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof, Predicate Calculus: Predicates, Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus.

UNIT II

Set Theory: Sets: Operations on Sets, Principle of Inclusion-Exclusion, Relations: Properties, Operations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering, Hassie Diagrams, Functions: Bijective, Composition, Inverse, Permutation, and Recursive Functions, Lattice and its Properties, Algebraic Structures: Algebraic Systems, Properties, Semi Groups and Monoids, Group, Subgroup and Abelian Group, Homomorphism, Isomorphism.

UNIT III

Combinatorics: Basis of Counting, Permutations, Permutations with Repetitions, Circular and Restricted Permutations, Combinations, Restricted Combinations, Binomial and Multinomial Coefficients and Theorems, Number Theory: Properties of Integers, Division Theorem, Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic, Fermat's and Euler's Theorems

UNIT IV

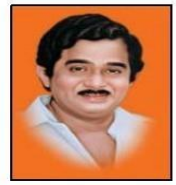
Recurrence Relations: Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations,



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Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations

UNIT V

Graph Theory: Basic Concepts, Graph Theory and its Applications, Sub graphs, Graph Representations: Adjacency and Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multigraphs, Bipartite and Planar Graphs, Euler's Theorem, Graph Colouring and Covering, Chromatic Number, Spanning Trees, Prim's and Kruskal's Algorithms, BFS and DFS Spanning Trees.

Text Books:

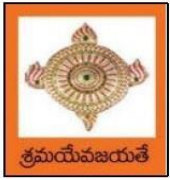
- 1) Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and P. Manohar, Tata McGraw Hill.
- 2) Elements of Discrete Mathematics-A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 3rd Edition, Tata McGraw Hill.

Reference Books:

- 1) Discrete Mathematics for Computer Scientists and Mathematicians, J. L. Mott, A. Kandel and T. P. Baker, 2nd Edition, Prentice Hall of India.
- 2) Discrete Mathematical Structures, Bernard Kolman, Robert C. Busby and Sharon Cutler Ross, PHI.
- 3) Discrete Mathematics and its Applications with Combinatorics and Graph Theory, K. H. Rosen, 7th Edition, Tata McGraw Hill.

e-Resources:

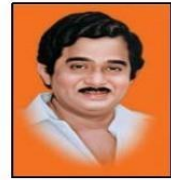
- 1) <https://nptel.ac.in/courses/106/106/106106094/>



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

I Year – II Semester	L	T	P	C
	3	0	0	3
DATA STRUCTURES				

Course Objectives:

The objective of the course is to

- Introduce the fundamental concept of data structures and abstract data types
- Emphasize the importance of data structures in developing and implementing efficient algorithms
- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms

Course Outcomes:

After completing this course, a student will be able to:

- Summarize the properties, interfaces, and behaviors of basic abstract data types
- Discuss the computational efficiency of the principal algorithms for sorting & searching
- Use arrays, records, linked structures, stacks, queues, trees, and Graphs in writing programs
- Demonstrate different methods for traversing trees

UNIT I

Data Structures - Definition, Classification of Data Structures, Operations on Data Structures, Abstract Data Type (ADT), Preliminaries of algorithms. Time and Space complexity.

Searching - Linear search, Binary search, Fibonacci search.

Sorting- Insertion sort, Selection sort, Exchange (Bubble sort, quick sort), distribution (radix sort), merging (Merge sort) algorithms.

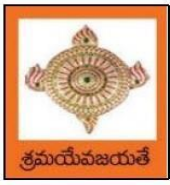
UNIT II

Linked List: Introduction, Single linked list, Representation of Linked list in memory, Operations on Single Linked List-Insertion, Deletion, Search and Traversal, Reversing Single Linked list, Applications on Single Linked list- Polynomial Expression Representation, Addition and Multiplication, Sparse Matrix Representation using Linked List, Advantages and Disadvantages of Single Linked list, Double Linked List-Insertion, Deletion, Circular Linked list-Insertion, Deletion.

UNIT III

Queues: Introduction to Queues, Representation of Queues-using Arrays and using Linked list, Implementation of Queues-using Arrays and using Linked list, Application of Queues-Circular Queues, Dequeues, Priority Queues, Multiple Queues.

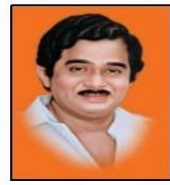
Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on Stacks, Linked list Representation of Stacks, Operations on Linked Stack, Applications-Reversing list, Factorial Calculation, Infix to Postfix Conversion, Evaluating Postfix Expressions.



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UNIT IV

Trees: Basic Terminology in Trees, Binary Trees-Properties, Representation of Binary Trees using Arrays and Linked lists. Binary Search Trees- Basic Concepts, BST Operations: Insertion, Deletion, Tree Traversals, Applications-Expression Trees, Heap Sort, Balanced Binary Trees-AVL Trees, Insertion, Deletion and Rotations.

UNIT V

Graphs: Basic Concepts, Representations of Graphs-Adjacency Matrix and using Linked list, Graph Traversals (BFT & DFT), Applications- Minimum Spanning Tree Using Prim's & Kruskal's Algorithm, Dijkstra's shortest path, Transitive closure, Warshall's Algorithm.

Text Books:

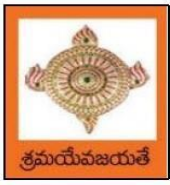
- 1) Data Structures Using C. 2nd Edition. Reema Thareja, Oxford.
- 2) Data Structures and algorithm analysis in C, 2nd ed, Mark Allen Weiss.

Reference Books:

- 1) Fundamentals of Data Structures in C, 2nd Edition, Horowitz, Sahni, Universities Press.
- 2) Data Structures: A Pseudocode Approach, 2/e, Richard F. Gilberg, Behrouz A. Forouzon, Cengage.
- 3) Data Structures with C, Seymour Lipschutz TMH

e-Resources:

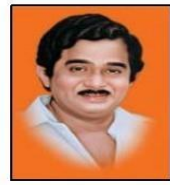
- 1) <http://algs4.cs.princeton.edu/home/>
- 2) https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – I Semester	L	T	P	C
	3	0	0	3
OBJECT ORIENTED PROGRAMMING WITH JAVA				

Course Objectives:

The learning objectives of this course are:

- To identify Java language components and how they work together in applications
- To learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- To learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- To understand how to design applications with threads in Java
- To understand how to use Java APIs for program development

Course Outcomes:

By the end of the course, the student will be

- Able to realize the concept of Object-Oriented Programming & Java Programming Constructs
- Able to describe the basic concepts of Java such as operators, classes, objects, inheritance, packages, Enumeration and various keywords
- Apply the concept of exception handling and Input/ Output operations
- Able to design the applications of Java & Java applet
- Able to Analyze & Design the concept of Event Handling and Abstract Window Toolkit

UNIT I

Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

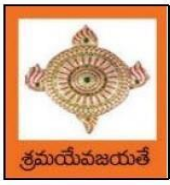
Data Types, Variables, and Operators: Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if-else Expressions, Ternary Operator, Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, For-Each for Loop, Break Statement, Continue Statement.

UNIT II

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

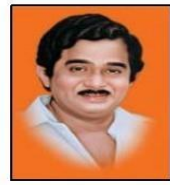
Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of



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Methods, Overriding Methods, Attributes Final and Static.

UNIT III

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNIT IV

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Unchecked Exceptions, Checked Exceptions, Custom Exceptions.

UNIT V

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Methods for Comparison of Strings, Methods for Modifying Strings, Methods for Searching Strings, Data Conversion and Miscellaneous Methods, Class String Buffer, Class String Builder.

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread- Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads

Swings: Introduction, components of swings: JButton, JLabel, JTextField, JPasswordField, JCheckBox, JRadioButton, JTable, JList, JMenu, JPopupMenu.

Java Database Connectivity: Introduction, Installing MySQL and MySQL Connector/J.

Text Books:

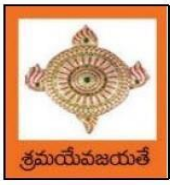
- 1) JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
- 2) The complete Reference Java, 8th edition, Herbert Schildt, TMH.

References Books:

- 1) Introduction to java programming, 7th edition by Y Daniel Liang, Pearson
- 2) Murach's Java Programming, Joel Murach

e-Resources:

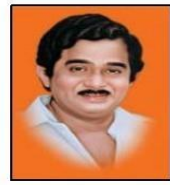
- 1) <https://nptel.ac.in/courses/106/105/106105191/>
- 2) https://www.w3schools.com/java/java_data_types.asp



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II B Tech I Sem	L	T	P	C
	3	0	0	3
OPERATING SYSTEMS				

DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

Course Objectives:

The objectives of this course is to

- Introduce to the internal operation of modern operating systems
- Define, explain, processes and threads, mutual exclusion, CPU scheduling, deadlock, memory management, and file systems
- Understand File Systems in Operating System like UNIX/Linux and Windows
- Understand Input Output Management and use of Device Driver and Secondary Storage (Disk) Mechanism
- Analyze Security and Protection Mechanism in Operating System

Course Outcomes:

After learning, the course the students should be able to:

- Describe various generations of Operating System and functions of Operating System
- Describe the concept of program, process and thread and analyze various CPU Scheduling Algorithms and compare their performance
- Solve Inter Process Communication problems using Mathematical Equations by various methods
- Compare various Memory Management Schemes especially paging and Segmentation in Operating System and apply various Page Replacement Techniques
- Outline File Systems in Operating System like UNIX/Linux and Windows

UNIT I:

Operating Systems Overview: Operating system functions, Operating system structure, Operating systems operations, Computing environments, Open-Source Operating Systems.

System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, operating system structure, operating system debugging, System Boot.

UNIT II:

Process Concept: Process scheduling, Operations on processes, Inter-process communication, Communication in client server systems.

Multithreaded Programming: Multithreading models, Thread libraries, Threading issues. **Process Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling.

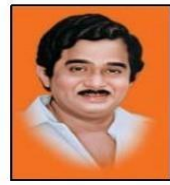
Inter-process Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Barriers, Classical IPC Problems - Dining philosophers' problem, Readers and writers' problem.



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UNIT III:

Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation.

Virtual Memory Management: Introduction, Demand paging, copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation.

UNIT IV:

Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention.

File Systems: Files, Directories, File system implementation, management and optimization. Secondary-Storage Structure, overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.

UNIT V:

System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights.

System Security: Introduction, Program threats, System and network threats, Cryptography for security, User authentication, implementing security defenses, Firewalling to protect systems and networks, Computer security classification.

Case Studies: Linux, Microsoft Windows.

Text Books:

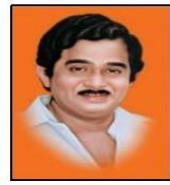
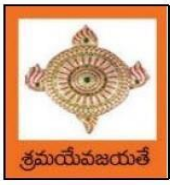
1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2013.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (for Interprocess Communication and File systems.)

Reference Books:

1. Dhamdhare D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw-Hill, 2012.
2. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009
3. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

e-Resources:

- 1) <https://nptel.ac.in/courses/106/105/106105214/>



DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – I Semester		L	T	P	C
		0	0	3	1.5
DATA STRUCTURES LAB					

Course Objectives:

The objective of this lab is to

- Demonstrate the different data structures implementation.

Course Outcomes:

By the end of this lab the student is able to

- Use basic data structures such as arrays and linked list.
- Programs to demonstrate fundamental algorithmic problems including Tree Traversals, Graph traversals, and shortest paths.
- Use various searching and sorting algorithms.

Exercise -1 (Searching)

Write C program that use both recursive and non recursive functions to perform Linear search for a Key value in a given list.

b) Write C program that use both recursive and non recursive functions to perform Binary search for a Key value in a given list.

Exercise – 2 (Sorting-I)

a) Write C program that implement Bubble sort, to sort a given list of integers in ascending order

b) Write C program that implement Quick sort, to sort a given list of integers in ascending order

c) Write C program that implement Insertion sort, to sort a given list of integers in ascending order

Exercise -3 (Sorting-II)

a) Write C program that implement radix sort, to sort a given list of integers in ascending order

b) Write C program that implement merge sort, to sort a given list of integers in ascending order

Exercise -4 (Singly Linked List)

a) Write a C program that uses functions to create a singly linked list

b) Write a C program that uses functions to perform insertion operation on a singly linked list

c) Write a C program that uses functions to perform deletion operation on a singly linked list

d) Write a C program to reverse elements of a single linked list.

Exercise -5(Queue)

a) Write C program that implement Queue (its operations) using arrays.

b) Write C program that implement Queue (its operations) using linked lists

Exercise -6 (Stack)

a) Write C program that implement stack (its operations) using arrays

b) Write C program that implement stack (its operations) using Linked list

c) Write a C program that uses Stack operations to evaluate postfix expression

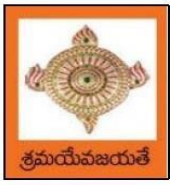
Exercise -7 (Binary Search Tree)

a) Write a C program to Create a BST

b) Write a C program to insert a node into a BST.

c) Write a C program to delete a node from a BST.

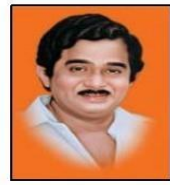
d) Write a recursive C program for traversing a binary tree in preorder, inorder and postorder



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II Year – I Semester		L	T	P	C
		0	0	3	1.5

OBJECT ORIENTED PROGRAMMING WITH JAVA LAB

Course Objectives:

The aim of this lab is to

- Practice programming in the Java
- Gain knowledge of object-oriented paradigm in the Java programming language
- Learn use of Java in a variety of technologies and on different platforms

Course Outcomes:

By the end of the course student will be able to write java program for

- Evaluate default value of all primitive data type, Operations, Expressions, Control-flow, Strings
- Determine Class, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrating simple inheritance, multi-level inheritance, Exception handling mechanism
- Construct Threads, Event Handling, implement packages, developing applets

Exercise - 1 (Basics)

- a) Write a JAVA program to display default value of all primitive data type of JAVA
- b) Write a java program that display the roots of a quadratic equation $ax^2+bx=0$. Calculate the discriminate D and basing on value of D, describe the nature of root.
- c) Five Bikers Compete in a race such that they drive at a constant speed which may or may not be the same as the other. To qualify the race, the speed of a racer must be more than the average speed of all 5 racers. Take as input the speed of each racer and print back the speed of qualifying racers.

Exercise - 2 (Operations, Expressions, Control-flow, Strings)

- a) Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
- b) Write a JAVA program to sort for an element in a given list of elements using bubble sort
- c) Write a JAVA program to sort for an element in a given list of elements using merge sort.
- d) Write a JAVA program using StringBuffer to delete, remove character.

Exercise - 3 (Class, Objects)

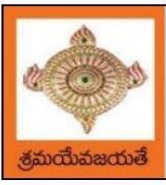
- a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
- b) Write a JAVA program to implement constructor.

Exercise - 4 (Methods)

- a) Write a JAVA program to implement constructor overloading.
- b) Write a JAVA program implement method overloading.

Exercise - 5 (Inheritance)

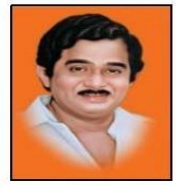
- a) Write a JAVA program to implement Single Inheritance



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- b) Write a JAVA program to implement multi level Inheritance
- c) Write a java program for abstract class to find areas of different shapes

Exercise - 6 (Inheritance - Continued)

- a) Write a JAVA program give example for “super” keyword.
- b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?

Exercise - 7 (Exception)

- a) Write a JAVA program that describes exception handling mechanism
- b) Write a JAVA program Illustrating Multiple catch clauses

Exercise – 8 (Runtime Polymorphism)

- a) Write a JAVA program that implements Runtime polymorphism
- b) Write a Case study on run time polymorphism, inheritance that implements in above problem

Exercise – 9 (User defined Exception)

- a) Write a JAVA program for creation of Illustrating throw
- b) Write a JAVA program for creation of Illustrating finally
- c) Write a JAVA program for creation of Java Built-in Exceptions
- d) Write a JAVA program for creation of User Defined Exception

Exercise – 10 (Threads)

- a) Write a JAVA program that creates threads by extending Thread class. First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds,(Repeat the same by implementing Runnable)
- b) Write a program illustrating is Alive and join ()
- c) Write a Program illustrating Daemon Threads.

Exercise - 11 (Threads continuity)

- a) Write a JAVA program Producer Consumer Problem
- b) Write a case study on thread Synchronization after solving the above producer consumer problem

Exercise – 12 (Packages)

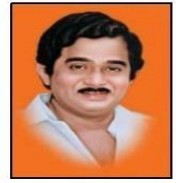
- a) Write a JAVA program illustrates class path
- b) Write a case study on including in class path in your os environment of your package.
- c) Write a JAVA program that import and use the defined your package in the previous Problem



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – I Semester		L	T	P	C
		0	0	3	1.5

OPERATING SYSTEM LAB

Course Objectives:

- To understand the design aspects of operating system
- To study the process management concepts & Techniques
- To study the storage management concepts
- To familiarize students with the Linux environment
- To learn the fundamentals of shell scripting/programming

Course Outcomes:

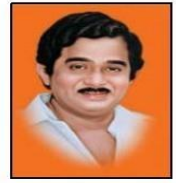
- To use Unix utilities and perform basic shell control of the utilities
 - To use the Unix file system and file access control
 - To use of an operating system to develop software
 - Students will be able to use Linux environment efficiently
 - Solve problems using bash for shell scripting
- 1) a) Study of Unix/Linux general purpose utility command list: man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown.
b) Study of vi editor
c) Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system
d) Study of Unix/Linux file system (tree structure)
e) Study of .bashrc, /etc/bashrc and Environment variables.
 - 2) Write a C program that makes a copy of a file using standard I/O, and system calls
 - 3) Write a C program to emulate the UNIX ls -l command.
 - 4) Write a C program that illustrates how to execute two commands concurrently with a command pipe. Ex: - ls -l | sort
 - 5) Simulate the following CPU scheduling algorithms:
(a) Round Robin (b) SJF (c) FCFS (d) Priority
 - 6) Multiprogramming-Memory management-Implementation of fork (), wait (), exec () and exit (), System calls
 - 7) Simulate the following:
a) Multiprogramming with a fixed number of tasks (MFT)
b) Multiprogramming with a variable number of tasks (MVT)
 - 8) Simulate Bankers Algorithm for Dead Lock Avoidance
 - 9) Simulate Bankers Algorithm for Dead Lock Prevention.



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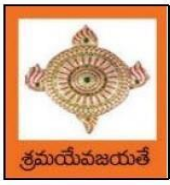
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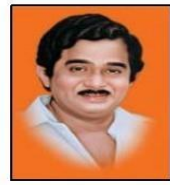
- 10) Simulate the following page replacement algorithms:
 - a) FIFO b) LRU c) LFU
- 11) Simulate the following File allocation strategies
 - (a) Sequenced (b) Indexed (c) Linked
- 12) Write a C program that illustrates two processes communicating using sharedmemory
- 13) Write a C program to simulate producer and consumer problem using semaphores
- 14) Write C program to create a thread using pthreads library and let it run its function.
- 15) Write a C program to illustrate concurrent execution of threads using pthreads library.



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year - I Semester	Skill Oriented Course- I	L	T	P	C
		0	0	4	2

APPLICATIONS OF PYTHON-NumPy

Course Objectives:

The objective of this lab is to acquire programming skills in Python package NumPy and perform mathematical and statistical operations.

Course Outcomes:

By the end of this lab the student is able to

- Explain how data is collected, managed and stored for processing
- Understand the workings of various numerical techniques, different descriptive measures of Statistics, correlation and regression to solve the engineering problems
- Understand how to apply some linear algebra operations to n-dimensional arrays
- Use NumPy perform common data wrangling and computational tasks in Python.

Perform the following:

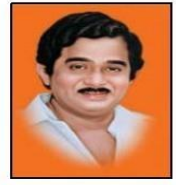
- 1) NumPy Installation using different scientific python distributions (Anaconda, Python(x,y), Win Python, Pyzo)
- 2) NumPy Basics (np.array, np.arange, np.linspace, np.zeros, np.ones, np.random.random, np.empty)
- 3) Arrays (array.shape, len(array), array.ndim, array.dtype, array.astype(type), type(array))
- 4) Array Manipulation (np.append, np.insert, np.resize, np.delete, np.concatenate, np.vstack, np.hstack)
- 5) Mathematical Operations (np.add, np.subtract, np.divide, np.multiply, np.sqrt, np.sin, np.cos, np.log, np.dot, np.roots), Statistical Operations (np.mean, np.median, np.std, array.corrcoef())
- 6) NumPy data types
- 7) NumPy ndarray
- 8) NumPy String Operations
- 9) NumPy Financial functions
- 10) NumPy Functional Programming



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II Year - I Semester		L	T	P	C
		2	0	0	0
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE					

Course Objectives:

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
- Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
- The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system

Course Outcomes:

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

- Understand the significance of Indian Traditional Knowledge
- Classify the Indian Traditional Knowledge
- Compare Modern Science with Indian Traditional Knowledge system.
- Analyze the role of Government in protecting the Traditional Knowledge
- Understand the impact of Philosophical tradition on Indian Knowledge System.

Unit I

Introduction to Traditional Knowledge: Define Traditional Knowledge- Nature and Characteristics- Scope and Importance- kinds of Traditional Knowledge- The historical impact of social change on Traditional Knowledge Systems- Value of Traditional knowledge in global economy.

Unit II

Basic structure of Indian Knowledge System: AstadashVidya- 4 Ved - 4 Upaved (Ayurved,Dhanurved,GandharvaVed&SthapthyaAdi),6vedanga(Shisha,Kalppa,Nirukha,Vyakaran,Jyothisha&Chand),4upanga(Dharmashastra,Meemamsa,purana&Tharka Shastra).

Unit III

Modern Science and Indian Knowledge System-Indigenous Knowledge, Characteristics- Yoga and Holistic Health care-cases studies.

Unit IV

Protection of Traditional Knowledge: The need for protecting traditional knowledge - Significance of Traditional knowledge Protection-Role of government to harness Traditional Knowledge.

Unit V

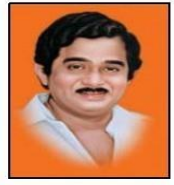
Impact of Traditions: Philosophical Tradition (Sarvadarshan) Nyaya, Vyshepec, Sankhya, Yog, Meemamsa, Vedantha, Chavanka, Jain &Boudh - Indian Artistic Tradition - Chitrakala, Moorthikala, Vasthukala , Sthapthya, Sangeetha, NruthyaYevamSahithya



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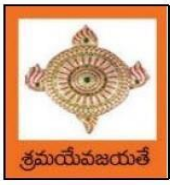
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Reference Books:

1. Traditional Knowledge System in India, by AmitJha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Sivarama krishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya
4. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
5. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
6. Pramod Chandra, India Arts, Howard Univ. Press, 1983.
7. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987.

Web Resources:

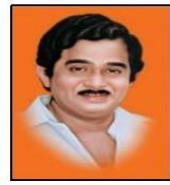
1. https://www.wipo.int/wipo_magazine/en/2017/01/article_0004.html
2. <http://iks.iitgn.ac.in/wp-content/uploads/2016/01/Indian-Knowledge-Systems-Kapil-Kapoor.pdf>
3. https://www.wipo.int/edocs/mdocs/tk/en/wipo_grtkf_ic_21/wipo_grtkf_ic_21_ref_facilitators_text.pdf



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – II Semester		L	T	P	C
		3	0	0	3
PROBABILITY AND STATISTICS					

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart probability concepts and statistical methods in various applications Engineering

Course Outcomes:

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

- Classify the concepts of data science and its importance
- Interpret the association of characteristics and through correlation and regression tools
- Make use of the concepts of probability and their applications
- Apply discrete and continuous probability distributions
- Design the components of a classical hypothesis test
- Infer the statistical inferential methods based on small and large sampling tests

UNIT I

Descriptive statistics and methods for data science: Data science – Statistics Introduction – Population vs Sample – Collection of data – primary and secondary data – Type of variable: dependent and independent Categorical and Continuous variables – Data visualization – Measures of Central tendency – Measures of Variability (spread or variance) – Skewness Kurtosis.

UNIT II

Correlation and Curve fitting: Correlation – correlation coefficient – rank correlation – regression coefficients and properties – regression lines – Method of least squares – Straight line – parabola – Exponential – Power curves.

UNIT III

Probability and Distributions: Probability– Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT IV

Sampling Theory: Introduction – Population and samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Introduction to t, χ^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT V

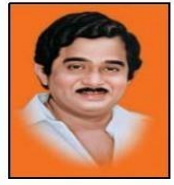
Tests of Hypothesis: Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.



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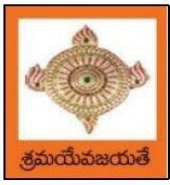
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Text Books:

- 1) Miller and Freund's, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
- 2) S. C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:

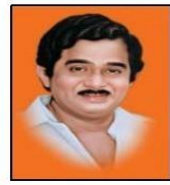
- 1) Shron L. Myers, Keying Ye, Ronald E Walpole, Probability and Statistics Engineers and the Scientists, 8th Edition, Pearson 2007.
- 2) Jay I. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
- 3) Sheldon M. Ross, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011.
- 4) Johannes Ledolter and Robert V. Hogg, Applied statistics for Engineers and Physical Scientists, 3rd Edition, Pearson, 2010.



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – II Semester	L	T	P	C
	3	0	0	3

COMPUTER ORGANIZATION

Course Objectives:

The course objectives of Computer Organization are to discuss and make student familiar with

- Principles and the Implementation of Computer Arithmetic
- Operation of CPUs including RTL, ALU, Instruction Cycle and Busses
- Fundamentals of different Instruction Set Architectures and their relationship to the CPU Design
- Memory System and I/O Organization
- Principles of Operation of Multiprocessor Systems and Pipelining

Course Outcomes:

By the end of the course, the student will

- Develop a detailed understanding of computer systems
- Cite different number systems, binary addition and subtraction, standard, floating-point, and micro-operations
- Develop a detailed understanding of architecture and functionality of central processing unit
- Exemplify in a better way the I/O and memory organization
- Illustrate concepts of parallel processing, pipelining and inter processor communication

UNIT I

Basic Structure of Computers: Basic Organization of Computers, Historical Perspective, Bus Structures, Data Representation: Data types, Complements, Fixed Point Representation. Floating Point Representation. Other Binary Codes, Error Detection Codes.

Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms.

UNIT II

Register Transfer Language and Microoperations: Register Transfer language. Register Transfer Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit.

Basic Computer Organization and Design: Instruction Codes, Computer Register, Computer Instructions, Instruction Cycle, Memory – Reference Instructions. Input –Output and Interrupt, Complete Computer Description.

UNIT III

Central Processing Unit: General Register Organization, STACK Organization. Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

Microprogrammed Control: Control Memory, Address Sequencing, Micro Program example, Design of Control Unit.

UNIT IV

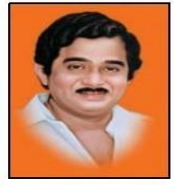
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.



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Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous datatransfer, Modes of Transfer, Priority Interrupts, Direct Memory Access.

UNIT V

Multi Processors: Introduction, Characteristics of Multiprocessors, Interconnection Structures, Inter Processor Arbitration.

Pipeline: Parallel Processing, Pipelining, Instruction Pipeline, RISC Pipeline, Array Processor.

Text Books:

- 1) Computer System Architecture, M. Morris Mano, Third Edition, Pearson, 2008.
- 2) Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 5/e, McGraw Hill, 2002.

Reference Books:

- 1) Computer Organization and Architecture, William Stallings, 6/e, Pearson, 2006.
- 2) Structured Computer Organization, Andrew S. Tanenbaum, 4/e, Pearson, 2005.
- 3) Fundamentals of Computer Organization and Design, Sivarama P. Dandamudi, Springer, 2006.

Web Resources:

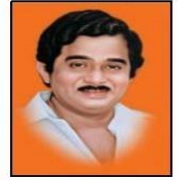
- 1) <https://nptel.ac.in/courses/106/105/106105163/>
- 2) <http://www.cuc.ucc.ie/CS1101/David%20Tarnoff.pdf>



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – II Semester		L	T	P	C
		3	0	0	3
ARTIFICIAL INTELLIGENCE					

Course Objectives

- To provide a strong foundation of fundamental concepts in Artificial Intelligence.
- To provide a basic exposition to the goals and methods of Artificial Intelligence.
- To apply the techniques in applications which involve perception, reasoning and learning.

Course Outcomes:

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

- Enumerate the history and foundations of Artificial Intelligence
- Apply the basic principles of AI in problem solving
- Choose the appropriate representation of Knowledge
- Solve the problems with uncertainty using probability
- Examine the Scope of AI and its societal implications

UNIT I

Introduction: What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

UNIT II

Problem Solving: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions.

UNIT III

Knowledge Representation: Knowledge-Based Agents, Logic, Propositional Logic: A Very Simple Logic, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, The Internet Shopping World.

UNIT IV

Uncertain Knowledge and Reasoning: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks.



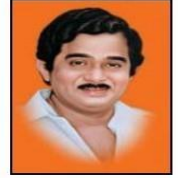
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UNIT V

AI present and Future: Weak AI: Can Machines Act Intelligently? Strong AI: Can Machines Really Think? The Ethics and Risks of Developing Artificial Intelligence, Agent Components, Agent Architectures, Are We Going in the Right Direction? What If AI Does Succeed?

Text Books:

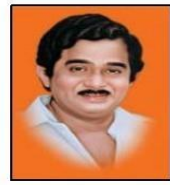
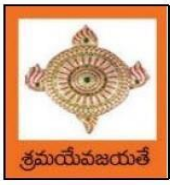
- 1) Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach” , 3rd Edition, Pearson.
- 2) Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill

Reference Books:

- 1) Saroj Kaushik, “Artificial Intelligence”, Cengage Learning India, 2011
- 2) David Poole and Alan Mackworth, “Artificial Intelligence: Foundations for Computational Agents”, Cambridge University Press 2010.
- 3) Trivedi, M.C., “A Classical Approach to Artificial Intelligence”, Khanna Publishing House, Delhi.

Web Resources:

- 1) <https://nptel.ac.in/courses/106105077>
- 2) <https://nptel.ac.in/courses/106106126>
- 3) <https://aima.cs.berkeley.edu>
- 4) https://ai.berkeley.edu/project_overview.html



DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – II Semester		L	T	P	C
		3	0	0	3
DATABASE MANAGEMENT SYSTEMS					

Course Objectives:

- To introduce about database management systems
- To give a good formal foundation on the relational model of data and usage of Relational Algebra
- To introduce the concepts of basic SQL as a universal Database language
- To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- To provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

Course Outcomes:

By the end of the course, the student will be able to

- Describe a relational database and object-oriented database
- Create, maintain and manipulate a relational database using SQL
- Describe ER model and normalization for database design
- Examine issues in data storage and query processing and can formulate appropriate solutions
- Outline the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage

UNIT I

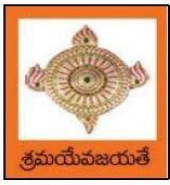
Introduction: Database system, Characteristics (Database Vs File System), Database Users (Actors on Scene, Workers behind the scene), Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

UNIT II

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).

UNIT III

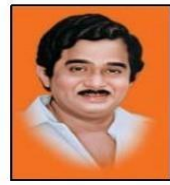
Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams. SQL: Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view (updatable and non-updatable), relational set operations.



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UNIT IV

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form (BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).

UNIT V

Transaction Concept: Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Indexing Techniques: B+ Trees: Search, Insert, delete algorithms, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing: Tree base Indexing, Comparison of File Organizations, Indexes and Performance Tuning

Text Books:

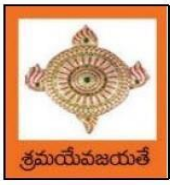
- 1) Database Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke, TMH
- 2) Database System Concepts, 5/e, Silberschatz, Korth, TMH

Reference Books:

- 1) Introduction to Database Systems, 8/e C J Date, PEA.
- 2) Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA
- 3) Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

e-Resources:

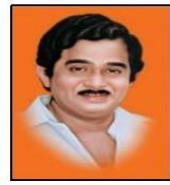
- 1) <https://nptel.ac.in/courses/106/105/106105175/>
- 2) <https://www.geeksforgeeks.org/introduction-to-nosql/>



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – II Semester	L	T	P	C
	3	0	0	3
MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTANCY				

Course Objectives:

- The Learning objectives of this paper are to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting
- To familiarize about the Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation
- Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals

Course Outcomes:

- The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product
- The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs
- The pupil is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units
- The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis
- The Learner can able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making

UNIT I

Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

UNIT II

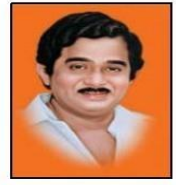
Theories of Production and Cost Analyses: Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.



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UNIT III

Introduction to Markets, Theories of the Firm & Pricing Policies: Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles : Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

UNIT IV

Introduction to Accounting & Financing Analysis: Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

UNIT V

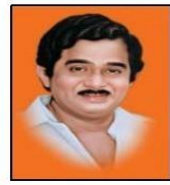
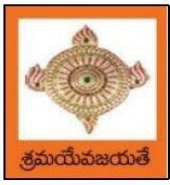
Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods (payback period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Text Books:

- 1) A R Aryasri, Managerial Economics and Financial Analysis, The McGraw – Hill companies.

Reference Books:

- 1) Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd.
- 2) JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition edition
- 3) N.P Srinivasan and M. Sakthivel Murugan, Accounting for Management, S. Chand &Company Ltd.
- 4) Maheswari S.N, An Introduction to Accountancy, Vikas Publishing House Pvt Ltd
- 5) I.M Pandey, Financial Management, Vikas Publishing House Pvt Ltd
- 6) V. Maheswari, Managerial Economics, S. Chand & Company Ltd.



DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – II Semester		L	T	P	C
		0	0	3	1.5
R PROGRAMMING LAB					

Course Objective: In this course student will learn about the fundamentals of R programming, standard R libraries, solid understanding of R functions, write programs using the R and gain skills in R programming Language, get acquaintances with Arrays, Files, Strings, Packages, and distributions using R.

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

1. Implement basic concepts of R programming, and its different module that includes conditional, looping, lists, Strings, Functions, Frames, Arrays, and File programming.
2. Implement the concepts of R Script to extract the data from data frames and file operations.
3. Implement the various statistical techniques using R.
4. Extend the functionality of R by using add-on packages
5. Use R Graphics and Tables to visualize results of various statistical operations on data

Lab Experiments:

Week 1:

Installing R and RStudio
Basic functionality of R, variable, data types in R

Week 2:

- a) Implement R script to show the usage of various operators available in R language.
- b) Implement R script to read person's age from keyboard and display whether he is eligible for voting or not.
- c) Implement R script to find biggest number between two numbers.
- d) Implement R script to check the given year is leap year or not.

Week 3:

- a) Implement R Script to create a list.
- b) Implement R Script to access elements in the list.
- c) Implement R Script to merge two or more lists. Implement R Script to perform matrix operation

Week 4:

Implement R script to perform following operations:

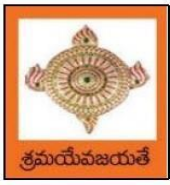
- a) various operations on vectors
- b) Finding the sum and average of given numbers using arrays.
- c) To display elements of list in reverse order.
- d) Finding the minimum and maximum elements in the array.

Week 5:

- a) Implement R Script to perform various operations on matrices
- b) Implement R Script to extract the data from data frames.
- c) Write R script to display file contents.
- d) Write R script to copy file contents from one file to another

Week 6:

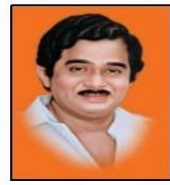
- a) Write an R script to find basic descriptive statistics using summary, str, quartile function on mt cars & cars datasets.
- b) Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset



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Week 7:

- Reading different types of data sets (.txt, .csv) from Web or disk and writing in file in specific disk location.
- Reading Excel data sheet in R.
- Reading XML dataset in R

Week 8:

- Implement R Script to create a Pie chart, Bar Chart, scatter plot and Histogram (Introduction to ggplot2 graphics)
- Implement R Script to perform mean, median, mode, range, summary, variance, standard deviation operations.

Week 9:

- Implement R Script to perform Normal, Binomial distributions.
- Implement R Script to perform correlation, Linear and multiple regression.

Week 10:

Introduction to Non-Tabular Data Types: Time series, spatial data, Network data.
Data Transformations: Converting Numeric Variables into Factors, Date Operations, String Parsing, Geocoding

Week 11:

Introduction Dirty data problems: Missing values, data manipulation, duplicates, forms of data dates, outliers, spelling

Week 12:

Data sources: SQLite examples for relational databases, Loading SPSS and SAS files, Reading from Google Spreadsheets, API and web scraping examples

References:

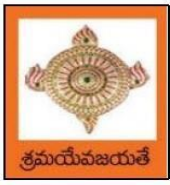
- R Cookbook Paperback – 2011 by Teetor Paul O Reilly Publications
- Beginning R: The Statistical Programming Language by Dr. Mark Gardener, Wiley Publications
- R Programming for Dummies by JorisMeysAndrie de Vries, Wiley Publications
- Hands-On Programming with R by Grolemund, O Reilly Publications
- Statistical Programming in R by KG Srinivas G.M. Siddesh, ChetanShetty&Sowmya B.J. - 2017 edition
- R Fundamentals and Programming Techniques, ThomasLumely.
- R for Everyone Advanced Analytics and Graphics, Jared P. Lander- Addison Wesley Series
- The Art of R Programming, Norman Matloff, Cengage Learning
- Maria DoloresUgarte,AnaF.Militino,AlanT.Arnholt—ProbabilityandStatisticswithR|2nd Edition on, CRC Press,2016.
- R-programming for Data science, RogerD.Peng.
- An Introduction to statistical learning-with applications in R, Trevor Hastie and Rob Tibshirani.

Web Links:

- URL: <https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf> (Online Resources)
- <http://nptel.ac.in/courses/106104135/48>
- <http://nptel.ac.in/courses/110106064/>

SOFTWARE requirements:

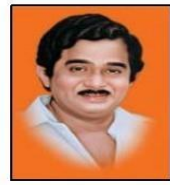
- The R statistical software program. Available from: <https://www.r-project.org/>
- RStudio an Integrated Development Environment (IDE) for R. Available from: <https://www.rstudio.com/>



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – II Semester	L	T	P	C
	0	0	3	1.5

DATABASE MANAGEMENT SYSTEMS LAB

Course Objectives:

This Course will enable students to

- Populate and query a database using SQL DDL/DML Commands
- Declare and enforce integrity constraints on a database
- Writing Queries using advanced concepts of SQL
- Programming PL/SQL including procedures, functions, cursors and triggers

Course Outcomes:

At the end of the course the student will be able to:

- Utilize SQL to execute queries for creating database and performing data manipulation operations
- Examine integrity constraints to build efficient databases
- Apply Queries using Advanced Concepts of SQL
- Build PL/SQL programs including stored procedures, functions, cursors and triggers

List of Exercises:

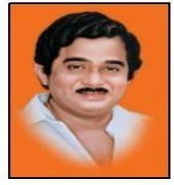
1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with subqueries) using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, Constraints. Example: - Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date)
5.
 - i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
 - ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE-APPLICATION ERROR.
8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.



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10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers
12. Create a table and perform the search operation on table using indexing and non-indexing techniques.

Text Books/Suggested Reading:

- 1) Oracle: The Complete Reference by Oracle Press
- 2) Nilesh Shah, "Database Systems Using Oracle", PHI, 2007
- 3) Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007

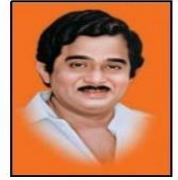


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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year – II Semester		L	T	P	C
		0	0	3	1.5
ARTIFICIAL INTELLIGENCE LAB					

Course Objectives:

- To provide a strong foundation of fundamental concepts in Artificial Intelligence.
- To provide a basic exposition to the goals and methods of Artificial Intelligence.
- To apply the techniques in applications which involve perception, reasoning and learning.

Course Outcomes:

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

- Apply the basic principles of AI in problem solving using LISP/PROLOG
- Implement different algorithms using LISP/PROLOG
- Develop an Expert System using JESS/PROLOG

List of Experiments

1. Implementation of DFS for water jug problem using LISP/PROLOG
2. Implementation of BFS for tic-tac-toe problem using LISP/PROLOG/Java
3. Implementation of TSP using heuristic approach using Java/LISP/Prolog
4. Implementation of Simulated Annealing Algorithm using LISP/PROLOG
5. Implementation of Hill-climbing to solve 8- Puzzle Problem
6. Implementation of Monkey Banana Problem using LISP/PROLOG
7. Implementation of A* Algorithm using LISP/PROLOG
8. Implementation of Hill Climbing Algorithm using LISP/PROLOG
9. Implementation Expert System with forward chaining using JESS/CLIPS
10. Implementation Expert System with backward chaining using RVD/PROLOG.

References:

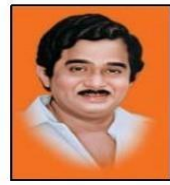
1. Greg Michelson, "A Practical Course in Functional Programming Using Standard ML", UCL press.
2. Richard Bosworth, "A Practical in Functional Programming Using Standard ML", McGraw-Hill.
3. Rachel Harrison, "Abstract Data Types in Standard ML", John Wiley & Sons.



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DEPARTMENT OF CSE - ARTIFICIAL INTELLIGENCE

II Year - II Semester	Skill Oriented Course- II	L	T	P	C
		0	0	4	2
APPLICATIONS OF PYTHON-Pandas					

Course Objectives:

The objective of this lab is to understand the fundamentals of the Pandas library in Python and how it is used to handle data and also develop basic skills in data analysis and visualization

Course Outcomes:

- By the end of this lab the student is able to
- Use Pandas to create and manipulate data structures like Series and Data Frames.
- Work with arrays, queries, and data frames
- Query Data Frame structures for cleaning and processing and manipulating files
- Understand best practices for creating basic charts

Perform the following:

- 1) Pandas Installation
- 2) Creating Data Frames

Exercises:

A) Pandas Data Series:

- 1) Write a Pandas program to create and display a one-dimensional array-like object containing an array of data using pandas module.
- 2) Write a Pandas program to convert a Panda module Series to Python list and it's type.
- 3) Write a Pandas program to add, subtract, multiple and divide two Pandas Series.
- 4) Write a Pandas program to convert a NumPy array to a Pandas series.

Sample Series: NumPy array:

```
[10 20 30 40 50]
```

Converted Pandas series: 0 10

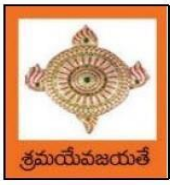
```
1 20
```

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2 30
```

```
3 40
```

```
4 50
```

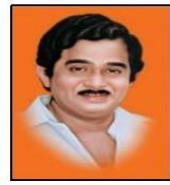
```
dtype: int64
```



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B) Pandas Data Frames:

Consider Sample Python dictionary data and list labels:

```
exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily', 'Michael', 'Matthew', 'Laura', 'Kevin', 'Jonas'],
'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19],
'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1],
'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']}
labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
```

- 1) Write a Pandas program to create and display a Data Frame from a specified dictionary data which has the index labels.
- 2) Write a Pandas program to change the name 'James' to 'Suresh' in name column of the Data Frame.
- 3) Write a Pandas program to insert a new column in existing Data Frame.
- 4) Write a Pandas program to get list from Data Frame column headers.
- 5) Write a Pandas program to get list from Data Frame column headers.

C) Pandas Index:

- 1) Write a Pandas program to display the default index and set a column as an Index in a given data frame.
- 2) Write a Pandas program to create an index label by using 64-bit integers, using floating-point numbers in a given data frame.

D) Pandas String and Regular Expressions:

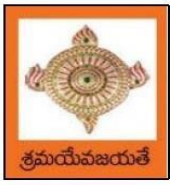
- 1) Write a Pandas program to convert all the string values to upper, lower cases in a given pandas series. Also find the length of the string values.
- 2) Write a Pandas program to remove whitespaces, left sided whitespaces and right sided whitespaces of the string values of a given pandas series.
- 3) Write a Pandas program to count of occurrence of a specified substring in a Data Frame column.
- 4) Write a Pandas program to swap the cases of a specified character column in a given Data Frame.

E) Pandas Joining and merging Data Frame:

- 1) Write a Pandas program to join the two given data frames along rows and assign all data.
- 2) Write a Pandas program to append a list of dictionaries or series to a existing Data Frame and display the combined data.
- 3) Write a Pandas program to join the two data frames with matching records from both sides where available.

F) Pandas Time Series:

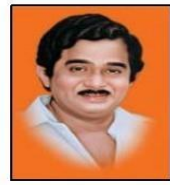
- 1) Write a Pandas program to create
 - a) Datetime object for Jan 15 2012.
 - b) Specific date and time of 9:20 pm.
 - c) Local date and time.
 - d) A date without time.
 - e) Current date.
 - f) Time from a date time.
 - g) Current local time.
- 2) Write a Pandas program to create a date from a given year, month, day and another date from a given string formats.
- 3) Write a Pandas program to create a time-series with two index labels and random values. Also print the type of the index.



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G) Pandas Grouping Aggregate:

Consider dataset:

	school	class	name	date_Of_Birth	age	height	weight	address
S1	s001	V	Alberto Franco	15/05/2002	12	173	35	street1
S2	s002	V	Gino Mcneill	17/05/2002	12	192	32	street2
S3	s003	VI	Ryan Parkes	16/02/1999	13	186	33	street3
S4	s001	VI	Eesha Hinton	25/09/1998	13	167	30	street1
S5	s002	V	Gino Mcneill	11/05/2002	14	151	31	street2
S6	s004	VI	David Parkes	15/09/1997	12	159	32	street4

- 1) Write a Pandas program to split the following data frame into groups based on schoolcode. Also check the type of Group By object.
- 2) Write a Pandas program to split the following data frame by school code and getmean, min, and max value of age for each school.

H) Pandas Styling:

- 1) Create a data frame of ten rows, four columns with random values. Write a Pandasprogram to highlight the negative numbers red and positive numbers black.
- 2) Create a data frame of ten rows, four columns with random values. Write a Pandasprogram to highlight the maximum value in each column.
- 3) Create a data frame of ten rows, four columns with random values. Write a Pandasprogram to highlight data frame's specific columns.

I) Excel:

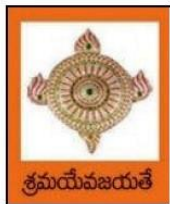
1. Write a Pandas program to import excel data into a Pandas data frame.
2. Write a Pandas program to find the sum, mean, max, min value of a column of file.

J) Plotting:

1. Write a Pandas program to create a horizontal stacked bar plot of opening, closingstock prices of any stock dataset between two specific dates.
2. Write a Pandas program to create a histograms plot of opening, closing, high, lowstock prices of stock dataset between two specific dates.
3. Write a Pandas program to create a stacked histograms plot of opening, closing, high,low stock prices of stock dataset between two specific dates with more bins.

K) Pandas SQL Query:

- 1) Write a Pandas program to display all the records of a student file.
- 2) Write a Pandas program to select distinct department id from employee's file.



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III Year I Semester	Machine Learning	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the basic concepts of Machine Learning.
- Apply Supervised Learning algorithms for solving various problems
- Apply Unsupervised Learning and Reinforcement learning algorithms for solving various problems
- Analyze the given application and use suitable machine learning algorithm.

UNIT I:

Introduction: Well Posed Learning Problems, Designing a Learning System, Perspectives and Issues in Machine Learning, Examples of Machine learning Applications. **Decision Tree Learning:** Decision Tree Representation, Appropriate Problems for Decision Tree Learning, Decision Tree Learning Algorithm.

UNIT II:

Artificial Neural Networks: Neural Network Representation, Appropriate Problems for Neural Network Learning, Perceptions, Multilayer Networks and the Back Propagation Algorithm.

UNIT III:

Bayesian Learning: Introduction, Bayes Theorem: An Example, Naïve Bayes Classifier, Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Measuring Classifier Accuracy, Ensemble Methods: Bagging, Boosting.

UNIT IV:

Support Vector Machines: The Case When the Data are Linearly Separable, The Case When the Data are Linearly Inseparable, Instance Based Learning: k-Nearest Neighbor Learning-DistanceWeighted Nearest Neighbor Based Reasoning

UNIT V:

Unsupervised Learning: Cluster Analysis, Partition Methods, Hierarchical Methods, Density based Methods, Grid based Methods. Measuring Clustering Quality.

Text Book

1. Machine Learning by Tom M. Mitchell, Indian Edition 2013, McGraw Hill Education.
2. Machine Learning Saikat Dutt,Subramanian Chandramouli, Amit Kumar Das, First Edition,2019,Pearson Education
3. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber,Jian Pei,Third Edition,2012.

References

1. Introduction to Machine Learning by ETHEM ALPAYDIN, Fourth Edition, Prentice Hall of India, MIT Press, 2020.
2. C Bishop – Pattern Recognition and Machine Learning – Springer, 2006. Machine Learning, Anuradha Srinivasa raghavan , and Vincy Joseph ,Kindle Edition, September 2020, WILEY.
3. Machine Learning in Production: Developing and optimizing Data Science Workflows and Applications, Andrew Kelleher, Adam Kelleher, First Edition,2012,Pearson Education
4. Introduction to Data Mining, Pearson, Tan, Vipin Kumar, Michael Steinbach, Ninth Impression,2013.

e-Resources and other Digital Material

- 1.<https://www.coursera.org/learn/machine-learning> 2.<https://nptel.ac.in/courses/106/106/106106139/>

III Year I Semester	Computer Networks	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide insight about networks, topologies, and the key concepts.
- To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities.
- To understand the principles, key protocols, design issues, and significance of each layers in ISO and TCP/IP.
- To know the basic concepts of network services and various network applications.

Course Outcomes:

- Demonstrate different network models for networking links OSI, TCP/IP, B-ISDN, N-BISDN and get knowledge about various communication techniques, methods and protocol standards.
- Discuss different transmission media and different switching networks.
- Analyze data link layer services, functions and protocols like HDLC and PPP.
- Compare and Classify medium access control protocols like ALOHA, CSMA, CSMA/CD, CSMA/CA, Polling, Token passing, FDMA, TDMA, CDMA protocols
- Determine application layer services and client server protocols working with the client server paradigms like WWW, HTTP, FTP, e-mail and SNMP etc.

UNIT I:

Introduction: Network Types, LAN, MAN, WAN, Network Topologies Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, OSI Vs TCP/IP, Lack of OSI models success, Internet History. **Physical Layer** –Introduction to Guided Media- Twisted-pair cable, Coaxial cable and Fiber optic cable and unguided media: Wireless- Radio waves, microwaves, infrared.

UNIT II:

Data link layer: Design issues, **Framing:** fixed size framing, variable size framing, flow control, error control, error detection and correction codes, CRC, Checksum: idea, one's complement internet checksum, services provided to Network Layer, **Elementary Data Link Layer protocols:** simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel.

Sliding window protocol: One bit, Go back N, Selective repeat-Stop and wait protocol, Data link layer in HDLC: configuration and transfer modes, frames, control field, point to point protocol (PPP): framing transition phase, multiplexing, multi link PPP.

UNIT – III:

Media Access Control: Random Access: ALOHA, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance, **Controlled Access:** Reservation, Polling, Token Passing, **Channelization:** frequency division multiple Access(FDMA), time division multiple access(TDMA), code division multiple access(CDMA).

Wired LANs: Ethernet, Ethernet Protocol, Standard Ethernet, Fast Ethernet(100 Mbps), Gigabit Ethernet, 10 Gigabit Ethernet.

UNIT – IV:

The Network Layer Design Issues – Store and Forward Packet Switching-Services Provided to the

Transport layer- Implementation of Connectionless Service-Implementation of Connection Oriented Service- Comparison of Virtual Circuit and Datagram Networks, Routing Algorithms-The Optimality principle-Shortest path, Flooding, Distance vector, Link state, Traffic Control Algorithm-Leaky bucket & Token bucket.

Internet Working: How networks differ- How networks can be connected- Tunnelling, internetwork routing-, Fragmentation, network layer in the internet – IP protocols-IP Version 4 protocol-IPV4 Header Format, IP addresses .

UNIT –V:

The Transport Layer: Transport layer protocols: Introduction-services- port number-User data gram protocol-User datagram-UDP services-UDP applications-Transmission control protocol: TCP services- TCP features- Segment- A TCP connection- windows in TCP- flow control-Error control, Congestion control in TCP.

Application Layer – World Wide Web: HTTP, Electronic mail-Architecture- web based mail- email security- TELENET-local versus remote Logging-Domain Name System: Name Space, DNS in Internet , -Resolution-Caching- Resource Records- DNS messages- Registrars-security of DNS Name Servers, SNMP.

Text Books:

1. Computer Networks — Andrew S Tanenbaum, Fifth Edition. Pearson Education/PHI
2. Data Communications and Networks – Behrouz A. Forouzan, Fifth Edition TMH.

References Books:

1. Data Communications and Networks- Achut S Godbole, Atul Kahate Computer Networks, Mayank Dave, CENGAG

III Year I Semester	Design and Analysis of Algorithm	L	T	P	C
		3	0	0	3

Course Objectives:

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

- Ability to understand, analyze and denote time complexities of algorithms
- To introduce the different algorithmic approaches for problem solving through numerous example problems
- Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.
- To provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness

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

- Analyze the performance of a given algorithm, denote its time complexity using the asymptotic notation for recursive and non-recursive algorithms
- List and describe various algorithmic approaches and Solve problems using divide and conquer & greedy Method
- Synthesize efficient algorithms dynamic programming approaches to solve in common engineering design situations.
- Organize important algorithmic design paradigms and methods of analysis: backtracking, branch and bound algorithmic approaches
- Demonstrate NP- Completeness theory ,lower bound theory and String Matching

UNIT I:

Introduction: Algorithm Definition, Algorithm Specification, performance Analysis, Performance measurement, asymptotic notation, Randomized Algorithms.

UNIT II:

Divide and Conquer: General Method, Defective chessboard, Binary Search, finding the maximum and minimum, Merge sort, Quick sort.

The Greedy Method: The general Method, knapsack problem, minimum-cost spanning Trees, Optimal Merge Patterns, Single Source Shortest Paths.

UNIT III:

Dynamic Programming: The general method, multistage graphs, All pairs-shortest paths, optimal Binary search trees, 0/1 knapsack, The traveling salesperson problem.

UNIT IV:

Backtracking: The General Method, The 8-Queens problem, sum of subsets, Graph coloring, Hamiltonian cycles, knapsack problem.

Branch and Bound: General method, applications – Travelling sales person problem, 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution.

UNIT V:

NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP - Hard and NP-Complete classes, Cook's theorem.

Text Books:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press.
2. Introduction to Algorithms Thomas H. Cormen, PHI Learning
3. Harsh Bhasin, "Algorithms Design & Analysis", Oxford University Press.

Reference Books:

1. Horowitz E. Sahani S: "Fundamentals of Computer Algorithms", 2nd Edition, Publications, 2008.
2. S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press. Edition, Galgotia.

III Year – I Semester	Highway Engineering			L	T	P	C
				3	0	0	3
Open Elective-I							

Course Learning Objectives:

The objectives of this course are:

- To impart different concepts in the field of Highway Engineering.
- To acquire design principles of Highway Geometrics and Pavements
- To acquire design principles of Intersections

Course Outcomes:

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

- Plan highway network for a given area.
- Determine Highway alignment and design highway geometrics.
- Design Intersections and prepare traffic management plans
- Judge suitability of pavement materials and design flexible and rigid pavements

UNIT I Highway Planning and Alignment: Highway development in India; Classification of Roads; Road Network Patterns; Necessity for Highway Planning; Different Road Development Plans– First, second, third road development plans, road development vision 2021, Rural Road Development Plan – Vision 2025; Planning Surveys; Highway Alignment-Factors affecting Alignment- Engineering Surveys – Drawings and Reports.

UNIT – II Highway Geometric Design: Importance of Geometric Design- Design controls and Criteria- Highway Cross Section Elements- Sight Distance Elements- Stopping sight Distance, Overtaking Sight Distance and Intermediate Sight Distance- Design of Horizontal Alignment-Design of Super elevation and Extra widening- Design of Transition Curves- Design of Vertical alignment- Gradients- Vertical curves.

UNIT – III Traffic Engineering: Basic Parameters of Traffic-Volume, Speed and Density- Traffic Volume Studies; Speed studies –spot speed and speed & delay studies; Parking Studies; Road Accidents-Causes and Preventive measures - Condition Diagram and Collision Diagrams; PCU Factors, Capacity of Highways – Factors Affecting; LOS Concepts; Road Traffic Signs; Road markings; Types of Intersections; At-Grade Intersections – Design of Plain, Flared, Rotary and Channelized Intersections; Design of Traffic Signals –Webster Method –IRC Method.

UNIT – IV Highway Materials: Sub-grade soil: classification –Group Index – Sub-grade soil strength – California Bearing Ratio – Modulus of Sub-grade Reaction. Stone aggregates: Desirable properties – Tests for Road Aggregates – Bituminous Materials: Types – Desirable properties – Tests on Bitumen – Bituminous paving mixes: Requirements – Marshall Method of Mix Design.

UNIT – V Design Of Pavements: Types of pavements; Functions and requirements of different components of pavements; Design Factors .*Flexible Pavements:* Design factors – Flexible Pavement Design Methods – CBR method – IRC method – Burmister method – Mechanistic method – IRC Method for Low volume Flexible pavements. *Rigid Pavements:* Design Considerations – wheel load stresses – Temperature stresses –Frictional stresses – Combination of stresses – Design of slabs – Design of Joints – IRC method – Rigid pavements for low volume roads – Continuously Reinforced Cement Concrete Pavements – Roller Compacted Concrete Pavements.

TEXT BOOKS:

- 1.Highway Engineering, Khanna S. K., Justo C. E. G and Veeraragavan A, Nem Chand Bros., Roorkee.
- 2.Traffic Engineering and Transportation Planning, Kadiyali L. R, Khanna Publishers, New Delhi.

REFERENCES:

- 1.Principles of Highway Engineering, Kadiyali L. R, Khanna Publishers, New Delhi
- 2.Principles of Transportation Engineering, Partha Chakroborthy and Animesh Das, PHI Learning Private Limited, Delhi.

III Year – I Semester	Air- Pollution	L	T	P	C
		3	0	0	3
Open Elective-I					

Course Learning Objectives:

The objective of this course is:

- Impart knowledge on fundamental aspects of air pollution & control, noise pollution, and solidwaste management.
- Provide basic knowledge on sustainable development.
- Introduces some basics of sanitation methods essential for protection of community health.
- Provide basic knowledge on solid waste management.

Course Learning Outcomes:

By the end of successful completion of this course, the students will be able to:

- Identify the air pollutant control devices
- Have knowledge on the NAAQ standards and air emission standards
- Differentiate the treatment techniques used for sewage and industrial wastewater treatment methods.
- Understand the fundamentals of solid waste management, practices adopted in histown/village and its importance in keeping the health of the city.
- Appreciate the methods of environmental sanitation and the management of community facilities without spread of epidemics.
- Appreciate the importance of sustainable development while planning a project or executing an activity.

UNIT – I

Air Pollution: Air pollution Control Methods–Particulate control devices – Methods of Controlling Gaseous Emissions – Air quality standards.

Noise Pollution: Noise standards, Measurement and control methods – Reducing residential and industrial noise – ISO14000.

UNIT –II

Industrial Wastewater Management: – Strategies for pollution control - Volume and Strength reduction – Neutralization – Equalization – Proportioning – Common Effluent Treatment Plants -Recirculation of industrial wastes – Effluent standards.

UNIT – III

Solid Waste Management: Solid waste characteristics – basics of on-site handling and collection – separation and processing – Incineration-Composting-Solid waste disposal methods – fundamentals of Land filling.

UNIT-IV

Role of Technology in Disaster Managements: Disaster management for infra structures, taxonomy of infra structure – treatment plants and process facilities-electrical substations- roads

and bridges- mitigation programme for earth quakes – flowchart, geospatial information in agriculture drought assessment - Multimedia Technology in disaster risk management and training - Transformable Indigenous Knowledge in disaster reduction – Role of RS & GIS.

UNIT-V

Multi-sectional Issues, Education and Community Preparedness: Impact of disaster on poverty and deprivation - Climate change adaptation and human health - Exposure, health hazards and environmental risk-Forest management and disaster risk reduction -The Red cross and red crescent movement - Corporate sector and disaster risk reduction- Education in disaster risk reduction- Essentials of school disaster education - Community capacity and disaster resilience-Community based disaster recovery - Community based disaster management and social capital-Designing resilience- building community capacity for action.

TEXT BOOKS:

1. An Introduction of Disaster Management- Natural Disasters & Vulnerable Hazards– S.Vaidyanathan: CBS Publishers& Distributors Pvt. Ltd.
2. Natural Hazards & Disaster Management, Vulnerability and Mitigation by RB Singh-RawatPublications
3. ‘Disaster Science & Management’ by Tushar Bhattacharya, Tata McGraw Hill Education Pvt.Ltd., New Delhi.
4. ‘Disaster Management – Future Challenges and Opportunities’ by Jagbir Singh (2007), I KInternational Publishing House Pvt. Ltd.

REFERENCE BOOKS:

2. ‘Disaster Management’ edited by H K Gupta (2003), Universities press.
3. ‘Disaster Management – Global Challenges and Local Solutions’ by Rajib shah & R RKrishnamurthy (2009), Universities press.
4. R. Nishith , Singh AK, “ Disaster Management in India : Perspectives, Issues and strategies”New Royal Book Company.”

III Year – I Semester	Remote Sensing & GIS	L	T	P	C
		3	0	0	3
Open Elective-I					

Course Learning Objectives:

The course is designed to,

1. Introduce the basic principles of Remote Sensing and GIS techniques.
2. Learn various types of sensors and platforms.
3. Learn concepts of visual and digital image analysis.
4. Understand the principles of spatial analysis.
5. Appreciate application of RS and GIS to Civil Engineering

Course outcomes

At the end of the course the student will be able to

- A. Be familiar with ground, air and satellite-based sensor platforms.
- B. interpret the aerial photographs and satellite imageries.
- C. create and input spatial data for GIS application.
- D. apply RS and GIS concepts for application in Civil Engineering.

UNIT – I

Introduction to Remote sensing: Basic concepts of remote sensing, electromagnetic radiation, electromagnetic spectrum, interaction with atmosphere, energy interaction with the earth surfaces, characteristics of remote sensing systems, types of resolutions - advantages & limitations, types of sensors, airborne remote sensing, space borne remote sensing, image data characteristics, digital image data formats-band interleaved by pixel, band interleaved by line, band sequential, IRS, LANDSAT, SPOT & Recent satellite.

UNIT – II

Image analysis: Introduction, elements of visual interpretations, digital image processing- image pre- processing, image enhancement, image classification, supervised classification, unsupervised classification.

UNIT – III

Geographic Information System: Basic Principles, components, application areas of GIS, map projections. Data entry and preparation: spatial data structures, raster and vector data formats, data inputs, data manipulation, data retrieval, data analysis and data display.

UNIT – IV

Spatial data analysis: Introduction, overlay function-vector overlay operations, raster overlay operations, arithmetic operators, comparison and logical operators, conditional expressions, overlay using a decision table, network analysis-optimal path finding, network allocation, network tracing.

UNIT – V

RS and GIS applications: Land cover and land use, agriculture, forestry, geology, geomorphology, urban & transportation, Hydrology and Water Resources: Flood zoning and mapping, ground application with case studies.

TEXTBOOKS:

1. 'Remote Sensing and GIS', by Bhatta B, Oxford University Press, (2011) 2nd Edition'.
2. 'Remote Sensing and Image Interpretation, by Lillesand, T.M, R.W. Kiefer and J.W. Chipman, Wiley India Pvt. Ltd., (2015), 7th Edition.
3. 'Remote Sensing - Models and Methods for Image Processing' by Robert A Schowenger, Elsevier publishers, (2009).
4. 'Fundamentals of Remote Sensing' by George Joseph, Universities Press, (2013) 3rd Edition.
5. 'Fundamentals of Geographic Information Systems' by Michael N. Demers, Wiley India Pvt. Ltd, (2012) 4th Edition.

REFERENCES:

1. 'Remote Sensing and its Applications' by Narayan LRA, Universities Press, 2012.
2. 'Concepts and Techniques of Geographical Information System' by Chor Pang Lo and Albert K.W. Yeung, Prentice Hall (India), (2016) 2nd Edition.
3. 'Introduction to Geographic Information Systems' by Kang Tsung Chang, McGraw Hill Higher Education, (2020) 9th Edition.
4. 'Basics of Remote sensing & GIS' by S. Kumar, Laxmi Publications, New Delhi, 2005.

III Year – I Semester	Software Engineering	L	T	P	C
		3	0	0	3
Professional Elective-1					

Course Objectives:

This course is designed to:

- Give exposure to phases of Software Development, common process models including Waterfall, and the Unified Process, and hands-on experience with elements of the agile process
- Give exposure to a variety of Software Engineering practices such as requirements analysis and specification, code analysis, code debugging, testing, traceability, and version control
- Give exposure to Software Design techniques

Course Outcomes:

Students taking this subject will gain software engineering skills in the following areas:

- Ability to transform an Object-Oriented Design into high quality, executable code
- Skills to design, implement, and execute test cases at the Unit and Integration level
- Compare conventional and agile software methods

UNIT I:

The Nature of Software, The Unique Nature of Web-Apps, Software Engineering, The Software Process, Software Engineering Practice, Software Myths. A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Process Technology.

UNIT II:

Agility, Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, A Tool Set for the Agile Process, Software Engineering Knowledge, Core Principles, Principles That Guide Each Framework Activity, Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements.

UNIT III:

Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case, Data Modeling Concepts, Class-Based Modeling, Requirements Modeling Strategies, Flow-Oriented Modeling, Creating a Behavioral Model, Patterns for Requirements Modelling, Requirements Modeling for Web-Apps.

UNIT IV:

Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model, Software Architecture, Architectural Genres, Architectural Styles, Assessing Alternative Architectural Designs, Architectural Mapping Using Data Flow, Components, Designing Class-Based Components, Conducting Component-Level Design, Component-Level Design for Web-Apps, Designing Traditional Components, Component-Based Development.

UNIT V:

The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Web-App Interface Design, Design Evaluation, Elements of Software Quality Assurance, SQA Tasks, Goals & Metrics, Statistical SQA, Software Reliability, A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for WebApps, Validation Testing, System

Testing, The Art of Debugging, Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing.

Text Books:

- 1) Software Engineering a practitioner's approach, Roger S. Pressman, Seventh Edition, McGraw Hill Higher Education.
- 2) Software Engineering, Ian Sommerville, Ninth Edition, Pearson.

Reference Books:

- 1) Software Engineering, A Precise Approach, Pankaj Jalote, Wiley India, 2010.
- 2) Software Engineering, Ugrasen Suman, Cengage.

E-Resources:

- 1) <https://nptel.ac.in/courses/106/105/106105182/>

III Year – I Semester	AI in Health Care	L	T	P	C
		3	0	0	3
(Professional Elective I)					

Course Outcomes: After finishing this course student will be able to:

- Understand the basics of Artificial Intelligence in Health Care.
- Understand the concepts in Digitalization of Health Care.
- Apply Artificial Intelligence concepts for developing the applications related to Health Care.
- Analyze to scale Artificial intelligence for e-Health Care with optimized cost.

UNIT I:

Introduction: Monitoring + AI = Rx for Personal Health: Prescription (Rx) for Personal Health, Three Realms Influencing Healthcare, Ambient Computing and Healthcare, Continuous Monitoring Using AI. Continuous Monitoring, Beeps, Chimes, Dings, and Dongs, Health Continuum, Application of IoT and AI to Medical Care, Health Determinants and Big Data.

UNIT-II:

Digital Transformation and AI: Digital Transformation of Healthcare: -Path A: Creating Digital Operations and Processes, Path B: Building New Capabilities, Path C: Transforming Business Processes, Paths to the Digital Transformation of Healthcare. **Digital Healthcare:**-AI Applied to Digital Healthcare, AI, Digitization, and Big Tech.

UNIT-III:

Preventive and Chronic Disease Management:-AI and Prevention, AI and Chronic Disease, AI and Mental Health. AI and Telemedicine, **Medication Management and AI Medication Adherence,** Digital Medication, AI and Digitization Applied to Administrative Tasks

Emerging Applications in Healthcare Using AI:

Improving Human Health, Improving Human Lives, Making Technology Work for Healthcare,

UNIT-IV: Ambient Intelligence:

Ambient Intelligence, From a Patient's Perspective, From a Doctor's Perspective, From a Hospital System's Perspective, From an Insurer's Perspective, Emerging Applications and Services, Coordination of Care Platform, Disease State Management Platform, Human to Machine Experience Services, Customer Journey Platform. Clinician Decision Support Tools, Ambient Intelligence Environments, Digital Twin Platform, Real-Time Healthcare.

UNIT-V:

AI at Scale for Healthcare Organizations: Achieving AI at scale, Transforming Health care, The Chasm, Invisible Engines—Healthcare Platforms, Inpatient Care. The Road to a Healthcare Platform. Ecosystems, Application Programming Interfaces (APIs)

Text Books:

1. Kerrie L. Holley and Siupo Becker, M.D -AI-First Healthcare, Published by O'Reilly Media, Inc, April 2021: First Edition

Reference Books:

1. Edward H. Short life; Leslie E. Perreault, Medical Informatics – Computer Applications in Healthcare and Biomedicine, Springer-Verlag New York Inc.Publishers, 2014.
- 2.Arnold, M. (2016). Digital health news update: Machine learning meets healthAtul search. Decision Resources Group
3. Blenner, S. R., Köllmer, M., Rouse, A. J., Daneshvar, N., Williams, C., Andrews, L. B. (2016) Privacy Policies of Android Diabetes Apps and Sharing ofHealth Information. JAMA, 315(10), 1051.

III Year I Semester	Data Visualization	L	T	P	C
		3	0	0	3
(Professional Elective I)					

Course Outcomes:

- Understand basics of Data Visualization
- Implement visualization of distributions
- Write programs on visualization of time series, proportions & associations
- Apply visualization on Trends and uncertainty
- Explain principles of proportions

UNIT I:

Introduction To Visualization: Visualizing Data-Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes- Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales-Color as a Tool to Distinguish, Color to Represent Data Values, Color as a Tool to Highlight, Directory of Visualizations- Amounts, Distributions, Proportions, x–y relationships, Geospatial Data

UNIT II:

Visualizing Distributions: Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heat maps, Visualizing Distributions: Histograms and Density Plots-Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time, Visualizing Distributions: Empirical Cumulative Distribution Functions and Q-Q Plots-Empirical Cumulative Distribution Functions, Highly Skewed Distributions, Quantile Plots, Visualizing Many Distributions at Once-Visualizing Distributions Along the Vertical Axis, Visualizing Distributions Along the Horizontal Axis

UNIT III:

Visualizing Associations & Time Series: Visualizing Proportions-A Case for Pie Charts, A-Case for Side-by-Side Bars, A Case for Stacked Bars and Stacked Densities, Visualizing Proportions Separately as Parts of the Total ,Visualizing Nested Proportions-Nested Proportions Gone Wrong, Mosaic Plots and Tree maps, Nested Pies ,Parallel Sets. Visualizing Associations Among Two or More Quantitative Variables-Scatter plots, Correlograms, Dimension Reduction, Paired Data. Visualizing Time Series and Other Functions of an Independent Variable-Individual Time Series , Multiple Time Series and Dose–Response Curves, Time Series of Two or More Response Variables

UNIT IV:

Visualizing Uncertainty: Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition, Visualizing Geospatial Data-Projections,Layers,ChoroplethMapping,Cartograms,VisualizingUncertainty-Framing ProbabilitiesasFrequencies,VisualizingtheUncertaintyofPointEstimates,Visualizingthe Uncertainty of Curve Fits, Hypothetical Outcome Plots

UNITV:

Principle Of Proportional Ink: The Principle of Proportional Ink-Visualizations Along Linear Axes, Visualizations Along Logarithmic Axes, Direct Area Visualizations, Handling Overlapping Points-Partial Transparency and Jittering, 2DHistograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information ,Using Nonmonotonic Color Scales to Encode Data Values, Not Designing for Color-Vision Deficiency

Text Books:

1. Claus Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", 1st edition, O'Reilly Media Inc, 2019.
2. Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, A press, 2018

Reference Books:

1. Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization, O'Reilly, 2016

III Year I Semester	Computer Networks Lab	L	T	P	C
				3	1.5

Course Objectives:

- Learn basic concepts of computer networking and acquire practical notions of protocols with the emphasis
- on TCP/IP. A lab provides a practical approach to Ethernet/Internet networking: networks are assembled,
- and experiments are made to understand the layered architecture and how do some important protocols
- work

Course Outcomes:

By the end of the course student will be able to

- Know how reliable data communication is achieved through data link layer.
- Suggest appropriate routing algorithm for the network.
- Provide internet connection to the system and its installation.
- Work on various network management tools

List of Experiments:

1. Study of Network devices in detail and connect the computers in Local Area Network.
2. Write a Program to implement the data link layer framing methods such as
i) Character stuffing ii) bit stuffing.
3. Write a Program to implement data link layer framing method checksum.
4. Write a program for Hamming Code generation for error detection and correction.
5. Write a Program to implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP.
6. Write a Program to implement Sliding window protocol for Goback N.
7. Write a Program to implement Sliding window protocol for Selective repeat.
8. Write a Program to implement Stop and Wait Protocol.
9. Write a program for congestion control using leaky bucket algorithm
10. Write a Program to implement Dijkstra's algorithm to compute the Shortest path through a graph.
11. Write a Program to implement Distance vector routing algorithm by obtaining routing table at each Node (Take an example subnet graph with weights indicating delay between nodes).
12. Write a Program to implement Broadcast tree by taking subnet of hosts.
13. Wireshark
 - i. Packet Capture Using Wire shark
 - ii. Starting Wire shark
 - iii. Viewing Captured Traffic
 - iv. Analysis and Statistics & Filters.

III Year I Semester	Machine Learning Lab	L	T	P	C
				3	1.5

1. Anaconda Software Installation and introduction to Jupiter and Co Lab
- 2 Apply Data pre-processing techniques
- 3 Implement 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 Implement 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 Implement k-nearest neighbors classification using python.
- 7 Implementation of K-means Clustering algorithm.
- 8 Implementation of DBSCAN Clustering algorithms.
- 9 Implementation of hierarchical agglomerative clustering algorithm

III Year I Semester	DevOps Lab	L	T	P	C
		3	0	0	3

Course Objectives:

- DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance

Course Outcomes:

At the end of the course, student will be able to

Enumerate the principles of continuous development and deployment, automation of

- configuration management, inter-team collaboration, and IT service agility
- Describe DevOps & DevSecOps methodologies and their key concepts
- Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models
- Set up complete private infrastructure using version control systems and CI/CD tools

1. Write code for simple user registration from for an event.
2. Explore Git and GitHub commands.
3. Practice source code management on GitHub.
4. Jenkins installation and setup, explore the environment.
5. Demonstrate continuous integration and development using Jenkins.
6. Explore Docker commands for content management.
7. Develop a simple containerized application using Docker.
8. Integrate Kubernetes and Docker.
9. Automate the process of running containerized application developed in 7 using Kubernetes.
10. Install and Explore Selenium for automated testing.
11. Write a simple program in JavaScript and perform testing using Selenium.
12. Develop test cases for the above containerized application using Selenium.

III Year –II Semester	Deep Learning	L	T	P	C
		3	0	0	3

Course Objectives: The main objective of the course is to make students:

- Learn deep learning methods for working with sequential data,
- Learn deep recurrent and memory networks,
- Learn deep Turing machines,
- Apply such deep learning mechanisms to various learning problems.
- Know the open issues in deep learning, and have a grasp of the current research directions.

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

- Demonstrate the fundamental concepts learning techniques of Artificial Intelligence, Machine Learning and Deep Learning.
- Discuss the Neural Network training, various random models.
- Explain the Techniques of Keras, Tensor Flow, Theano and CNTK
- Classify the Concepts of CNN and RNN
- Implement Interactive Applications of Deep Learning.

UNIT I: Fundamentals of Deep Learning: Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines, Fundamentals of Machine Learning: Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Under fitting.

UNIT II: Introducing Deep Learning: Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks.

UNIT III: Neural Networks: Anatomy of Neural Network, Introduction to Keras: Keras, Tensor Flow, Theano and CNTK, Classifying Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification.

UNIT IV:

Convolution Neural Networks: Neural Network and Representation Learning, Convolutional Layers, Multichannel Convolution Operation, **Recurrent Neural Networks:** Introduction to RNN, RNN Code, Py Torch Tensors: Deep Learning with PyTorch, CNN in PyTorch.

UNIT V:

Interactive Applications of Deep Learning: Machine Vision, Natural Language processing, Generative Adversarial Networks, Deep Reinforcement Learning.

Deep Learning Research: Auto encoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks.

Text Books:

1. Deep Learning- Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 2016
2. Deep Learning with Python - Francois Chollet, Released December 2017, Publisher(s):

Manning Publications, ISBN: 9781617294433

3. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence - Jon Krohn, Grant Beyleveld, Aglaé Bassens, Released September 2019, Publisher(s): Addison-Wesley Professional, ISBN: 9780135116821
4. Deep Learning from Scratch - Seth Weidman, Released September 2019, Publisher(s): O'ReillyMedia, Inc., ISBN: 9781492041412

Reference Books:

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., and Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

III Year II Semester	Big Data Analytics	L	T	P	C
		3	0	0	3

Course Objective:

- The main objective of this course is to provide the student with the basic understanding of Data Analysis.
- Program the related analysis of different types of data and using Hadoop programming to predict the trends.

Course Outcomes:

- Understand the concepts of Big Data Analytics.
- Apply machine learning algorithms for Big Data Analytics
- Apply text categorization algorithms
- Solve the Big Data Analytics problems using various technologies and tools
- Apply Snoop, and Zookeeper tools for solving the Data Analysis problems.

UNIT-I: Introduction to Big Data Analytics: Big Data Overview, State of the Practice in Analytics, Key Roles for the New Big Data Ecosystem, Examples of Big Data Analytics. Data Analytics Lifecycle: Data Analytics Lifecycle Overview, Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize.

UNIT-II: Introduction to Hadoop: Data storage and analysis, Comparison with other systems, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem. **Hadoop Distributed File system:** The Design of HDFS, HDFS concepts, Command-Line Interface, Hadoop file systems, The Java Interface, Data Flow, Hadoop Archives.

UNIT-III: Hadoop I/O: Data Integrity in HDFS, Local-FileSystem, Checksum-FileSystem, Compression, Serialization, File-Based Data Structures, Sequentail File, Map File. **Map-Reduce:** A Weather Dataset, Analyzing the data with Hadoop, Map and Reduce, Java Map and Reduce, Scaling Out, Hadoop Streaming, Hadoop Pipes. **Map-Reduce Types and Formats:** Map-Reduce Types, Input Formats, Output Formats.

UNIT-IV: Pig: Pig-Installation and Running of Pig, Execution Types, Running Pig Programs, Pig Latin Editors, Comparison with databases, Pig Latin, Functions, Data Processing Operators. Hive: Installing Hive, An Example, Running Hive, Comparison with Traditional Databases, Hive-QL, Tables, Querying Data.

UNIT-V: Zookeeper: Zookeeper Service, Building applications with Zookeeper, Zookeeper in production. Sqoop: Database Imports, working with Imported Data, Importing Large Objects, Performing an Export.

Text Books:

1. Data Science and Big Data Analytics, EMC2 Education Services, wiley,2015.
2. Tom White,Hadoop: The Definitive Guide, 4rd Edition, O'reilly Publication, 2015.
3. John A. Rice, Mathematical Statistics and Data Analysis, 3rd Edition, Cengage.

Reference Books:

1. Franks, Taming, The Big Data Tidal Wave, 1st Edition, Wiley, 2012.
2. Vignesh Prajapati, Big Data Analytics with R and Hadoop, packet publishing 2013 Bill.
3. Frank J. Ohlhorst, Big Data Analytics

III Year II Semester	Cloud Computing	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on Virtualization and Cloud computing concepts.
- To understand the basic knowledge on Cloud Models and Services.
- To develop cloud environments suitable for societal services through Cloud platforms.
-

COURSE OUTCOMES:

- After successful completion of the course, students will be able to:
- Demonstrate basic concepts and terminologies of Cloud Computing and Virtualization.
- Understand Cloud deployment models, Service models and Architectures.
- Analyze Cloud services, Applications and Capacity Planning.
- Use different PaaS application frameworks to construct Cloud applications.
- Develop web applications through Google, Microsoft and Amazon web services as per societal needs.

UNIT I: Introduction & Cloud Computing Architecture ,Cloud computing at a glance: The vision of cloud computing, Defining a cloud, A closer look, The cloud computing reference model, Characteristics and benefits Historical developments: Distributed systems, Virtualization, Web 2.0, Service oriented computing, Utility-oriented computing

UNIT II– Building cloud computing environments: Application development, Infrastructure and system development, Computing platforms and technologies The cloud reference model: Architecture, Infrastructure-and hardware-as-a- service, Platform as a service, Software as a service .

Types of clouds: Architecture, Infrastructure-and hardware-as-a-service, Platform as a service, Software as a service, Open Challenges: Cloud definition, Cloud interoperability and standards, Scalability and fault tolerance, Security, trust, and privacy, Organizational aspects.

UNIT-III

Virtualization & SOA:Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques - Execution Virtualization, Other types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples – Xen, VMware, Microsoft Hyper-V

Introducing Service Oriented Architecture - Event-driven SOA or SOA 2.0, The Enterprise Service Bus, Service catalogs Defining SOA Communications - Business Process Execution Language, Business process modeling Managing and Monitoring SOA - SOA management tools, SOA security, The Open Cloud Consortium, Relating SOA and Cloud Computing.

UNIT IV: Cloud Platforms, Applications and Cloud Programming and Software Environments Amazon web services - Compute services, Storage services, Communication services and Additional Services. Google AppEngine - Architecture and core concepts, Application life cycle, Cost model, Observations. Microsoft Azure – Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance Scientific Applications – Healthcare, Biology, Geoscience, Business and Consumer Applications – CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming Features of Cloud and Grid Platforms - Cloud Capabilities and Platform Features, Traditional Features Common to Grids and Clouds.

UNIT V: Cloud Security and Mobile Cloud Securing the Cloud - The security boundary, Security service boundary, Security mapping. Securing Data - Brokered cloud storage access, Storage location and tenancy, Encryption, Auditing and compliance. Establishing Identity and Presence - Identity protocol standards, Windows Azure identity standards, Presence. Working with Mobile Devices - Defining the Mobile Market, Connecting to the cloud, Adopting mobile cloud applications.

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, S Tamarai Selvi "Mastering Cloud Computing Foundations And Applications Programming" , McGraw Hill Education, 2016.
2. Kai Hwang, Geoffrey C Fox, Jack J Dongarra, "Distributed and Cloud Computing - From Parallel Processing to the Internet of Things", Morgan Kaufman Publishing, 2012
3. Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishers, 2012

REFERENCE BOOKS:

1. Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer, 2012
2. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", 1st Edition, Pearson, 2014

III Year II Semester	Software Project Management	L	T	P	C
		3	0	0	3
(Professional Elective-II)					

Course Objectives:

At the end of the course, the student shall be able to:

- To describe and determine the purpose and importance of project management
- from the perspectives of planning, tracking and completion of project
- To compare and differentiate organization structures and project structures
- To implement a project to manage project schedule, expenses and resources with
- the application of suitable project management tools

Course Outcomes:

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

- Apply the process to be followed in the software development life-cycle models.
- Apply the concepts of project management & planning.
- Implement the project plans through managing people, communications and change
- Conduct activities necessary to successfully complete and close the Software projects
- Implement communication, modeling, and construction & deployment practices in software development.

UNIT I: Conventional Software Management: The waterfall model, conventional software Management performance.

Evolution of Software Economics: Software Economics, pragmatic software cost estimation. Improving Software Economics: Reducing Software product size, improving software processes improving team effectiveness, improving automation, Achieving required quality, peer inspections.

UNIT II:

The Old Way and The New: The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process. Life Cycle Phases: Engineering and production stages, inception, Elaboration, construction, transition phases. Artifacts of The Process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.

UNIT III:

Model Based Software Architectures: A Management perspective and technical perspective. Work Flows of the Process: Software process workflows, Iteration workflows. Checkpoints of the Process: Major milestones, Minor Milestones, Periodic status assessments.

UNIT IV:

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning. Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.

UNIT V:

Process Automation: Automation Building blocks, The Project Environment. Project Control and Process Instrumentation: The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation. Project Estimation and Management: COCOMO model, Critical Path Analysis, PERT technique, Monte Carlo approach

Text Books:

- 1) Software Project Management, Walker Royce, Pearson Education, 2005.
- 2) Software Project Management, Bob Hughes, 4th edition, Mike Cotterell, TMH.

Reference Books:

- 1) Software Project Management, Joel Henry, Pearson Education.
- 2) Software Project Management in practice, Pankaj Jalote, Pearson Education, 2005.
- 3) Effective Software Project Management, Robert K. Wysocki, Wiley, 2006.

III Year II Semester	Data Science	L	T	P	C
		3	0	0	3
(Professional Elective-II)					

Course Objectives:

- Provide you with the knowledge and expertise to become a proficient data scientist
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- Learn to statistically analyze a dataset
- Explain the significance of exploratory data analysis (EDA) in data science
- Critically evaluate data visualizations based on their design and use for communicating stories from data

Course Outcomes:

- Describe what Data Science is and the skill sets needed to be a data scientist
- Illustrate in basic terms what Statistical Inference means. Identify probability distributions
- Use R to carry out basic statistical modeling and analysis
- Apply basic tools (plots, graphs, summary statistics) to carry out EDA
- Describe the Data Science Process and how its components interact

UNIT I:

Introduction, The Ascendance of Data, Motivating Hypothetical: Data Science, Finding Key Connectors, The Zen of Python, Getting Python, Virtual Environments, Whitespace Formatting, Modules, Functions, Strings, Exceptions, Lists, Tuples, Dictionaries default dict, Counters, Sets, Control Flow, Truthiness, Sorting, List Comprehensions, Automated Testing and assert, Object Oriented Programming, Iterables and Generators, Randomness, Regular Expressions, Functional Programming, zip and Argument Unpacking, args and kwargs, Type Annotations, How to Write Type Annotations.

UNIT II:

Visualizing Data: matplotlib, Bar Charts, Line Charts, Scatterplots. Linear Algebra: Vectors, Matrices, Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational Caveats, Correlation and Causation. Gradient Descent: The Idea Behind Gradient Descent, Estimating the Gradient, Using the Gradient, Choosing the Right Step Size, Using Gradient Descent to Fit Models, Mini batch and Stochastic Gradient Descent.

UNIT III:

Getting Data: stdin and stdout, Reading Files, Scraping the Web, Using APIs, Working with Data: Exploring Your Data Using Named Tuples, Data-classes, Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction. Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem.

UNIT IV:

Machine Learning: Modeling, Overfitting and Underfitting, Correctness, The Bias-Variance Tradeoff, Feature Extraction and Selection, k-Nearest Neighbors, Naive Bayes, Simple Linear Regression, Multiple Regression, Digression, Logistic Regression

UNIT V:

Clustering: The Idea, The Model, Choosing k, Bottom-Up Hierarchical Clustering. Recommender Systems: Manual Curation, Recommending What's Popular, User-Based Collaborative Filtering, Item-Based Collaborative Filtering, Matrix Factorization Data Ethics, Building Bad Data Products, Trading Off Accuracy and Fairness, Collaboration, Interpretability, Recommendations, Biased Data, Data Protection IPython, Mathematics, NumPy, pandas, scikit-learn, Visualization, R

Textbooks:

- 1) Joel Grus, "Data Science From Scratch", O'Reilly.
- 2) Allen B.Downey, "Think Stats", O'Reilly.

Reference Books:

- 1) Doing Data Science: Straight Talk From The Frontline, 1st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013
- 2) Mining of Massive Datasets, 2nd Edition, Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, v2.1, Cambridge University Press, 2014
- 3) "The Art of Data Science", 1st Edition, Roger D. Peng and Elizabeth matsui, Lean Publications, 2015
- 4) "Algorithms for Data Science", 1st Edition, Steele, Brian, Chandler, John, Reddy, Swarna, springers Publications, 2016

e-Resources:

- 1) <https://github.com/joelgrus/data-science-from-scratch>
- 2) <https://github.com/donnemartin/data-science-ipython-notebooks>
- 3) <https://github.com/academic/awesome-datascience>

III Year I I Semester	Distributed Systems	L	T	P	C
		3	0	0	3
(Professional Elective-II)					

Course Objectives:

- To understand the foundations of distributed systems.
- To learn issues related to clock Synchronization and the need for global state in distributed systems
- To learn distributed mutual exclusion and deadlock detection algorithms
- To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems
- To learn the characteristics of peer-to-peer and distributed shared memory systems

Course Outcomes:

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

- Elucidate the foundations and issues of distributed systems
- Illustrate the various synchronization issues and global state for distributed systems
- Illustrate the Mutual Exclusion and Deadlock detection algorithms in distributed systems
- Describe the agreement protocols and fault tolerance mechanisms in distributed systems
- Describe the features of peer-to-peer and distributed shared memory systems

UNIT I:

Distributed Systems: Definition, Relation to computer system components, Motivation, Relation to parallel systems, Message-passing systems versus shared memory systems, Primitives for distributed communication, Synchronous versus asynchronous executions, Design issues and challenges.

A model of distributed computations: A distributed program, A model of distributed executions, Models of communication networks, Global state, Cuts, Past and future cones of an event, Models of process communications.

Logical Time: A framework for a system of logical clocks, Scalar time, Vector time, Physical clock synchronization: NTP.

UNIT II:

Message Ordering & Snapshots: Message ordering and group communication: Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order. Global state and snapshot recording algorithms: Introduction, System model and definitions, Snapshot algorithms for FIFO channels.

UNIT III:

Distributed Mutex & Deadlock: Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport’s algorithm – Ricart-Agrawala algorithm – Maekawa’s algorithm –Suzuki–Kasami’s broadcast algorithm. Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp’s classification – Algorithms for the single resource model, the AND model and the OR model.

UNIT IV:

Recovery & Consensus: Check pointing and rollback recovery: Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Coordinated check pointing algorithm – Algorithm for asynchronous check pointing and recovery. Consensus and

agreement algorithms: Problem definition – Overview of results – Agreement in a failure – free system – Agreement in synchronous systems with failures.

UNIT V:

Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Chord – Content addressable networks – Tapestry. Distributed shared memory: Abstraction and advantages – Memory consistency models – Shared memory Mutual Exclusion.

Text-Books:

- 1) Distributed Systems Concepts and Design, George Coulouris, Jean Dollimore and Tim Kindberg, Fifth Edition, Pearson Education, 2012.
- 2) Distributed computing: Principles, algorithms, and systems, Ajay D Kshemkalyani and Mukesh Singhal, Cambridge University Press, 2011.

Reference Books:

- 1) Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, Prentice Hall of India, 2007.
- 2) Advanced concepts in operating systems. Mukesh Singhal and Niranjana G. Shivaratri, McGraw-Hill, 1994.
- 3) Distributed Systems: Principles and Paradigms, Tanenbaum A.S., Van Steen M., Pearson Education, 2007.

E-Resources:

- 1) <https://nptel.ac.in/courses/106/106/106106168/>

III Year II Semester	Internet Of Things	L	T	P	C
		3	0	0	3
Open Elective-II					

Course Objective:

- The main objective of this course is to provide the student with the basic understanding of Embedded software
- Program the related analysis of different types of smart devices can be built by using Arduino and Rasberry-Pi boards.

Course Outcomes:

- Summarize the genesis and impact of IoT applications, architectures in real world.
- Apply diverse methods in deploying smart objects and connecting them to network.
- Construct simple applications using Arduino.
- Analyze different protocols and select which protocol can be used for a specific application.
- Identify and develop a solution for a given application using APIs

UNIT-I: Genesis of IoT, IoT and Digitization, IoT Impact-Connected roadways, Smart connected buildings, Convergence of IT and IoT, IoT Challenges, Comparing IoT Architectures - OneM2M IoT Architecture and IoTWF Architecture, A Simplified IoT Architecture.

UNIT-II: Smart Objects: The Things in IoT- Sensors, Actuators, and Smart Objects, Sensor Networks- Advantages and Disadvantages, Communications Criteria-Range, Frequency bands, Power consumption, Topology, IoT Access Technologies- IEEE 802.15.4, IEEE 1901.2a, IEEE 802.11ah (only Standardization and Alliances, Physical Layer, MAC Layer and Topology)

UNIT-III: Embedded Computing Basics- Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino- Developing on the Arduino, Some Notes on the Hardware, Openness

UNIT-IV: Communication in the IoT: Internet Principles, Internet Communications: An Overview- IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses- DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports- An Example: HTTP Ports, Other Common Ports.

UNIT-V: Application Layer Protocols- HTTP, HTTPS: Encrypted HTTP, Other Application Layer Protocols. Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, other Protocols.

Text Books:

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, ||IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

Reference Books:

1. Arshdeep Bahga, Vijay Madiseti - Internet of Things: A Hands-On Approach, Universities Press, 2014
2. Srinivasa K G, Internet of Things, CENGAGE Learning India, 2017

III Year I I Semester	Management Science	L	T	P	C
		3	0	0	3
Open Elective-II					

Course Objectives:

- To familiarize with the process of management and to provide basic insight into select contemporary management practices
- To provide conceptual knowledge on functional management and strategic management.

Course Outcome:

- After completion of the Course the student will acquire the knowledge on management functions, global leadership and organizational behavior.
- Will familiarize with the concepts of functional management project management and strategic management.

UNIT I

Introduction to Management: Concept –nature and importance of Management –Generic Functions of Management – Evaluation of Management thought- Theories of Motivation – Decision making process- Designing organization structure- Principles of organization – Organizational typology- International Management: Global Leadership and Organizational behavior Effectiveness(GLOBE) structure

UNIT II

Operations Management: Principles and Types of Management – Work study- Statistical Quality Control- Control charts (P-chart, R-chart, and C-chart) Simple problems- Material Management: Need for Inventory control- EOQ, ABC analysis (simple problems) and Types of ABC analysis (HML, SDE, VED, and FSN analysis).

UNIT III

Functional Management: Concept of HRM, HRD and PMIR- Functions of HR Manager- Wage payment plans(Simple Problems) – Job Evaluation and Merit Rating - Marketing Management- Functions of Marketing – Marketing strategies based on product Life Cycle, Channels of distributions. Operationlizing change through performance management.

UNIT IV

Project Management: (PERT/CPM): Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability- Project Crashing (Simple Problems)

UNIT V

Strategic Management: Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process – Environmental Scanning – SWOT analysis- Steps in Strategy Formulation and Implementation, Generic Strategy Alternatives. Global strategies, theories of Multinational Companies.

Text Books:

- 1.Dr. P. Vijaya Kumar & Dr. N. Appa Rao, 'Management Science' Cengage, Delhi, 2012.
- 2.Dr. A. R. Aryasri, 'Management Science' TMH 2011.

References:

- 1.Koontz & Weihrich: 'Essentials of management' TMH 2011
- 2.Seth & Rastogi: Global Management Systems, Cengage learning , Delhi, 2011
- 3.Robbins: Organizational Behaviour, Pearson publications, 2011

- 4.Kanishka Bedi: Production & Operations Management, Oxford Publications, 2011
- 5.Philip Kotler & Armstrong: Principles of Marketing, Pearson publications
- 6.Biswajit Patnaik: Human Resource Management, PHI, 2011
- 7.Hitt and Vijaya Kumar: Strategic Management, Cengage learning
- 8.Prem Chadha: Performance Management, Trinity Press(An imprint of Laxmi Publications Pvt. Ltd.)Delhi 2015.
- 9.Anil Bhat& Arya Kumar : Principles of Management, Oxford University Press, New Delhi, 2015.

III Year II Semester	Deep Learning With Tensor Flow	L	T	P	C
		3	0	0	3

Course Outcomes :

- Implement deep neural networks to solve real world problems (Apply-L3)
- Choose an appropriate pre-trained model to solve real-time problems. (Analyze – L4)
- Interpret the results of two different deep learning models. (Analyze – L4)
- Improve individual / teamwork skills, communication & report writing skills with ethical values.

Experiments:

1. Numerical Methods to solve matrix problems in Python
2. Eigen Value decomposition techniques
3. Dimensionality Reduction-PCA
4. Fundamentals of Tensor flow
5. Build a Convolution Neural Network for MNIST Handwritten Digit Classification
6. Build a Convolution Neural Network for simple image Classification
7. Implement one hot encoding of words or characters.
8. Word2vec Framework
9. Implement word embeddings for IMDB dataset.
10. Implement a Recurrent Neural Network for IMDB movie review classification problem.

Text Book:

Reza Zadeh and Bharath Ramsundar, “Tensorflow for Deep Learning”, O’Reilly publishers, 2018

References:

<https://github.com/fchollet/deep-learning-with-python-notebooks>

III Year II Semester	Big Data Analytics Lab	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the concepts of Big Data Analytics.
- Apply machine learning algorithms for Big Data Analytics
- Apply text categorization algorithms
- Solve the Big Data Analytics problems using various technologies and tools

List of Lab Tasks

Task 1: Configure apache hoop environment: To understand distributed and parallel computing environment.

Task 2: Hadoop file management: Adding files and directories, Retrieving files, Deleting files.

Task 3: Word Count Application: Map-Reduce program to understand Map-Reduce Paradigm.

Task 4: Semi structured data: Map reduce program that mines a given semi structured dataset (weather data.)

Task 5: Graph Mining: Use Map-Reduce to find the shortest path between two people in a social graph.

Task 6: NO-SQL database –Apcache Hbase: To set Hbase shell environment and to create tables, insert rows, display contents etc.

Task 7: Pig Latin scripts: To sort, group, join for a given dataset.

Task 8: Database manipulation using Hive: To create, alter, drop databases and views.

Task 9: Functions and indexes in Hive.

Task 10: Use Hive to Drop Functions and indexes.

III Year I I Semester	Cloud Computing Lab	L	T	P	C
		3	0	0	3

Task 1: Case Studies

Study about Amazon AWS, Google Apps and Microsoft Azure.

Task 2: Working with Google App Engine

Task 3: Working with Microsoft Azure

Building and hosting a simple cloud application using Microsoft Azure.

Task 4: Working with Oracle VM Virtual Box Manager

Implement Virtual OS using Oracle VM Virtual Box Manager.

Task 5: Working with Cloud Simulator

Implement Cloud Simulator using Eclipse and create a datacenter with one host and run one cloudlet on it.

Task 6: Working with AWS

To launch a virtual machine using Amazon ec2 Instance in AWS.

Task 7: Working with AWS

Host a Static Personal Website or Marketing Website on AWS.

Task 8: Working with AWS

Deploy and host a production ready WordPress website on AWS.

Task 9: Working with Salesforce Trailhead.

To Build a Battle Station App using Salesforce Trailhead.

Task 10: Working with Salesforce Trailhead.

To work with Apex and Apex Triggers using the Salesforce Trailhead Platform.

Task 11: Working with Yellow Circle

To Create and launch Windows Server virtual machine using Yellow Circle platform.

Task 12: Case Studies

Study about Amazon AWS, Hadoop, Aneka

III Year I I Semester	Mean-stacktechnologies-Module Html5,Javascript, Node. Js Express. Js and typescript	L	T	P	C
		0	0	4	2
(Skill Oriented Course)					

Course Outcomes:

At the end of the Course, Student will be able to:

- Develop professional web pages of an application using HTML elements like, lists, navigations, tables, various form elements, embedded media which includes images, audio, video and CSS Styles.
- Utilize Java Script for developing interactive HTML web-pages and validate form data.
- Build a basic web server using Node.js and also working with Node Package Manager (NPM).
- Build web-server using Express.js
- Make use of Typescript to optimize JavaScript code by using the concept of strict type checking..

List of Exercises

1.a	CourseName: HTML5-The Language
	ModuleName: Case-insensitivity,Platform-independency,DOCTYPEDeclaration, Types of Elements, HTML Elements-Attributes ,Meta data Element
	IncludetheMetadatelementinHomepage.htmlforprovidingdescriptionas "IEKart'sisanonlineshoppingwebsitethatsellsgoodsinretail.Thiscompanydeals With various categories like Electronics ,Clothing, Accessories etc.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28320667711144660000_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
1.b	CourseName: HTML5-The Language
	Module Name: Sectioning Elements
	EnhancetheHomepage.htmlofIEKart'sShoppingApplicationbyaddingappropriate Sectioning elements.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6372291347110857000_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
1.c	CourseName: HTML5-The Language
	Module Name: Paragraph Element, Division and Span Elements, List Element
	Makeuseofappropriategroupingelementssuchaslistitemsto>AboutUs"pageof IEKart's Shopping Application
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32785192040894940000_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
1.d	CourseName: HTML5-The Language
	Module Name: Link Element
	Link"Login","SignUp"and"Trackorder"to>Login.html","SignUp.html"and"Track.html"pagesrespectively.BookmarkeachcategorytoitsdetailsofIEKart's Shopping application.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15515105953273338000_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course

1.e	Course Name: HTML5-The Language
	Module Name: Character Entities
	Addthe©symbolintheHomepagefooterofIEKart'sShopping application.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_547667376938096260_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
1.f	CourseName: HTML5-The Language
	ModuleName: HTML5GlobalAttributes
	Addtheglobalattributessuchascontenteditable,spellcheck,idetc.toenhancethe SignupPagefunctionalityofIEKart'sShoppingapplication.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28723566050321920000_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
2.a	CourseName: HTML5-The Language
	ModuleName: CreatingTableElements,TableElements:Colspan/Rowspan Attributes, border, cellspacing, cellpadding attributes
	EnhancedetailspageofIEKart'sShoppingapplicationbyaddingatableelement todisplaytheavailablemobile/anyinventories.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013168035284033536113_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
2.b	CourseName: HTML5-The Language
	ModuleName: CreatingFormElements,ColorandDatePickers,SelectandDatalist Elements
	Usingtheformelements createSignuppagementforIEKart'sShopping application.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13975270903118459000_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
2.c	CourseName: HTML5-The Language
	ModuleName: InputElements-Attributes
	EnhanceSignuppagement functionalityofIEKart'sShoppingapplicationbyadding attributestoinputelements.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14048414537062347000_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
2.d	CourseName: HTML5-The Language
	ModuleName: Media, Iframe
	Addmediacontentinaframeusingaudio,video,iframeelementstotheHomepage ofIEKart'sShopping application.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30738402225794945000_shared?collectionId=lex_17739732834840810000_shared&collectionType=Course
3.a	CourseName: Javascript
	ModuleName: TypeofIdentifiers
	WriteaJavaScriptprogramtofindtheareaofacircleusingradius(varandlet-reassignandobservethedifferencewithvarandlet)andPI(const)
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013053264414818304732_shared?collectionId=lex_181096983663

	32810000_shared&collectionType=Course
3.b	CourseName: Javascript
	ModuleName: PrimitiveandNonPrimitiveData Types
	WriteJavaScriptcodetodisplaythemoviedetailssuchasmoviename,starring, language,andratings.Initializethevariableswithvaluesofappropriatetypes.Use templateliteralswherever necessary.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21528322245232402000_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course
3.c	CourseName: Javascript
	ModuleName: Operatorsand TypesofOperators
	WriteJavaScriptcodetobookmovieticketsonlineandcalculatethetotalprice, consideringthenumberofticketsandpriceperticketasRs.150.Also,apply afestive seasondiscountof10% andcalculatethediscountedamount.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13808338384481720000_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course
3.d	CourseName: Javascript
	ModuleName: TypesofStatements,Non-ConditionalStatements,Typesof ConditionalStatements, ifStatements,switchStatements
	WriteaJavaScriptcodetobookmovieticketsonlineandcalculatethetotalprice basedonthe3conditions:(a)Ifseatstobebookedarenotmorethan2,thecostper ticketremains Rs.150. (b)Ifseatsare6ormore,bookingisnotallowed.(c)Ifse
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_16257498471333610000_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course
3.e	CourseName: Javascript
	ModuleName: TypesofLoops
	WriteaJavaScriptcodetobookmovieticketsonlineandcalculatethetotalprice basedonthe3conditions:(a)Ifseatstobebookedarenotmorethan2,thecostper ticketremains Rs.150.(b) Ifseatsare6ormore,bookingisnotallowed.(c)If
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6238536888292970000_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course
4.a	CourseName: Javascript
	ModuleName: TypesofFunctions,DeclaringandInvokingFunction,Arrow Function,FunctionParameters,NestedFunction,Built-inFunctions,VariableScope inFunctions
	WriteaJavaScriptcodetobookmovieticketsonlineandcalculatethetotalprice based on the 3 conditions: (a) If seats to be booked are not more than 2, the costperticket remains Rs. 150.(b) Ifseats are 6 or more, booking is not allowed.(c) If
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15455199570613326000_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course
4.b	CourseName: Javascript
	ModuleName: WorkingWithClasses,CreatingandInheritingClasses
	CreateanEmployeeclassextending fromabaseclassPerson.Hints:(i) Createaclass Personwithnameandageasattributes.(ii)Addaconstructortoinitializethevalues

	<p>(iii) Create a class Employee extending Person with additional attributes role</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012599811117760512458_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course</p>
4.c	<p>CourseName: Javascript</p> <p>ModuleName: In-built Events and Handlers</p> <p>Write a JavaScript code to book movie tickets online and calculate the total price based on the 3 conditions: (a) If seats to be booked are not more than 2, the cost per ticket remains Rs. 150. (b) If seats are 6 or more, booking is not allowed. (c) If se</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4192188372573027000_shared?collectionId=lex_18109698366332810000_0_shared&collectionType=Course</p>
4.d	<p>CourseName: Javascript</p> <p>ModuleName: Working with Objects, Types of Objects, Creating Objects, Combining and cloning Objects using Spread operator, Destructuring Objects, Browser Object Model, Document Object Model</p> <p>If a user clicks on the given link, they should see an empty cone, a different heading, and a different message and a different background color. If user clicks again, they should see a re-filled cone, a different heading, a different message, and a diffe</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13197025862804100000_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course</p>
5.a	<p>CourseName: Javascript</p> <p>ModuleName: Creating Arrays, Destructuring Arrays, Accessing Arrays, Array Methods</p> <p>Create an array of objects having movie details. The objects should include the movie name, starring, language, and ratings. Render the details of movies on the page using the array.</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013053270191734784711_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course</p>
5.b	<p>CourseName: Javascript</p> <p>ModuleName: Introduction to Asynchronous Programming, Callbacks, Promises, Async and Await, Executing Network Requests using Fetch API</p> <p>Simulate a periodic stock price change and display on the console. Hints: (i) Create a method which returns a random number - use Math.random, floor and other methods to return a rounded value. (ii) Invoke the method for every three seconds and stop when</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012599811633905664460_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course</p>
5.c	<p>CourseName: Javascript</p> <p>ModuleName: Creating Modules, Consuming Modules</p> <p>Validate the user by creating a login module. Hints: (i) Create a file login.js with a User class. (ii) Create a validate method with username and password as arguments. (iii) If the username and password are equal it will return "Login Successful" elsew</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013052857053585408667_shared?collectionId=lex_18109698366332810000_shared&collectionType=Course</p>

	32810000_shared&collectionType=Course
6.a	CourseName: Node.js
	ModuleName: Howtouse Node.js
	VerifyhowtoexecutedifferentfunctionssuccessfullyintheNode.jsplatform. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19002830632103186000_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
6.b	CourseName: Node.js
	ModuleName: CreateawebsserverinNode.js
	WriteaprogramtoshowtheworkflowofJavaScriptcodeexecutablebycreatingweb server inNode.js. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28177338996267815000_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
6.c	CourseName: Node.js
	ModuleName: ModularprogramminginNode.js
	WriteaNode.jsmoduletoshowtheworkflowofModularizationofNode application. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28865394191004004000_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
6.d	CourseName: Node.js
	ModuleName: RestartingNode Application
	Writea programtoshowthe workflow ofrestartinga Nodeapplication. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9174073856000159000_shared?collectionId=lex_32407835671946760000_0_shared&collectionType=Course
6.e	CourseName: Node.js
	ModuleName: FileOperations
	Createatextfilesrc.txtandaddthefollowingdatatoit.Mongo,Express,Angular, Node. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33376440180246100000_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
7.a	CourseName: Express.js
	ModuleName: Definingaroute,HandlingRoutes,RouteParameters,Query Parameters
	ImplementroutingfortheAdventureTrailsapplicationbyembeddingthenecessary codeintheroutes/route.jsfile. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_29394215542149950000_shared?collectionId=lex_32407835671946760000_00_shared&collectionType=Course
7.b	CourseName: Express.js
	ModuleName: HowMiddlewareworks,ChainingofMiddlewares,Typesof Middlewares
	InmyNotesapplication:(i)wewanttohandlePOSTsubmissions.(ii)display customizederrormessages.(iii)performlogging. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13930661312009580000_shared?collectionId=lex_32407835671946760000

	00_shared&collectionType=Course
7.c	CourseName: Express.js
	ModuleName: ConnectingtoMongoDBwithMongoose,ValidationTypesand Defaults
	WriteaMongoosesthematoconnectwithMongoDB.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035588775485440691_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
7.d	CourseName: Express.js
	ModuleName: Models
	Writeaprogramto wraptheSchemainto aModelobject.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035593896869888662_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
8.a	CourseName: Express.js
	ModuleName: CRUD Operations
	Writeaprogramto performvariousCRUD(Create-Read-Update-Delete)operations usingMongooselibraryfunctions.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035684270129152696_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
8.b	CourseName: Express.js
	ModuleName: APIDevelopment
	In the myNotes application, include APIs based on the requirements provided. (i) API should fetchthe details ofthe notes based on a notesID which is provided inthe URL. Test URL - http://localhost:3000/notes/7555(ii) API should update the details bas
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035745250975744755_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
8.c	CourseName: Express.js
	ModuleName: WhySessionmanagement,Cookies
	Writeaprogramto explainsessionmanagementusing cookies.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24299316914857090000_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
8.d	CourseName: Express.js
	ModuleName: Sessions
	Writeaprogramto explainsessionmanagementusing sessions.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_905413034723449100_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course
8.e	CourseName: Express.js
	ModuleName: Whyand WhatSecurity,HelmetMiddleware
	ImplementsecurityfeaturesinmyNotesapplication
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_31677453061177940000_shared?collectionId=lex_32407835671946760000_shared&collectionType=Course

9.a	CourseName: TypeScript
	ModuleName: BasicsofTypeScript
	Onthepage,display thepriceofthemobile-basedinthree different colors.Insteadof usingthenumberinourcode,representthembystringvalueslikeGoldPlatinum, PinkGold, SilverTitanium.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28910354929502245000_shared?collectionId=lex_943623311651267800_0_shared&collectionType=Course
9.b	CourseName: TypeScript
	ModuleName: Function
	Defineanarrowfunctioninsidetheeventhandlertofiltertheproductarraywiththe selected product object using the productId received bythe function. Pass the selected product object to the next screen.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10783156469383723000_shared?collectionId=lex_943623311651267800_0_shared&collectionType=Course
9.c	CourseName: TypeScript
	ModuleName: ParameterTypesandReturnTypes
	Considerthatdeveloperneedstodeclareafunction-getMobileByVendorwhich acceptsstringas inputparameterandreturnsthelistofmobiles.
	https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712912427057152901_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course
9.d	CourseName: TypeScript
	ModuleName: ArrowFunction
	Considerthatdeveloperneedstodeclareamanufacturer's arrayholding4objects with id and price as a parameter and needs to implement anarrow function - myfunctionto populate the id parameter of manufacturers array whose price is greater than or equ
	https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712910875500544904_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course
9.e	CourseName: TypeScript
	ModuleName: OptionalandDefaultParameters
	Declareafunction-getMobileByManufacturerwithtwoparametersnamely manufacturerandid,wheremanufacturervalueshouldpassedasSamsungandid parameter should be optional while invoking the function, if id is passed as 101 thenthis function shoul
	https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712914940641280906_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course
10.a	CourseName: TypeScript
	ModuleName: RestParameter
	Implementbusiness logicforaddingmultipleProductvaluesintoacartvariablewhich istypeofstring array.
	https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712921860915200909_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course

10.b	CourseName: Typescript
	ModuleName: CreatinganInterface
	Declareaninterfacenamed-ProductwithtwopropertieslikeproductIdand productNamewithanumberandstringdatatypeandneedtoimplementlogicto populate the Product details.
	https://infyspringboard.onwingspan.com/web/en/viewer/hands- on/lex_auth_012712925244276736910_shared?collectionId=lex_9436233116512678 000_shared&collectionType=Course
10.c	CourseName: Typescript
	ModuleName: Duck Typing
	Declareaninterfacenamed-ProductwithtwopropertieslikeproductIdand productNamewiththenumberandstringdatatypeandneedtoimplementlogicto populate the Product details.
	https://infyspringboard.onwingspan.com/web/en/viewer/hands- on/lex_auth_012712925995458560912_shared?collectionId=lex_9436233116512678 000_shared&collectionType=Course
10.d	CourseName: Typescript
	ModuleName: FunctionTypes
	Declareaninterface withfunctiontypeandaccess itsvalue.
	https://infyspringboard.onwingspan.com/web/en/viewer/hands- on/lex_auth_012712948945346560918_shared?collectionId=lex_9436233116512678000 _shared&collectionType=Course
11.a	CourseName: Typescript
	ModuleName: ExtendingInterfaces
	DeclareaproductListinterfacewhichextendspropertiesfromtwootherdeclared interfaceslikeCategory,Productaswellasimplementationtocreateavariablenameofthis interfacetype.
	https://infyspringboard.onwingspan.com/web/en/viewer/hands- on/lex_auth_012712951652139008920_shared?collectionId=lex_9436233116512678000 _shared&collectionType=Course
11.b	CourseName: Typescript
	ModuleName: Classes
	ConsidertheMobileCartapplication,CreateobjectsoftheProductclassandplace themintotheproductlistarray.
	https://infyspringboard.onwingspan.com/web/en/viewer/web- module/lex_3705824317381604400_shared?collectionId=lex_9436233116512678000 _shared&collectionType=Course
11.c	CourseName: Typescript
	ModuleName: Constructor
	Declareaclassnamed-Productwiththebelow-mentioneddeclarations:(i)productId as number property(ii) Constructor to initialize this value (iii) getProductIdmethodto return the message "Product id is <<id value>>".
	https://infyspringboard.onwingspan.com/web/en/viewer/hands- on/lex_auth_012712954616782848927_shared?collectionId=lex_9436233116512678 000_shared&collectionType=Course
11.d	CourseName: Typescript
	ModuleName: AccessModifiers
	Create a Product class with 4 properties namely productId, productName,

	<p>productPrice,productCategorywithprivate,public,static,andprotectedaccess modifiersandaccessingthemthroughGadgetclassanditsmethods.</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712953517170688931_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course</p>
12.a	<p>CourseName:Typescript</p> <p>ModuleName: Propertiesand Methods</p> <p>CreateaProductclasswith4propertiesnamelyproductIdandmethodsto setProductId()andgetProductId().</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9356738095572543000_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course</p>
12.b	<p>CourseName:Typescript</p> <p>ModuleName:Creatingandusing Namespaces</p> <p>CreateanamespacecalledProductUtilityandplacetheProductclassdefinitioninit. ImporttheProductclassinsideproductlistfileanduse it.</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_20787271128051925000_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course</p>
12.c	<p>CourseName:Typescript</p> <p>ModuleName:Creatingandusing Modules</p> <p>ConsidertheMobileCartapplicationwhichisdesignedaspartofthefunctionsina module to calculate the total price of the product using the quantity and price valuesand assign it to a totalPrice variable.</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24788158187785620000_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course</p>
12.d	<p>CourseName:Typescript</p> <p>ModuleName:WhatisGenerics,WhatareTypeParameters,GenericFunctions, GenericConstraints</p> <p>Createagenericarrayandfunctiontosortnumbersaswellasstring values.</p> <p>https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_446287045482942800_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course</p>

TextBooks:

1. Programming the World Wide Web, 7thEdition,RobertWSebesta, Pearson.
2. ProMeanStackDevelopment,1stEdition,ELadElrom,ApressO'Reilly.
3. FullStackJavaScriptDevelopmentwithMEAN,ColinJlhrig,AdamBretz,1stedition,SitePoint, Site Point Pty. Ltd., O'Reilly Media.

Reference Books:

1. WebTechnologies,HTML,JavaScript,PHP,Java,JSP,XMLandAJAX,Blackbook,1stEdition, Dream Tech.
2. AnIntroductiontoWebDesign,Programming,1stEdition,PaulSWang,SandaSKatila,Cengage Learning.

Web Links:

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex_17739732834840810000_shared/overview\(HTML5\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_17739732834840810000_shared/overview(HTML5))
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex_18109698366332810000_shared/overview\(JavaScript\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_18109698366332810000_shared/overview(JavaScript))

3. [https://infyspringboard.onwingspan.com/en/app/toc/lex_32407835671946760000_shared/overview\(Node.js & Express.js\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_32407835671946760000_shared/overview(Node.js%20%26%20Express.js))
4. [https://infyspringboard.onwingspan.com/en/app/toc/lex_9436233116512678000_shared/overview\(Typescript\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_9436233116512678000_shared/overview(Typescript))

IV Year I Semester	Reinforcement Learning	L	T	P	C
		3	0	0	3
(Professional Elective-III)					

Course Objectives: Knowledge on fundamentals of reinforcement learning and the methods used to create agents that can solve a variety of complex tasks.

Course Outcomes

1. Understand basics of RL.
2. Understand RL Framework and Markov Decision Process.
3. Analyzing ning through the use of Dynamic Programming and Monte Carlo.
4. Understand TD(0) algorithm, TD(λ) algorithm.

UNIT - I

Basics of probability and linear algebra, Definition of a stochastic multi-armed bandit, Definition of regret, Achieving sublinear regret, UCB algorithm, KL-UCB, Thompson Sampling.

UNIT - II

Markov Decision Problem, policy, and value function, Reward models (infinite discounted, total, finite horizon, and average), Episodic & continuing tasks, Bellman's optimality operator, and Value iteration & policy iteration.

UNIT - III

The Reinforcement Learning problem, prediction and control problems, Model-based algorithm, Monte Carlo methods for prediction, and Online implementation of Monte Carlo policy evaluation.

UNIT - IV

Bootstrapping; TD(0) algorithm; Convergence of Monte Carlo and batch TD(0) algorithms; Model-free control: Q-learning, Sarsa, Expected Sarsa.

UNIT - V

n-step returns; TD(λ) algorithm; Need for generalization in practice; Linear function approximation and geometric view; Linear TD(λ). Tile coding; Control with function approximation; Policy search; Policy gradient methods; Experience replay; Fitted Q Iteration; Case studies.

TEXT BOOKS:

1. "Reinforcement learning: An introduction," First Edition, Sutton, Richard S., and Andrew G. Barto, MIT press 2020.
2. "Statistical reinforcement learning: modern machine learning approaches," First Edition, Sugiyama, Masashi. CRC Press 2015.

REFERENCE BOOKS:

1. "Bandit algorithms," First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020.
2. "Reinforcement Learning Algorithms: Analysis and Applications," Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021.
3. Alexander Zai and Brandon Brown "Deep Reinforcement Learning in Action," First Edition, Manning Publications 2020.

IV Year I Semester	Quantum Computing	L	T	P	C
		3	0	0	3
(Professional Elective-III)					

Course Objectives:

By the end of the course, students will be able to

- Understand how block chain systems (mainly Bit coin and Ethereum) work and to securely interact with them.
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from block chain technology into their own projects.

Course Outcomes:

At the end of the course, student will be able to

- Demonstrate the foundation of the Block chain technology and understand the processes in payment and funding.
- Identify the risks involved in building Block chain applications.
- Review of legal implications using smart contracts.
- Choose the present landscape of Block chain implementations and Understand Crypto currency markets
- Examine how to profit from trading crypto currencies

UNIT I

Introduction, Scenarios, Challenges Articulated, Block chain, Block chain Characteristics, Opportunities Using Block chain, History of Block chain.

Evolution of Block chain : Evolution of Computer Applications, Centralized Applications, Decentralized Applications, Stages in Block chain Evolution, Consortia, Forks, Public Block chain Environments, Type of Players in Block chain Ecosystem, Players in Market.

UNIT II

Block chain Concepts: Introduction, Changing of Blocks, Hashing, Merkle-Tree, Consensus, Mining and Finalizing Blocks, Currency aka tokens, security on block chain, data storage on Block chain, wallets, coding on block chain: smart contracts, peer-to-peer network, types of Block chain nodes, risk associated with block chain solutions, life cycle of block chain transaction.

UNIT III

Architecting Block chain solutions: Introduction, Obstacles for Use of Block chain, Block chain Relevance Evaluation Framework, Block chain Solutions Reference Architecture, Types of Block chain Applications. Cryptographic Tokens, Typical Solution Architecture for Enterprise Use Cases, Types of Block chain Solutions, Architecture Considerations, Architecture with Block chain Platforms, Approach for Designing Block chain Applications.

UNIT IV

Ethereum Block chain Implementation: Introduction, Tuna Fish Tracking Use Case, Ethereum Ecosystem, Ethereum Development, Ethereum Tool Stack, Ethereum Virtual Machine, Smart Contract Programming, Integrated Development Environment, Truffle Framework, Ganache, Unit Testing, Ethereum Accounts, MyEtherWallet, Ethereum Networks/Environments, Infura, Etherscan, Ethereum Clients, Decentralized Application, Metamask, Tuna Fish Use Case Implementation, OpenZeppelin Contracts

UNIT V

Hyperledger Blockchain Implementation, Introduction, Use Case – Car Ownership Tracking, Hyperledger Fabric, Hyperledger Fabric Transaction Flow, FabCar Use Case Implementation, Invoking Chaincode Functions Using Client Application. Advanced Concepts in Block chain: Introduction, Inter Planetary File System (IPFS), Zero-Knowledge Proofs, Oracles, Self-Sovereign Identity, Block chain with IoT and AI/ML Quantum Computing and Block chain, Initial Coin Offering, Block chain Cloud Offerings, Block chain and its Future Potential.

Text Books:

- 1) Ambadas, Arshad Sarfarz Ariff, Sham “Blockchain for Enterprise Application Developers”, Wiley
- 2) Andreas M. Antonopoulos, “Mastering Bitcoin: Programming the Open Blockchain” ,O’Reilly.

Reference Books:

- 1) Block chain: A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph Bambara, Paul R. Allen, Mc Graw Hill.
- 2) Block chain: Blueprint for a New Economy, Melanie Swan, O’Reilly

IV Year I Semester	Social Network Analysis	L	T	P	C
		3	0	0	3
(Professional Elective-III)					

Course Objective:

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behavior in social web and related communities.
- To learn visualization of social networks.

Course Outcomes:

- Develop semantic web related applications.
- Represent knowledge using ontology.
- Predict human behaviour in social web and related communities.
- Visualize social networks.

Unit I Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

Unit II Modelling, Aggregating And Knowledge Representation: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

Unit II Extraction And Mining Communities In Web Social Network: Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

Unit IV Predicting Human Behavior And Privacy Issues: Understanding and predicting human behavior for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and

countermeasures.

Unit V Visualization And Applications Of Social Networks: Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

Text Books:

1. Peter Mika, —Social Networks And The Semantic Web, First Edition, Springer 2007.
2. Borko Furht, —Handbook Of Social Network Technologies And Applications, 1st Edition, Springer, 2010.

References:

1. Guandong Xu, Yanchun Zhang And Lin Li, —Web Mining And Social Networking – Techniques And Applications, First Edition, Springer, 2011.
2. Dion Goh And Schubert Foo, —Social Information Retrieval Systems: Emerging Technologies And Applications For Searching The Web Effectively, Igi Global Snippet, 2008.

IV Year I Semester	Block Chain Technology	L	T	P	C
		3	0	0	3
(Professional Elective-III)					

Course Objectives:

- By the end of the course, students will be able to
- Understand how block chain systems (mainly Bit coin and Ethereum) work and to securely interact with them, design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from block chain technology into their own projects.

Course Outcomes:

At the end of the course, student will be able to

- Demonstrate the foundation of the Block chain technology and understand the processes in payment and funding.
- Identify the risks involved in building Block chain applications.
- Review of legal implications using smart contracts.
- Choose the present landscape of Block-chain implementations and Understand Crypto currency markets
- Examine how to profit from trading crypto currencies

UNIT I

Introduction, Scenarios, Challenges Articulated, Blockchain, Blockchain Characteristics, Opportunities Using Blockchain, History of Blockchain.

Evolution of Blockchain : Evolution of Computer Applications, Centralized Applications, Decentralized Applications, Stages in Blockchain Evolution, Consortia, Forks, Public Blockchain Environments, Type of Players in Blockchain Ecosystem, Players in Market.

UNIT II

Blockchain Concepts: Introduction, Changing of Blocks, Hashing, Merkle-Tree, Consensus, Mining and Finalizing Blocks, Currency aka tokens, security on blockchain, data storage on blockchain, wallets, coding on blockchain: smart contracts, peer-to-peer network, types of blockchain nodes, risk associated with blockchain solutions, life cycle of blockchain transaction.

UNIT III

Architecting Blockchain solutions: Introduction, Obstacles for Use of Blockchain, Blockchain Relevance Evaluation Framework, Blockchain Solutions Reference Architecture, Types of Blockchain Applications. Cryptographic Tokens, Typical Solution Architecture for Enterprise Use Cases, Types of Blockchain Solutions, Architecture Considerations, Architecture with Blockchain Platforms, Approach for Designing Blockchain Applications.

UNIT IV

Ethereum Blockchain Implementation: Introduction, Tuna Fish Tracking Use Case, Ethereum Ecosystem, Ethereum Development, Ethereum Tool Stack, Ethereum Virtual Machine, Smart Contract Programming, Integrated Development Environment, Truffle Framework, Ganache, Unit Testing, Ethereum Accounts, MyEtherWallet, Ethereum Networks/Environments, Infura, Etherscan, Ethereum Clients, Decentralized Application, Metamask, Tuna Fish Use Case Implementation, OpenZeppelin Contracts.

UNIT V

Hyperledger Blockchain Implementation, Introduction, Use Case – Car Ownership Tracking, Hyperledger Fabric, Hyperledger Fabric Transaction Flow, FabCar Use Case Implementation, Invoking Chaincode Functions Using Client Application.

Advanced Concepts in Blockchain: Introduction, InterPlanetary File System (IPFS), Zero-Knowledge Proofs, Oracles, Self-Sovereign Identity, Blockchain with IoT and AI/ML Quantum Computing and Blockchain, Initial Coin Offering, Blockchain Cloud Offerings,Blockchain and its Future Potential.

Text Books:

- 1) Ambadas, Arshad Sarfarz Ariff, Sham “Blockchain for Enterprise Application Developers”, Wiley
- 2) Andreas M. Antonopoulos, “Mastering Bitcoin: Programming the Open Blockchain” , O’Reilly

Reference Books:

- 1) Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph Bambara, Paul R. Allen, Mc Graw Hill.
- 2) Blockchain: Blueprint for a New Economy, Melanie Swan, O’Reilly

IV Year I Semester	Virtual Reality Technologies & AR Development	L	T	P	C
		3	0	0	3
(Professional Elective-IV)					

Course Outcomes:

- Understand the concepts of virtual reality and Communication Media.
- Understand about the human perceptual system.
- Understand about various input and output devices used in the virtual reality
- Apply the concepts of Representation and Rendering of the Virtual World.

UNIT-I

Introduction To Virtual Reality (VR): Defining Virtual Reality, Five key elements of the virtual reality experience, Virtual Reality, Tele presence, Augmented Reality and Cyberspace, History of Virtual Reality. VR-The Medium: Communicating through a Medium, Communication: Conveyance of Ideas, Common Issues of Human Communication Media.

UNIT-II

The Human In the Loop: The Human Perceptual System: Sensation- The Physiological Side Of Perception, Visual Perception, Aural Perception, Haptic Perception, Vestibular Perception, Olfactory Perception, Gustation Perception, Cross-Sensory Effects And Virtual Reality. PRESENCE AND EMBODIMENT: The Concept Of Presence, The Determinants And Responses Of Presence, Measuring Presence, Embodiment.

UNIT-III

Interfacing the Participant(s) with the Virtual World (INPUT): Input Technologies-Input Classifications, Position-Tracking Technologies, Using Inputs within a Virtual Reality System-Position Tracking the Body, Physical Input Devices, Body Posture and Gesture Recognition, Speech Recognition (Audio Input). Input Technologies-Input Classifications, Position-Tracking Technologies, Using Inputs within a Virtual Reality System-Position Tracking the Body, Physical Input Devices, Body Posture and Gesture Recognition, Speech Recognition (Audio Input).

UNIT-IV

Interfacing The Virtual World With The Participant(S)(Output): Visual Displays-Nonocclusive Head-Based Displays, Smartphone-Virtual Reality Head-Based Displays, Handheld Virtual Reality, Summary Of Visual Display Paradigms; Aural Displays-Properties Of Aural Displays, Aural Display Paradigms; Haptic Displays-Properties Of Haptic Displays, Haptic Display Paradigms, Tactile Haptic Displays, End-Effector Displays.

UNIT-V

Presenting The Virtual World: Representation Of The Virtual World- Verisimilitude, Human Perception, Choosing A Mapping, Quantitative And Qualitative Representations; Visual Representation In VR, Aural Representation In VR, Haptic Representation In VR; Rendering Systems- Visual Rendering Systems, Sonic Rendering Systems, Haptic Rendering Systems. The Virtual Reality Experience: Immersion, Providing The Context, Physical/Sensory Immersion, Mental Immersion, The Virtual World: Substance Of The Virtual World, Object Modelling And World Layout.

Text Book:

- 1) William R. Sherman and Alan B. Craig, Understanding Virtual Reality Interface, Application, and Design, 2nd Edition, Morgan Kaufmann Publishers, Elsevier, 2019

Reference Book:

- 1 Rajesh K. Maurya, Computer Graphics with Virtual Reality System, 3rd Edition, Wiley Publication, 2018.
- 2 Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, 2nd Edition, Wiley, 2017.
- 3 K.S. Hale and K. M. Stanney, Handbook on Virtual Environments, 2nd Edition, CRC Press, 2015.

IV Year I Semester	High Performance Computing	L	T	P	C
		3	0	0	3
(Professional Elective-IV)					

Course Outcomes:

- Understand parallel programming platforms and parallel algorithms on parallel computer systems.
- Analyze the performance of a parallel program to outfit a particular platform.
- Understand the accelerated technologies of Multi-core processor systems using MPI, Open MP and threading techniques.
- Apply the concepts of dense matrix, sorting and graphs.

UNIT I

Parallel Programming Platforms: Implicit parallelism: Trends in Microprocessor Architectures, Limitations of memory system performance, Dichotomy of parallel computing platforms, physical organization of parallel platforms, Routing mechanisms for interconnection networks.

Principles of Parallel Algorithm Design: Preliminaries, decomposition Techniques, Characteristics of tasks and interactions, mapping techniques for load balancing, parallel algorithm models.

UNIT II

Basic communication operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather.

Analytical modeling of parallel programs: sources of overhead in parallel programs, performance metrics for parallel systems, The Effect of granularity on performance, scalability of parallel systems.

UNIT III

Programming using the message passing paradigm: Principles of Message passing programming, the building blocks: Send and Receive Operations, MPI: the message passing interface, Overlapping communication with computation, collective communication and computation Operations.

UNIT-IV

Programming shared address space platforms: Thread Basics, why Threads, Thread Basics: Creation and Termination, Synchronization primitives in Pthreads, OpenMP: a standard for Directive based Parallel Programming.

UNIT V

Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix – Matrix Multiplication, Quick sort.

Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bubble sort and its variants.

Graph Algorithms: Minimum Spanning Tree: Single- Source shortest paths: Dijkstra's Algorithm, all-pairs shortest paths, Transitive closure, connected components.

Text Books:

1. AnanthGramma, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education, 2016.

Reference Books:

1. Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill International Editions, Computer Science Series, 2004.
2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
3. Joseph Jaja, "An Introduction to Parallel Algorithms", Addison-wesley, 1992.

IV Year I Semester	Robotic Process Automation	L	T	P	C
		3	0	0	3
(Professional Elective-IV)					

Course Outcomes:

- Describe RPA, where it can be applied and how it's implemented.
- Describe the different types of variables, Control Flow and data manipulation techniques.
- Identify and understand Image, Text and Data Tables Automation.
- Describe how to handle the User Events and various types of Exceptions and strategies.
- Understand the Deployment of the Robot and to maintain the connection.
-

UNIT I : Introduction to Robotic Process Automation: Scope and techniques of automation, Robotic process automation, What can RPA do, Benefits of RPA, Components of RPA, RPA platforms, The future of automation. RPA Basics: History of Automation, What is RPA, RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, What Processes can be Automated, Types of Bots, Workloads which can be automated, RPA Advanced Concepts, Standardization of processes, RPA Development methodologies, Difference from SDLC, Robotic control flow architecture, RPA business case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and emerging ecosystem.

UNIT II : RPA Tool Introduction and Basics: Introduction to RPA Tool: The User Interface, Variables, Managing Variables, Naming Best Practices, The Variables Panel, Generic Value Variables, Text Variables, True or False Variables, Number Variables, Array Variables, Date and Time Variables, Data Table Variables, Managing Arguments, Naming Best Practices, The Arguments Panel, Using Arguments, About Imported Namespaces, Importing New Namespaces, Control Flow, Control Flow Introduction, If Else Statements, Loops, Advanced Control Flow, Sequences, Flowcharts, About Control Flow, Control Flow Activities, The Assign Activity, The Delay Activity, The Do While Activity, The If Activity, The Switch Activity, The While Activity, The For Each Activity, The Break Activity, Data Manipulation, Data Manipulation Introduction, Scalar variables, collections and Tables, Text Manipulation, Data Manipulation, Gathering and Assembling Data

UNIT III: Advanced Automation Concepts & Techniques: Recording Introduction, Basic and Desktop Recording, Web Recording, Input/Output Methods, Screen Scraping, Data Scraping, Scraping advance techniques, Selectors, Defining and Assessing Selectors, Customization, Debugging, Dynamic Selectors, Partial Selectors, RPA Challenge, Image, Text & Advanced Citrix Automation, Introduction to Image & Text Automation, Image based automation, Keyboard based automation, Information Retrieval Advanced Citrix Automation challenges, Best Practices, Using tab for Images, Starting Apps, Excel Data Tables & PDF, Data Tables in RPA, Excel and Data Table basics, Data Manipulation in excel, Extracting Data from PDF, Extracting a single piece of data, Anchors, Using anchors in PDF.

UNIT IV:

Handling User Events & Assistant Bots, Exception Handling: What Are Assistant Bots, Monitoring System Event Triggers, Hotkey Trigger, Mouse Trigger, System Trigger, Monitoring Image And Element Triggers, An Example Of Monitoring Email, Example Of Monitoring A Copying Event And Blocking It, Launching An Assistant Bot On A Keyboard Event. Exception Handling: Debugging And Exception Handling, Debugging Tools, Strategies For Solving Issues, Catching Errors.

UNITV:

Deploying and Maintaining The Bot: Publishing using publish utility, Creation of Server, UsingServer to control the bots, Creating a provision Robotfrom the Server, Connecting a Robot to Server, Deploy the Robot to Server, Publishing and managing updates, Managing packages, Uploading packages, Deleting packages

Text Books:

1.AlokManiTripathi,“*LearningRoboticProcessAutomation*”,PacktPublishing, 2018.

Reference Books:

1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, “Introductionto Robotic Process Automation:a Primer”, Institute of Robotic Process Automation,1st Edition 2015.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate RepetitiveTasks &Become An RPA Consultant”, Independently Published, 1st Edition2018.

WebReferences:

1. <https://www.uipath.com/rpa/robotic-process-automation>
2. <https://www.academy.uipath.com>

IV Year I Semester	Information Retrieval System	L	T	P	C
		3	0	0	3
(Professional Elective-IV)					

Course Outcomes:

- Ability to apply IR principles to locate relevant information large collections of data
- Ability to design different document clustering algorithms
- Implement retrieval systems for web search tasks.
- Design an Information Retrieval System for web search tasks.

UNIT-I

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities

UNIT-II

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction

Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models

UNIT-III

Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages Document and Term Clustering:

Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters

UNIT-IV

User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext. Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies

UNIT-5

Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval

TEXT BOOK

1. Information Storage and Retrieval Systems – Theory and Implementation, Second Edition, Gerald J. Kowalski, Mark T. Maybury, Springer

REFERENCES

1. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992.
2. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons.
3. Modern Information Retrieval By Yates and Neto Pearson Education.

IVYear I Semester	Artificial Neural Networks	L	T	P	C
		3	0	0	3
(Professional Elective-V)					

Course Objective:

- 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

Course Outcomes:

- Demonstrate ANN structure and activation Functions
- Define foundations and learning mechanisms and state-space concepts
- Identify structure and learning of perceptions
- Explain Feed forward, multi-layer feed forward networks and Back propagation algorithms
- Analyze Radial Basis Function Networks, Theory Regularization and RBF networks

UNIT-I: Introduction and ANN Structure, Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures.

UNIT-II: Mathematical Foundations and Learning mechanisms. Re-visiting vector and matrix algebra, State-space concepts, Concepts of optimization, Error-correction learning. Memory-based learning, Hebbian learning. Competitive learning.

UNIT-III: 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.

UNIT-IV: Feed forward ANN, Structures of Multi-layer feed forward networks. Back propagation algorithm, Back propagation - training and convergence, Functional approximation with back propagation. Practical and design issues of back propagation learning.

UNIT-V: Radial Basis Function Networks, Pattern separability and interpolation, Regularization Theor Regularization and RBF networks. RBF network design and training. Approximation properties of RBF.

Text Books:

1. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.

Reference Books:

1. Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997.

IV Year I Semester	Recommender Systems	L	T	P	C
		3	0	0	3
(Professional Elective-V)					

Course Objectives:

- To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering
- To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations

Course Outcomes:

- Design recommendation system for a particular application domain.
- Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity
- Explain User-based recommendation, knowledge-based recommender system
- Define Opportunities for hybridization, Monolithic hybridization
- Identify hybridization design, Weighted, Switching, Mixed, Pipelined hybridization

UNIT-I: Introduction: Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT-II: Content-based Filtering: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

UNIT-III: Collaborative Filtering: User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems. Types of Recommender Systems: Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems

UNIT-IV: Hybrid Approaches: opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade, Meta-level, Limitations of hybridization strategies

UNIT-V: Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.

Text Books:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.

Reference Books:

1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

IV Year I Semester	AI Chat Boats	L	T	P	C
		3	0	0	3
(Professional Elective-V)					

Course Objectives:

- Learn how artificial intelligence powers chatbots, get an overview of the bot ecosystem and bot anatomy, and study different types of bots and use cases.
- Identify best practices for defining a chatbot use case, and use a rapid prototyping framework to develop a use case for a personalized chatbot.

Course Outcomes:

- Develop an in-depth understanding of conversation design, including onboarding, flows, utterances, entities, and personality.
- Design, build, test, and iterate a fully-functional, interactive chatbot using a commercial platform.
- Deploy the finished chatbot for public use and interaction.

UNIT I:

Introduction: Benefits from Chatbots for a Business, A Customer-Centric Approach in Financial Services, Chatbots in the Insurance Industry, Conversational Chatbot Landscape, Identifying the Sources of Data: Chatbot Conversations, Training Chatbots for Conversations, Personal Data in Chatbots, Introduction to the General Data Protection Regulation (GDPR)

UNIT II:

Chatbot Development Essentials: Customer Service-Centric Chatbots, Chatbot Development Approaches, Rules-Based Approach, AI-Based Approach, Conversational Flow, Key Terms in Chatbots, Utterance, Intent, Entity, Channel, Human Takeover, Use Case: 24x7 Insurance Agent

UNIT III:

Building a Chatbot Solution: Business Considerations, Chatbots Vs Apps, Growth of Messenger Applications, Direct Contact Vs Chat, Business Benefits of Chatbots, Success Metrics, Customer Satisfaction Index, Completion Rate, Bounce Rate, Managing Risks in Chatbots Service, Generic Solution Architecture for Private Chatbots

UNIT IV:

Natural Language Processing, Understanding, and Generation: Chatbot Architecture, Popular Open Source NLP and NLU Tools, Natural Language Processing, Natural Language Understanding, Natural Language Generation, Applications.

UNIT V:

Introduction to Microsoft Bot, RASA, and Google Dialog flow: Microsoft Bot Framework, Introduction to QnA Maker, Introduction to LUIS, Introduction to RASA, RASA Core, RASA NLU, Introduction to Dialog flow

Chatbot Integration Mechanism: Integration with Third-Party APIs, Connecting to an Enterprise Data Store, Integration Module

Text Books:

1. Abhishek Singh, KarthikRamasubramanian, ShreyShivam, “Building an Enterprise Chatbot: Work with Protected Enterprise Data Using Open Source Frameworks”, ISBN 978-1-4842-5034-1, Apress,2019

Reference Books:

1. Janarthanam and Srin, Hands-on chatbots and conversational UI development: Build chatbots and voice user interfaces with C (1 ed.), Packt Publishing Ltd, 2017. ISBN 978-1788294669.
2. Galitsky, Boris., Developing Enterprise Chatbots (1 ed.), Springer International Publishing, 2019. ISBN 978-303004298
3. Kelly III, John E. and Steve Hamm, Smart machines: IBM's Watson and the era of cognitive computing (1 ed.), Columbia University Press, 2013. ISBN 978-0231168564.
4. Abhishek Singh, KarthikRamasubramanian and ShreyShivam, Building an Enterprise Chatbot (1ed.), Springer, 2019. ISBN 978-1484250334

IV Year I Semester	Cyber Security	L	T	P	C
		3	0	0	3
(Professional Elective-V)					

Course Outcomes:

- Understand classification of cyber crimes.
- Understand the impact of cyber attacks
- Analyse tools and methods used in cyber crime
- Understand organizational implications of cyber security

UNIT I: Introduction of Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes: E- Mail Spoofing, Spamming, Internet Time Theft, Salami Attack/Salami Technique, Data Diddling, Forgery, Web Jacking, New group Spam, Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses, Software Piracy.

UNIT II: Computer Sabotage, E-Mail bombing, computer network intrusions, password sniffing, credit card frauds, identity theft. minimizing attack, Attacks on Wireless Networks. Cyber offenses: Criminals Plan: Categories of Cybercrime Cyber Attacks: Reconnaissance, Passive Attack, Active Attacks, Scanning/Scrutinizing gathered Information, Attack.

UNIT III: Social Engineering: Classification of Social Engineering , Cybers talking: Types of Stalkers, Working of Stalking, Real-Life Incident of Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Botnet, Attack Vector, Attacks on mobile/cell phones – Theft, viruses, mishing, vishing, smishing, hacking Bluetooth.

UNIT IV: Tools and Methods: Introduction, Proxy Servers and Anonymizers, how phishing works, password cracking, key loggers and spywares, types of viruses, steganography, DoS and DDoS attacks – classification, types, tools used for launch, DDoS attacks, protection, SQL injection – steps and prevention, Buffer Overflow – types.

UNIT V: Cyber security: Organizational Implications –Introduction –Insider threats, Privacy, Key challenges to organizations, Cost of Cybercrimes and IPR issues, Incident Handling: Definitions, Why Organizations need Incident Response systems, Examples of incidents, what organizations can do to protect, best practices for organizations.

Text Books:

1. Nina Godbole, Sunit Belapur, “Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, 2nd edition, Wiley India Publications, April, 2015

Reference Books:

1. James Graham, R Howard, R Olson, "Cyber Security Essentials" CRC Press, 2018
2. Michael E Whitman, Herbert J Mattord, "Principles of Information Security", 4th Edition, Cengage Learning, 2012
3. William Stallings, “Cryptography and Network Security- Principles and Practice”, 7th Edition, Pearson Education, 2017

IV Year I Semester	Cyber Security	L	T	P	C
		3	0	0	3
(Open Elective-III)					

Course Objectives:

- To develop, design and implement two and three dimensional graphical structures
- To enable students to acquire knowledge Multimedia compression and animations
- To learn Creation, Management and Transmission of Multimedia objects

Course Outcomes:

After learning the course, the student will be able:

- Illustrate the basics of computer graphics, different graphics systems and applications of computer graphics with various algorithms for line, circle and ellipse drawing objects for 2D transformations
- Apply projections and visible surface detection techniques for display of 3D scene on 2D screen
- Illustrate able to create the general software architecture of programs that use 3D object sets with computer graphics

UNIT I: Introduction to Graphics: Application areas of Computer Graphics, overview of graphics systems, video-display devices, graphics monitors and work stations and input devices. 2D Primitives: Output primitives-Line, Circle and Ellipse drawing algorithms, Attributes of output primitives, Two dimensional Geometric transformations, Two dimensional viewing Line, Polygon, Curve and Text clipping algorithms.

UNIT II: 3D Concepts: Parallel and Perspective projections, Three dimensional object representation-Polygons, Curved lines, Splines, Quadric Surfaces, Visualization of data sets, 3D transformations, Viewing, Visible surface identification.

UNIT III: Graphics Programming: Color Models- RGB, YIQ, CMY, HSV, Animations -General Computer Animation, Raster, Keyframe. Graphics programming using OpenGL-Basic graphics primitives, Drawing three dimensional objects, Drawing three dimensional scenes.

UNIT IV: Rendering: Introduction to shading models, Flat and Smooth shading, Adding texture to faces, Adding shadows of objects, Building a camera in a program, Creating shaded objects.

UNIT V:

Overview of Ray Tracing: Intersecting rays with other primitives, Adding Surface texture, Reflections and Transparency, Boolean operations on Objects.

Text Books:

- 1) Donald Hearn, Pauline Baker, Computer Graphics – C Version, second edition, Pearson Education, 2004.
- 2) Schaum's Outline of Computer Graphics Second Edition, Zhigang Xiang, Roy A. Plastock.

Reference Books:

- 1) James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics- Principles and practice, Second Edition in C, Pearson Education, 2007

IV Year I Semester	Software Testing Methodologies	L	T	P	C
		3	0	0	3
(Open Elective-III)					

Course Objectives:

- To study fundamental concepts in software testing and discuss various software testing issues and solutions in software unit, integration, regression and system testing
- To learn how to plan a test project, design test cases and data, conduct testing, manage software problems and defects, generate a test report
- To expose the advanced software testing concepts such as object-oriented software testing methods, web-based and component-based software testing
- To understand software test automation problems and solutions
- To learn how to write software test documents and communicate with engineers in various forms

Course Outcomes:

By the end of the course, the student should have the ability to:

- Identify and understand various software testing problems, apply software testing knowledge and engineering methods and solve these problems by designing and selecting software test models, criteria, strategies, and methods
- Design and conduct a software test process for a software project
- Analyze the needs of software test automation
- Use various communication methods and skills to communicate with their teammates to conduct their practice-oriented software testing projects
- Basic understanding and knowledge of contemporary issues in software testing, such as component-based, web based and object oriented software testing problems
- Write test cases for given software to test it before delivery to the customer and write test scripts for both desktop and web based applications
-

UNIT I: Software Testing: Introduction, Evolution, Myths & Facts, Goals, Psychology, definition, Model for testing, Effective Vs Exhaustive Software Testing.

Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle, Software Testing Methodology.

Verification and Validation: Verification & Validation Activities, Verification, Verification of Requirements, High level and low level designs, verifying code, Validation.

UNIT II: Dynamic Testing-Black Box testing techniques: Boundary Value Analysis, Equivalence class Testing, State Table based testing, Decision table based testing, Cause-Effect Graphing based testing, Error guessing. White-Box Testing: need, Logic Coverage criteria, Basis Path testing, Graph matrices, Loop testing, data flow testing, mutation testing.

UNIT III: Static Testing: Inspections, Structured Walkthroughs, Technical Reviews.

Validation activities: Unit testing, Integration Testing, Function testing, system testing, acceptance testing.

Regression testing: Progressive Vs regressive testing, Regression test ability, Objectives of regression testing, Regression testing types, Regression testing techniques.

UNIT IV: Efficient Test Suite Management: growing nature of test suite, Minimizing the test suite and its benefits, test suite prioritization, Types of test case prioritization, prioritization techniques, measuring the effectiveness of a prioritized test suite Software Quality Management: Software Quality metrics, SQA models. Debugging: process, techniques, correcting bugs.

UNIT V: Automation and Testing Tools: need for automation, categorization of testing tools, selection of testing tools, Cost incurred, Guidelines for automated testing, overview of some commercial testing tools such as Win Runner, Load Runner, Jmeter and JUnit . Test Automation using Selenium tool. Testing Object Oriented Software: basics, Object oriented testing Testing Web based Systems: Challenges in testing for web based software, quality aspects, web engineering, testing of web based systems, Testing mobile systems.

Text Books:

- 1) Software Testing, Principles and Practices, Naresh Chauhan, Oxford
- 2) Software Testing, Yogesh Singh, CAMBRIDGE

Reference Books:

- 1) Foundations of Software testing, Aditya P Mathur, 2ed, Pearson
- 2) Software testing techniques – Baris Beizer, Dreamtech, second edition.
- 3) Software Testing, Principles, techniques and Tools, M G Limaye, TMH
- 4) Effective Methods for Software testing, Willian E Perry, 3ed, Wiley

IV Year I Semester	Expert System	L	T	P	C
		3	0	0	3
(Open Elective-III)					

Course Objectives:

- Understand the basic techniques of artificial intelligence.
- Understand the Non-monotonic reasoning and statistical reasoning.

Course Outcomes:

- Apply the basic techniques of artificial intelligence.
- Discuss the architecture of an expert system and its tools.
- Understand the importance of building an expert systems.
- Understand various problems with an expert systems.

UNIT –I: Introduction to AI programming languages, Blind search strategies, Breadth-first – Depth-first –Heuristic search techniques Hill Climbing – Best first – A Algorithms AO* algorithm – game tress, Min-max algorithms, game playing – Alpha-beta pruning.

UNIT-II: Knowledge representation issues predicate logic – logic programming Semantic nets- frames and inheritance, constraint propagation; Representing Knowledge using rules, Rules-based deduction systems.

UNIT-III: Introduction to Expert Systems, Architecture of expert systems, Representation and organization of knowledge, Basics characteristics, and types of problems handled by expert systems.

UNIT- IV: Expert System Tools: Techniques of knowledge representations in expert systems, knowledge engineering, system-building aids, support facilities, stages in the development of expert systems.

UNIT-V: Building an Expert System: Expert system development, Selection of the tool, Acquiring Knowledge, Building process. Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain experts,difficulties during development.

Text Books:

1. Elain Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw-Hill, New Delhi.
2. Waterman D.A., “A Guide to Expert Systems”, Addison Wesley Longman.

Reference Books:

1. Stuart Russel and other Peter Norvig, “Artificial Intelligence – A Modern Approach”, Prentice-Hall.
2. Patrick Henry Winston, “Artificial Intelligence”, Addison Wesley.
3. Patterson, Artificial Intelligence & Expert System, Prentice Hall India, 1999.
4. Hayes-Roth, Lenat, and Waterman: Building Expert Systems, Addison Wesley.
5. Weiss S.M. and Kulikowski C.A., “A Practical Guide to Designing Expert Systems”, Rowman & Allanheld, New Jersey.

IV Year I Semester	Mean Stack Technologies- Module II- Angular-js and Mongo-DB	L	T	P	C
		3	0	0	3
(Skill Oriented Course)					

Course Objectives:

From the course the student will learn

- Translate user requirements into the overall architecture and implementation of new systems and Manage Project and coordinate with the Client
- Writing optimized front end code HTML and JavaScript
- Monitor the performance of web applications & infrastructure and Troubleshooting web application with a fast and accurate a resolution
- Design and implementation of Robust and Scalable Front End Applications

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

- Enumerate the Basic Concepts of Web & Markup Languages
- Develop web Applications using Scripting Languages & Frameworks
- Make use of Express JS and Node JS frameworks
- Illustrate the uses of web services concepts like restful, react js
- Apply Deployment Techniques & Working with cloud platform

List of Exercises:

1.a	CourseName: AngularJS
	ModuleName: AngularApplicationSetup
	Observe the link http://localhost:4200/welcomeonwhichthemCartapplicationisrunning . Perform the below activities to understand the features of the application.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24049616594198490000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
1.b	CourseName: AngularJS
	ModuleName: Components and Modules
	Create a new component called hello and render Hello Angular on the page
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28217843279641040000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
1.c	CourseName: AngularJS
	ModuleName: Elements of Template
	Add an event to the hello component template and when it is clicked, it should change the courseName.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19226434057992030000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
1.d	CourseName: AngularJS
	ModuleName: Change Detection
	progressively building the PoolCarz application

	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2560981637120771000_shared?collectionId=lex_2085851554325460000_0_shared&collectionType=Course
2.a	CourseName: AngularJS
	ModuleName: StructuralDirectives-ngIf
	Create login form with username and password fields. If the user enters the correct credentials, it should render a "Welcome<<username>>" message otherwise it should render "Invalid Login!!! Please try again..." message
	https://infyspringboard.onwingspan.com/web/en/viewer/web-

	module/lex_auth_0127637402260439042595_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
2.b	CourseName: AngularJS
	ModuleName: ngFor
	Create a courses array and rendering it in the template using ngFor directive in a list format. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32795774277593590000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
2.c	CourseName: AngularJS
	ModuleName: ngSwitch
	Display the correct option based on the value passed to ngSwitch directive. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_23388127475984175000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
2.d	CourseName: AngularJS
	Module Name: CustomStructuralDirective
	Create a custom structural directive called 'repeat' which should repeat the element given a number of times. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24073319904331424000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
3.a	CourseName: AngularJS
	ModuleName: Attribute Directives- ngStyle
	Apply multiple CSS properties to a paragraph in a component using ngStyle. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24037156998765367000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
3.b	CourseName: AngularJS
	ModuleName: ngClass
	Apply multiple CSS classes to the text using ngClass directive. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3459610297074182000_shared?collectionId=lex_208585155432546000000_shared&collectionType=Course
3.c	CourseName: AngularJS
	ModuleName: CustomAttributeDirective
	Create an attribute directive called 'showMessage' which should display the given message in a paragraph when a user clicks on it and should change the text color to red. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14783742359773809000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
4.a	CourseName: AngularJS
	ModuleName: PropertyBinding
	Binding image with class property using property binding. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_8951964709153619000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course

4.b	CourseName: AngularJS
	ModuleName: Attribute Binding
	Bindingcolspanattributeofatableelementtothe class property.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7154252883180625000_shared?collectionId=lex_2085851554325460000_0_shared&collectionType=Course
4.c	CourseName: AngularJS
	ModuleName: StyleandEventBinding
	Bindinganelementusinginlinestyleanduseractionslikeenteringtextininputfields.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7417401021103822000_shared?collectionId=lex_2085851554325460000_0_shared&collectionType=Course
5.a	CourseName: AngularJS
	ModuleName: BuiltinPipes
	Displaytheproductcodeinlowercaseandproductnameinuppercaseusingbuilt-in pipes.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_11810543990912035000_shared?collectionId=lex_2085851554325460000_00_shared&collectionType=Course
5.b	CourseName: AngularJS
	ModuleName: PassingParameterstoPipes
	Applybuilt-inpipeswithparameterstodisplayproductdetails.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21187073707540988000_shared?collectionId=lex_2085851554325460000_00_shared&collectionType=Course
5.c	CourseName: AngularJS
	ModuleName: NestedComponentsBasics
	LoadCourseslistComponentintherootcomponentwhenauserclicksontheView courseslistbutton.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24231999287700136000_shared?collectionId=lex_2085851554325460000_00_shared&collectionType=Course
6.a	CourseName: AngularJS
	ModuleName: PassingdatafromContainerComponenttoChildComponent
	Create an AppComponent that displays a dropdown with a list of courses as values in it. Create another component called the CoursesList component and load it in AppComponentwhichshoulddisplaythecoursedetails.Whentheuserselectsa course fromthe
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15758356947336235000_shared?collectionId=lex_2085851554325460000_00_shared&collectionType=Course
6.b	CourseName: AngularJS
	ModuleName: PassingdatafromChildComponenttoContainerComponent
	Create an AppComponent that loads another component called the CoursesList component. Create another component called CoursesListComponent which should displaythecourseslistinatablealongwitharegister.buttonineachrow.Whena user clickson th
	https://infyspringboard.onwingspan.com/web/en/viewer/web-

	module/lex_2494980689916818400_shared?collectionId=lex_2085851554325460000_0_shared&collectionType=Course
6.c	CourseName: AngularJS
	ModuleName: ShadowDOM
	ApplyShadowDOMandNoneencapsulation modestocomponents. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10312243404892470000_shared?collectionId=lex_2085851554325460000_00_shared&collectionType=Course
6.d	CourseName: AngularJS
	ModuleName: ComponentLifeCycle
	Overridecomponentlife-cyclehooksandloggingthecorrespondingmessagesto understandtheflow. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10818939635948007000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
7.a	CourseName: AngularJS
	ModuleName: TemplateDrivenForms
	Createacourse registration formasatemplate-drivenform. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2810668513603024400_shared?collectionId=lex_2085851554325460000_0_shared&collectionType=Course
7.b	CourseName: AngularJS
	ModuleName: ModelDrivenFormsorReactiveForms
	Createanemployeeregistrationformasareactiveform. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33704702617536004000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
7.c	CourseName: AngularJS
	ModuleName: CustomValidatorsinReactive Forms
	Createacustomvalidatorforanemailfieldintheemployeeregistrationform(reactive form) https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33728128192769250000_shared?collectionId=lex_208585155432546000_00_shared&collectionType=Course
8.a	CourseName: AngularJS
	Module Name: CustomValidatorsinTemplateDrivenforms
	Createacustomvalidator forthemailfieldinthecourseregistrationform. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_27688491925133280000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
8.b	CourseName: AngularJS
	ModuleName: ServicesBasics
	Create a Book Component which fetches book details like id, name and displays them onthepageinalistformat.Storethebookdetailsinanarray andfetchthedatausing acustomservice. https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32584403823635940000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course

8.c	CourseName: AngularJS
	ModuleName: RxJSObservables
	CreateanduseanobservableinAngular.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6209609363905256000_shared?collectionId=lex_2085851554325460000_0_shared&collectionType=Course
9.a	CourseName: AngularJS
	ModuleName: ServerCommunicationusingHttpClient
	CreateanapplicationforServerCommunicationusing HttpClient
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637395317063682615_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
9.b	CourseName: AngularJS
	ModuleName: CommunicatingwithdifferentbackendservicesusingAngularHttpClient
	CreateacustomservicecalledProductServiceinwhichHttpclassis usedtofetchdata stored intheJSON files.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4266333361795059700_shared?collectionId=lex_20858515543254600000_s_hared&collectionType=Course
10.a	CourseName: AngularJS
	ModuleName: RoutingBasics, Router Links
	Createmultiplecomponentsandaddroutingtoprovidenavigationbetweenthem.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3782024852517635000_shared?collectionId=lex_20858515543254600000_s_hared&collectionType=Course
10.b	CourseName: AngularJS
	ModuleName: RouteGuards
	Consideringthesameexampleusedfor routing,addrouteguardtoBooksComponent. Only after logging in, the user should be able to access BooksComponent. If the user tries to give the URLofBookscomponent inanothertaborwindow,orifthe user tries
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30303325731876470000_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course
10.c	CourseName: AngularJS
	ModuleName: AsynchronousRouting
	Apply lazyloadingtoBookComponent.If lazy loadingisnotadded to the demo,it hasloadedin1.14s.Observetheloadtimeat thebottomofthebrowser console.Press F12inthebrowserand click theNetworktaband check theLoad time
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_98787398901182460000_shared?collectionId=lex_20858515543254600000_s_hared&collectionType=Course
10.d	CourseName: AngularJS
	ModuleName: Nested Routes
	ImplementChildRoutestoasubmodule.
	https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012768043900444672140_shared?collectionId=lex_20858515543254600000_shared&collectionType=Course

11. a	CourseName: MongoDBEssentials-ACompleteMongoDB Guide
	ModuleName: InstallingMongoDBontheLocalComputer,CreateMongoDBAtlas Cluster
	InstallMongoDBandconfigureATLAS
	https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821437313024030083_shared?collectionId=lex_auth_013177169294712832113_shared&collectionType=Course
11. b	CourseName: MongoDBEssentials-ACompleteMongoDB Guide
	ModuleName: IntroductiontotheCRUDOperations
	WriteMongoDBqueries to perform CRUD operations on documents using insert(), find(), update(), remove()
	https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821874166169630118_shared?collectionId=lex_auth_013177169294712832113_shared&collectionType=Course
12. a	CourseName: MongoDBEssentials-ACompleteMongoDB Guide
	ModuleName: CreateandDeleteDatabasesandCollections
	WriteMongoDBqueries to create and drop databases and collections.
	https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821654119219230121_shared?collectionId=lex_auth_013177169294712832113_shared&collectionType=Course
12. b	CourseName: MongoDBEssentials-ACompleteMongoDB Guide
	ModuleName: IntroductiontoMongoDBQueries
	WriteMongoDBqueries to work with records using find(), limit(), sort(), createIndex(), aggregate().
	https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_0132890816264519682505_shared?collectionId=lex_auth_013177169294712832113_shared&collectionType=Course

TextBooks:

1. Programming the World Wide Web, 7th Edition, Robert W. Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, Elad Elrom, Apress O'Reilly.
3. Full Stack JavaScript Development with MEAN, Colin J. Ihrig, Adam Bretz, 1st edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.
4. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly

WebLinks:

1. https://infyspringboard.onwingspan.com/en/app/toc/lex_2085851554325460000_shared/overview (Angular JS)
2. https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview (MongoDB)

IV Year I Semester	Embedded systems	L	T	P	C
		3	0	0	3
(Open Elective-IV)					

Course Outcomes:

1. Apply design methodologies for embedded systems
2. Implement embedded systems design with specifications and technological choice.
3. Build fundamental systems such as sensors, actuators, converters, processors, intra- and inter-communication networks and interfaces.
4. Use modern hardware/software tools for building prototypes of embedded systems.

Unit-1

Introduction to Embedded Systems: Embedded systems vs general computing systems, history of embedded systems, classification of embedded systems, major application of embedded systems, purpose of embedded systems, elements of an embedded systems, core of the embedded systems, memory.

Unit-2

Communication Buses in Embedded Systems: On board communication interfaces: I2C, SPI bus, 1 Wire bus, parallel interface, External Communication interfaces: RS-232, RS485, USB, IEEE 1394 firewire bus, IrDA, Bluetooth, Wi-Fi, Zigbee.

Unit-3

Software Development Tools: Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In-circuit emulator, target hardware debugging, need for hardware-software partitioning and co-design, Overview of UML, scope of UML modeling, conceptual model of UML, architectural, UML basic elements-diagram- Modeling techniques - structural, behavioral, activity diagrams

Unit-4

Introduction to Real-Time Operating Systems: A brief history of operating systems, defining an RTOS, the scheduler, introduction to task, task states and scheduling, round-robin scheduling algorithm, co-operative scheduling algorithm, pre-emptive scheduling algorithm, introduction to semaphores.

Unit-5

Embedded System Application Development: Objectives, different phases & modeling of the embedded product development life cycle (edlc), case studies on smart card- adaptive cruise control in a car -mobile phone software for key inputs.

Text Books:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', 3e, TMH, 2017.
2. Shibu.K.V, "Introduction to Embedded Systems", Tata McGraw Hill, 2017

References:

1. Peckol, "Embedded system Design", John Wiley & Sons, 2010
2. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson, 2013
3. Embedded/Real-Time Systems, Dr. K.V.K.K. Prasad, dream Tech press

e- Resources & other digital material

1. Microsoft PowerPoint - pcp_embedded_system_intro (iitb.ac.in)
2. NPTEL :: Electrical Engineering - Embedded Systems

IV Year I Semester	Optimization Techniques	L	T	P	C
		3	0	0	3
(Open Elective-IV)					

Course Outcomes:

1. State and formulate the optimization problem without and with constraints, also apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints and arrive at an optimal solution.
2. Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
3. Formulate a mathematical model and apply non-linear programming techniques for constrained case studies.
4. Solve transportation and assignment problem by using Linear programming Simplex method.
5. Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

Unit – 1

Introduction to Optimization Techniques Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Classical Optimization Techniques Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn –Tucker conditions.

Unit – 2

Linear Programming Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm - Duality in Linear Programming – Dual Simplex method.

Unit – 3

Nonlinear Programming Unconstrained cases - One – dimensional minimization methods: Classification - Fibonacci method and Quadratic interpolation method – Uni variate method - Powell’s method and steepest descent method. Constrained cases - Characteristics of a constrained problem - Classification - Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods.

Unit – 4

Transportation Problem Finding initial basic feasible solution by north – west corner rule - least cost method and Vogel’s approximation method – testing for optimality of balanced transportation problems – Special cases in transportation problem.

Unit - 5

Dynamic Programming Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

Text Books:

1. “Engineering optimization: Theory and practice”-by S. S.Rao- New Age International (P) Limited- 3rd edition - 1998.
2. “Introductory Operations Research” by H.S. Kasene& K.D. Kumar - Springer (India) 2013.

Reference Books:

1. “Optimization Methods in Operations Research and systems Analysis” – by K.V. Mital and C. Mohan - New Age International (P) Limited - Publishers - 3rd edition - 1996.
2. Operations Research – by Dr. S.D.Sharma- Kedarnath - Ramnath& Co - 2012.
3. “Operations Research: An Introduction” – by H.A.Taha - PHI pvt. Ltd. - 6th edition
4. Linear Programming–by G.Hadley.

IV Year I Semester	Human Computer Interaction	L	T	P	C
		3	0	0	3
(Open Elective-IV)					

Course Outcomes:

1. Understand the concepts of Screen design and Graphical User Interface
2. Understand human interaction characteristics in the design process.
3. Discover and Use screen elements for presenting information simply and effectively.
4. Analyze device based, screen based controls and components of a window.
5. Create user interface design using various software tools.

Unit-1

Introduction: Importance of user interface, definition, importance of good design, A brief history of Screen Design Graphical User Interface: Popularity of graphics, the concept of direct manipulation, graphical system, characteristics.

Unit-2

Web user Interface: popularity, characteristics- principles of user interface. Design Process: Human interaction with computers, importance of human characteristics, human considerations, human interaction speeds.

Unit-3

Screen designing: Interface design goals, screen meaning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, visually pleasing composition, amount of information, focus and emphasis, presenting information simply and meaningfully, technological considerations in interface design.

Unit-4

Windows: Characteristics, components, operations. Selection of device based and screen based controls. Components: Icons and images, Multimedia, choosing proper colors.

Unit-5

Software Tools: Specification methods, interface, Building tools Interaction devices: Keyboard and function keys, pointing devices, speech recognition, digitization and generation, image and video displays, drivers.

Text Books:

- 1 .Wilbert O Galitz, The Essential Guide to User Interface Design. 2nd edition, Wiley Dreama Tech
- 2 .Ben Shneidermann, Designing the User Interface. 3rd edition, Pearson Education Asia.

Reference Books:

- 1.Alan Dix, Janet Fincay, Gre Goryd, Abowd and Russell Bealg, Human Computer Interaction,2nd edition

Pearson Education.

2. Prece, Rogers, Sharps Interaction Design. Wiley Dreamatech Soren Lauesen, User Interface Design, 2nd edition Pearson Education.

E-Resources And Other Digital Material:

1. Interaction Design Specialization By Prof. Scott Klemmer from University of California, San Diego in www.coursera.org. URL:<https://www.coursera.org/course/hciucsd>, <https://class.coursera.org/hci/lecture>
Accessed on 12/19/2015 Course Schedule (coursera): Self paced learning
2. Human Computer Interaction by Prof. Alan Dix, University of Birmingham , Scotland URL : <http://hcicourse.com/> Accessed on 12/19/2015 Course Schedule (hcicourse): 4 Weeks