SCHEME AND SYLLABUS FOR

FOUR YEAR UNDER GRADUATE DEGREE COURSE

B. TECH

Computer Science and Engineering (Artificial Intelligence and Machine Learning)

[W.E.F. 2022 - 2023 ADMITTED BATCH]

DEPARTMENT OF COMPUTER SCIENCE & SYSTEMS ENGINEERING

ANDHRA UNIVERSITY COLLEGE OF ENGINEERING (A)

ANDHRA UNIVERSITY

VISAKHAPATNAM-530 003

ANDHRA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND SYSTEMS ENGINEERING

SCHEME AND SYLLABI

(With effect from 2022-23 admitted batch)

B. TECH Computer Science and Engineering (Artificial Intelligence and Machine Learning)

(Common with CSE and IT)

I Year – I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI1101	BS	Engineering Mathematics –I	4	0	30	70	100	3
AI1102	BS	Green Chemistry	4	0	30	70	100	3
AI1103	HSS	English	4	0	30	70	100	3
AI1104	ES	Computer Programming Using C	4	0	30	70	100	3
AI1105	ES	IT Essentials	4	0	30	70	100	3
AI1106	HSS	Communication skills Lab	0	3	50	50	100	1.5
AI1107	ES	Computer Engineering Workshop Lab	0	3	50	50	100	1.5
AI1108	ES	Computer Programming using C lab	0	3	50	50	100	1.5
Total Credits								**19.5**

I Year-II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI1201	BS	Engineering Mathematics–II	4	0	30	70	100	3
AI1202	BS	Engineering Physics	4	0	30	70	100	3
AI1203	ES	Elements of Electronics Engineering	4	0	30	70	100	3
AI1204	ES	Data Structures Using C	4	0	30	70	100	3
AI1205	ES	Digital Logic Design	4	0	30	70	100	3
AI1206	ES	Linux Administration Lab	0	3	50	50	100	1.5
AI1207	BS	Engineering Physics Lab	0	3	50	50	100	1.5
AI1208	ES	Data Structures Lab	0	3	50	50	100	1.5
Total Credits								**19.5**

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II Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI2101	ES	Discrete Mathematical Structures	4	0	30	70	100	3
AI2102	PC	Computer Organization and Architecture	4	0	30	70	100	3
AI2103	BS	Probability, Statistics and Queuing theory	4	0	30	70	100	3
AI2104	PC	Operating Systems	4	0	30	70	100	3
AI2105	PC	Object Oriented Programming Through Java	4	0	30	70	100	3
AI2106	PC	Computer Organization & Architecture Lab	0	3	30	70	100	1.5
AI2107	PC	Object Oriented Programming Through Java Lab	0	3	50	50	100	1.5
AI2108	PC	Operating Systems Lab	0	3	50	50	100	1.5
AI2109	SC	Intellectual Property Rights (Internal)	1	2	100	0	100	2
AI2110	MC	Environmental Science	0	0	-	100	100	0
Total credits								**21.5**

II Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI2201	ES	Microprocessors	4	0	30	70	100	3
AI2202	PC	Design and Analysis of Algorithms	4	0	30	70	100	3
AI2203	PC	Database Management Systems	4	0	30	70	100	3
AI2204	PC	Formal Languages & Automata Theory	4	0	30	70	100	3
AI2205	HSS	Managerial Economics	4	0	30	70	100	3
AI2206	PC	Algorithms Lab through C++	0	3	50	50	100	1.5
AI2207	PC	Database Management Systems Lab	0	3	50	50	100	1.5
AI2208	SC	Web Technologies	1	2	50	50	100	2
AI2209	MC	Professional Ethics & Universal Human Values	0	0	0	100	100	0
AI2210	MC	NCC/NSS	0	2	-	-	-	0
Total credits								**20**
Internship-I								

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III Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI3101	PC	Data Warehousing and Data Mining	4	0	30	70	100	3
AI3102	PC	Artificial Intelligence	4	0	30	70	100	3
AI3103	PC	Machine Learning Techniques	4	0	30	70	100	3
AI3104	PE	Professional Elective-I	4	0	30	70	100	3
AI3105	OE	Open Elective-I	4	0	30	70	100	3
AI3106	PC	Data Warehousing and Data Mining Lab	0	3	50	50	100	1.5
AI3107	PC	Machine Learning Techniques Lab	0	3	50	50	100	1.5
AI3108	SC	Skill Development Course-I: (Continuous Integration and Continuous Delivery using DevOps)	1	3	50	50	100	2
AI3109	INT	Internship-I	0	0	50	50	100	2
Summer Internship 2 Months (Mandatory) after 2nd year (to be evaluated during III year I Semester								
Total credits								**22**

III Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI3201	PC	Computer Networks	4	0	30	70	100	3
AI3202	PC	Deep Learning Techniques	4	0	30	70	100	3
AI3203	PC	Big Data and Hadoop	4	0	30	70	100	3
AI3204	PE	Professional Elective-II	4	0	30	70	100	3
AI3205	OE	Open Elective-II	1	3	30	70	100	3
AI3206	PC	Computer Networks Lab						1.5
AI3207	PC	Deep Learning Techniques Lab	0	3	50	50	100	1.5
AI3208	PC	Big Data and Hadoop Lab	0	3	50	50	100	1.5
AI3209	SC	Skill Development Course-II: MEAN Stack Technologies	1	3	50	50	100	2
Total credits								**21.5**
Internship-II								

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B. TECH Computer Science and Engineering (Artificial Intelligence and Machine Learning)

IV Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI4101	PE	Professional Elective-III	4	0	30	70	100	3
AI4102	PE	Professional Elective-IV	4	0	30	70	100	3
AI4103	PE	Professional Elective-V	4	0	30	70	100	3
AI4104	OE	Open Elective-III	4	0	30	70	100	3
AI4105	OE	Open Elective-IV	4	0	30	70	100	3
AI4106	HSSE	HSSE Elective	4	0	30	70	100	3
AI4107	SC	Natural Language Processing Lab	1	3	50	50	100	2
AI4108	INT	Internship-II	0	0	50	50	100	2
Summer Internship 2 Months (Mandatory) after 3rd year (to be evaluated during IV year I Semester)								
Total Credits								**22**

IV Year - II Semester

Course code	Category	Course Title	Internal Marks	External Marks	Total Marks	Credits
AI4201	PROJ	Project Work	100	100	200	14
Internship (6 months)						
Total Credits						**14**

Professional Electives:

1. Software Engineering
2. Reinforcement Learning
3. Modern Cryptography & Network Security
4. Security and Privacy in Cloud
5. Compiler Design
6. Augmented Reality/Virtual Reality
7. Object-Oriented Analysis and Design
8. Image and Video Analytics
9. Digital and Mobile Forensics
10. Game Development
11. Soft Computing
12. Software Project Management
13. Ethical Hacking

14. Quantum Computing
15. Computer Vision
16. Cloud Computing
17. Natural Language Processing

Open Electives:

1. Python for Data Science
2. Renewable Energy Sources
3. Data Communications
4. Blockchain Technologies
5. Internet of Things
6. Introduction to Psychology
7. Industry 4.0
8. Geographic Information System
9. Business Analytics
10. Electric and Hybrid Vehicles
11. NoSQL Databases
12. Data Science
13. Python Programming
14. Mobile Computing
15. AI Chatbots

HSS Electives:

1. Human Resource Management
2. Operations Research
3. Industrial Management and Entrepreneurship
4. Financial Management for Engineers

Guidelines for Obtaining MINOR in Computer Science and Engineering (Artificial Intelligence and Machine Learning):

Students belonging to other departments have to complete the following courses to obtain MINOR degree in Computer Science and Engineering (Artificial Intelligence and Machine Learning):

1. A student belonging to other department have to study CPNM and Python Programming as Compulsory courses and any two of the following 4 open electives as follows:
   OE I: Python for Data Science
   OE II: NoSQL Databases
   OE III: Business Analytics
   OE IV: AI Chatbots

   OR

   One or two MOOCS courses from NPTEL related to Computer Science and Engineering (Artificial Intelligence and Machine Learning) without repetition from subjects within the curriculum can be used in Lieu of any of the aboveOpen electives.

2. The duration of NPTEL courses should **NOT** be less than 12 weeks.
3. The MOOCS course(s) chosen by students of other departments for obtaining a MINOR in CSE

(AI&ML) should be taken prior permission/ approval from the Chairperson – BoS of the departmentof **CS & SE, AUCE(A)**.

Guidelines for Obtaining HONORS in Computer Science and Engineering (Artificial Intelligence and Machine Learning):

The student shall earn additional 15 credits beyond 160 credits from the same branch/department/ discipline registered for major degree.

(i) The students having 7.0 CGPA without any backlog subjects will be permittedto register for HONORS.

(ii) If a student is detained due to lack of attendance either in Major or in Honors,registration shall be cancelled.

(iii) Honors is to be completed simultaneously with B. Tech program.

To obtain Honors in CSE (AI&ML) the following subjects are to be taken for obtaining Honors:

1. Generative AI Models
2. High Performance Computing
3. Social Network Analysis
4. Speech Processing
5. Data Visualization
6. MOOCs for 3 credits of 12 weeks duration related to any one of the above courses. MOOCs may be treated as optional to obtain Honors degree in CSE (AI&ML). If a student completes MOOCs with good grade, then it may be considered as betterment for any of the above five Courses (1 to 5)

The above five courses and MOOCs may be completed or pursued during 3rd and 4th years of his/her study of B.Tech, B.Tech + M.Tech program

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AI1106	HSS	Communication skills Lab	0	3	50	50	100	1.5
AI1107	ES	Computer Engineering Workshop Lab	0	3	50	50	100	1.5
AI1108	ES	Computer Programming using C lab	0	3	50	50	100	1.5
Total Credits								**19.5**

AI1101 ENGINEERING MATHEMATICS-I

Course Objectives

- To transmit the knowledge of Partial differentiation.
- To know of getting maxima and minima of function of two variables and finding errorsand approximations.
- To evaluate double and triple integrals, volumes of solids and area of curved surfaces.
- To expand a periodical function as Fourier series and half-range Fourier series

Course Outcomes

- Find the partial derivatives of functions of two or more variables.
- Evaluate maxima and minima, errors and approximations.
- Evaluate double and triple integrals, volumes of solids and area of curved surfaces.
- To expand a periodical function as Fourier series and half-range Fourier series.
- Have a fundamental understanding of Fourier series and be able to givenFourier expansions of a given function.

SYLLABUS

Partial Differentiation: Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins.Mean value Theorems (without proofs)

Applications of Partial Differentiation: Geometrical interpretation -Tangent plane and Normal to a surface -Taylor's theorem for functions of two variables - Errors and approximations -Total differential. Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rule.

Multiple Integrals: Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

Multiple Integrals-Applications: Area enclosed by plane curves - Volumes of solids - Areaof a curved surface - Calculation of Mass - Centre of gravity - Moment of inertia - product of inertia – principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

Fourier Series: Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis

Text Book

1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

Reference Books

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K.International publishinghouse Pvt. Ltd.
2. Advanced Engineering Mathematics by Erwin Kreyszig.
3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company
5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company. 6.
6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

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AI1102 GREEN CHEMISTRY

Course Objectives:

- To apply the basic knowledge of Chemistry to the Engineering Discipline.
- To develop knowledge about water and its treatment for industrial and potablepurposes.
- To develop understanding in the areas of Batteries, Fuels Mechanism of Corrosion ofMetals and Corrosion Control Methods, Green Chemistry and Technology and Processes involving Green Chemistry and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

Learning outcome:

- The students are able to apply the basic concepts and principles studied in Chemistry to the field of Engineering.
- The students are able to apply chemistry to different branches of engineering
- The students are able to acquire the knowledge in the areas of Water Chemistry, Mechanism of Corrosion of Metals and Corrosion Control Methods, Batteries, Fuel Cells, Green Chemistry and Technology and Processes involving Green Chemistry and suggest innovative solutions for existing challenges in these areas.

SYLLABUS

Water Technology

Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime- Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Batteries

Primary batteries: The chemistry - Types: Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells – liquid cathode, solid cathode and lithium- ferrous sulphide cells. Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells. Advanced Batteries for electric vehicles, requirements of the battery – sodium-beta and redox batteries.

Fuel Cells

Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells- Membranes and Fuels

Corrosion

Corrosion: Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting,Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion. Corrosion Controlling Methods, Protective Coatings, Metallic Coatings, Electroplating and Electroless Plating.

Green Chemistry and Technology

Introduction and significance of green chemistry, Goals of green chemistry, 12 principles of green chemistry, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, functional group approaches to green chemistry, Elimination of toxic functional group, optimization of frameworks for the design of greener synthetic pathways, Applications of green chemistry - Green solvents, green fuels and propellants, biocatalysis.

Text Books

1. Engineering Chemistry – PC Jain and M. Jain – Dhanpath Rai and Sons, New Delhi.
2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & Co. New Delhi.
3. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.

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AI1103 ENGLISH

Course Objectives

- To make students understand the explicit and implicit meanings of a text/topic;
- To give exposure to new words and phrases, and aid to use them in different contexts;
- To apply relevant writing formats to draft essays, letters, emails and presentations; and
- To adapt oneself to a given situation and develop a functional approach to findingsolutions: adaptability and problem solving.

Course Outcomes

- Students will be able to analyse a given text and discover the various aspects related tolanguage and literature;
- Learn the various language structures, parts of speech and figures of speech;
- Develop one's reading and writing abilities for enhanced communication; and
- Learn to apply the topics in real-life situations for creative and critical use.

SYLLABUS

On the conduct of life: William Hazlitt

Life skills: Values and EthicsIf: Rudyard Kipling The Brook: Alfred Tennyson

Life skills: Self-Improvement How I Became a Public Speaker: George Bernard ShawThe Death Trap: Saki

Life skills: Time ManagementOn saving Time: Seneca Chindu Yellama

Life skills: InnovationMuhammad Yunus Politics and the English Language: George Orwell

Life skills: Motivation Dancer with a White Parasol: Ranjana Dave

Grammar: Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers–Clichés, Redundancies.

Vocabulary: Introduction to Word Formation – Root Words from other Languages –Prefixes and Suffixes–Synonyms, Antonyms– Common Abbreviations

Writing: Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary Writing: Essay Writing**Life skills:** Innovation Muhammad Yunus

Textbook

1. Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India.2018.

References

1. Practical English Usage, Michael Swan. OUP. 1995.
2. Remedial English Grammar, F.T. Wood. Macmillan.2007
3. On Writing Well, William Zinsser. Harper Resource Book. 2001
4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills, Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
6. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

AI1104 COMPUTER PROGRAMMING USING C

Course Objectives

- The course is designed to provide complete knowledge of C language.
- To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
- To provide knowledge to the students to develop logics which will help them to create programs, applications in C.
- This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.
- This course provides the fundamental knowledge which is useful in understanding the other programming languages.

Course Outcomes

- Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and apply them in problem solving.
- Apply various operations on derived data types like arrays and strings in problem solving.
- Design and implement of modular Programming and memory management using Functions, pointers.
- Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.
- Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

Introduction to C: Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

Decision Making, Branching, Looping: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else.. if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops.

Arrays & Strings: One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

Functions: Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

Pointers: Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications.

Structure and Unions: Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within

structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

File handling: Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications.

Text Books

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India)Private Limited.

Reference Books

1. Let Us C ,Yashwant Kanetkar, BPB Publications, 5th Edition.
2. Computer Science, A structured programming approach using C", B.A.Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.
3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.
4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M.Barone (Author), EnzoMarinari (Author), Giovanni Organtini, World Scientific.

AI1105 IT ESSENTIALS

Course Objectives

- Select the appropriate computer components to build, repair, or upgrade personalcomputers.
- Explain how to correctly use tools and safely work in a lab.
- Install components to build, repair, or upgrade personal computers.
- Configure computers to communicate on a network
- Configure devices to connect to the Internet and Cloud services
- Explain how to use, configure, and manage laptops and mobile devices

Course Outcomes

- Understands the roles and responsibilities of the IT professional
- Able to Troubleshoot advanced hardware and software problems
- Provides an experience-oriented course that employs industry-relevant instructionalapproaches to prepare students for entry-level jobs in the industry.

Syllabus

Introduction to the Personal Computer Describe a Computer System, Identify the Names, Purposes, and Characteristics of Cases and Power Supplies, Identify the Names, Purposes, and Characteristics of Internal Components, Identify the Names, Purposes, and Characteristics of Ports and Cables, Identify the Names, Purposes, and Characteristics of Input Devices, Identify the Names, Purposes, and Characteristics of Output Devices, Explain System Resources and Their Purposes.

Safe Lab Procedures and Tool Use Explain the Purpose of Safe Working Conditions and Procedures, Identify Tools and Software Used with Personal Computer Components and Their Purposes, Implement Proper Tool Use.

Computer Assembly Attach the Components to the Motherboard and Install the Motherboard, Install Internal Drives, Install Drives in External Bays, Install Adapter Cards, Connect the Power Cables Reattach the Side Panels to the Case, Boot the Computer for the First Time. **Basics of Preventive Maintenance and Troubleshooting** Explain the Purpose of Preventive Maintenance, Identify the Steps of the Troubleshooting Process.

Fundamental Laptops and Portable Devices Identify Common Preventive Maintenance Techniques for Laptops and Portable Devices, Describe How to Troubleshoot Laptops and Portable Devices.

Fundamental Operating Systems Explain the Purpose of an Operating System, Describe and Compare Operating Systems to Include Purpose, Limitations, and Compatibilities, Determine Operating System Based on Customer Needs, Install an Operating System, Identify and Apply Common Preventive Maintenance Techniques for Operating Systems, Troubleshoot Operating Systems.

Fundamental Networks Explain the Principles of Networking, Describe Types of Networks, Describe Basic Networking Concepts and Technologies, Describe the Physical Components ofa Network, Describe LAN Topologies and Architectures.

Fundamental Security: Explain Why Security Is Important, Describe Security Threats, Identify Security Procedures, Identify Common Preventive Maintenance Techniques for Security, Troubleshoot Security.

Text books:

1. IT Essentials: PC Hardware and Software Companion Guide Fourth Edition, CiscoNetworking Academy.

References:

1. Network security essentials application and standrads, by William stallings, 4th edition,prentice hall.
2. Mike Meyers' CompTIA A+ Guide to Managing and Troubleshooting PCs, SixthEdition 6th Edition

AIS1106 COMMUNICATION SKILLS LAB

Course Objectives

- To make students recognize the sounds of English through Audio-Visual aids;
- To help students build their confidence and help them to overcome their inhibitions andself-consciousness while speaking in English;
- To familiarize the students with stress and intonation and enable them to speak Englisheffectively; and
- To give learners exposure to and practice in speaking in both formal and informalcontexts.

Course Outcomes

- Students will be sensitized towards recognition of English sound patterns and thefluency in their speech will be enhanced;
- A study of the communicative items in the laboratory will help students becomesuccessful in the competitive world;
- Students will be able to participate in group activities like roleplays, group discussionsand debates; and
- Students will be able to express themselves fluently and accurately in social as wellprofessional context.

SYLLABUS

Introduction to Phonetics: The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

Listening Skills: Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

Speaking Skills: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

Reading and Writing skills: Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

Presentation skills: Verbal and non-verbal communication - Body Language - Making aPresentation

Reference Books

1. Ashraf Rizvi. Effective Technical Communication. Tata McGraw Hill Education Private Limited, New Delhi.
2. Speak Well. Orient Blackswan Publishers, Hyderabad.
3. Allan Pease. Body Language. Manjul Publishing House, New Delhi.

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AI1107 COMPUTER ENGINEERING WORKSHOP LAB

Course Objectives

- Explain the internal parts of a computer, peripherals, I/O ports, connecting cables
- Demonstrate basic command line interface commands on LINUX
- Teach the usage of Internet for productivity and self-paced lifelong learning
- Describe about Compression, Multimedia and Antivirus tools
- Demonstrate Office Tools such as Word processors, Spreadsheets and Presentationtools

Course Outcomes

- Assemble and disassemble components of a PC
- Construct a fully functional virtual machine, Summarize various LINUX operatingsystem commands.
- Able to Troubleshoot hardware and software problems.

Syllabus

Module I – Hardware Concepts

1. Every student should identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor. Every student should disassemble and assemble the PC back to working condition.

Module II – Software Installations

1. Every student should individually install operating system like LINUX or MS windows on the personal computer. The system should be configured as dual boot with both windows and LINUX.

2. Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fixit to get the computer back to working condition.

3. Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition.

4. Cyber Hygiene: Students should learn about viruses on the internet and install antivirus software. Student should learn to customize the browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

5. Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and popup blockers.

Module III – MS-Office

1. MS Word - Features to be covered: Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colours, Inserting Header and Footer, Using Date.

2. Creating project abstract Features to be covered: Formatting Styles, inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

3. Creating a Newsletter: Features to be covered: Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs in

word.

4. Spreadsheet Orientation: Accessing, overview of toolbars, saving spreadsheet files,Using help and resources. Creating a Scheduler: Gridlines, Format Cells, Summation, auto fill, Formatting Text.

5. Calculating GPA - Features to be covered: Cell Referencing, Formulae in spreadsheet – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, Sorting, Conditional formatting.

6. Creating Power Point: Student should work on basic power point utilities and tools in Latex and Ms Office/equivalent (FOSS) which help them create basic power point presentation. PPT Orientation, Slide Layouts, Inserting Text, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting Images, Tables and charts.

AI1108 Computer Programming Using C Lab

Course Objectives

- To impart writing skill of C programming to the students and solving problems.
- To write and execute programs in C to solve problems such as Modularize the problemsinto small modules and then convert them into programs.,
- To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.
- This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

Course Outcomes

- Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.
- Analysing the complexity of problems, Modularize the problems into small modules and then convert them into programs.
- Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.
- Apply and practice logical ability to solve the real-world problems.
- Apply Numerical methods to Solve the complex Engineering problems.

Syllabus

Practice the following concepts with algorithm, flow chart and implementation.

1. C – Tokens, Data Types - Format Specifiers, I/O Statements.
2. Operators in C, their Precedence and Associativity, ArithmeticExpressions/Instructions, Type casting, Math.h functions.
3. Control Statements (Conditional): If and its Variants, Switch (Break).
4. Goto Statement, Control Statements (Looping): While, Do-While, For Loop, Continue& Break (Unconditional), Nested Loops
5. Arrays, One Dimensional Array: Declaration and Initialization, Accessing Array Elements.
6. Two Dimensional Array: Declaration and Initialization, Accessing Array Elements.
7. Strings: Read & Write, “String.h” Predefined Functions, without predefined functions. Pointers: Declarations, Types, Pointers to Arrays, Pointers to Character Strings, Pointers to Pointers, Array of Pointers
8. Structures: Nested Structures, Pointers to Structures, Unions.
9. Functions: Function Declaration, Classification (Arguments and Return Type), StorageClasses.
10. Parameter Passing Techniques, Passing Parameters Types, Recursion
11. Files: Opening, Closing of Files, Reading and Writing of Files.
12. Binary Files, Random Accessing of Files, Enum, Typedef, Pre-processor Commands.
13. Numerical methods: Bisection method, Newton Raphson method, Lagrange’s interpolation, Simpson’s rule for numerical integration.

References:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India)Private Limited.
2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

ANDHRA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND SYSTEM ENGINEERING

SCHEME AND SYLLABI

(With effect from 2022-23 admitted batch)

B. TECH Computer Science and Engineering (Artificial Intelligence and Machine Learning)

(Common with CSE and IT)

I Year – II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI1201	BS	Engineering Mathematics–II	4	0	30	70	100	3
AI1202	BS	Engineering Physics	4	0	30	70	100	3
AI1203	ES	Elements of Electronics Engineering	4	0	30	70	100	3
AI1204	ES	Data Structures Using C	4	0	30	70	100	3
AI1205	ES	Digital Logic Design	4	0	30	70	100	3
AI1206	ES	LINUX Administration Lab	0	3	50	50	100	1.5
AI1207	BS	Engineering Physics Lab	0	3	50	50	100	1.5
AI1208	ES	Data Structures Lab	0	3	50	50	100	1.5
							Total Credits	**19.5**

AI1201 ENGINEERING MATHEMATICS – II

Course Objectives

- The way of obtaining rank, eigen values and eigen vectors of a matrix.
- To know the importance of Cayley-Hamilton theorem and getting canonical form froma given quadratic form.
- To solve the system of equations by using direct and indirect methods.
- To solve first order and higher order differential equations by various methods.
- To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

Course Outcomes

- Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.
- Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.
- Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling
- Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.
- Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

SYLLABUS

Linear Algebra: Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

Eigen Values and Eigen Vectors: Eigen Values and Eigen Vectors of a Matrix - Cayley- Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

Ordinary Differential Equations of First Order and its Applications: Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

Differential Equations of Higher Order: Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

Laplace Transforms: Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by tn - Division by t – Evaluation of integrals by Laplace Transforms

- Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients - Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

Text Book

1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd edition, Khanna publishers.

Reference Books

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishinghouse Pvt. Ltd.
2. Advanced Engineering Mathematics by Erwin Kreyszig.
3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.
4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

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AI1202 ENGINERING PHYSICS

Course Objectives

- To impart knowledge in basic concept of physics of Thermodynamics relevant toengineering applications.
- To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonics and their applications in engineering.
- To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.
- To Learn basics of lasers and optical fibres and their use in some applications.
- To Understand concepts and principles in quantum mechanics and Nanophase Materials. Relate them to some applications.

Course Outcomes

- Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.
- Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications.
- Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due toa single slit
- Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fibre. Realize their role in optical fibre communication.
- Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one-Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

SYLLABUS

Thermodynamics: Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

Electromagnetism: Concept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

Ultrasonics: Introduction, Production of Ultrasonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonics.

Optics-Interference: Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.
Diffraction: Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer

diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitativetreatment).

Polarisation: Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

Lasers And Fibre Optics: Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers Introduction to optical fibres, principle of propagation of light in optical fibres, Acceptance Angle and cone of a fibre, Numerical aperture, Modes of propagations, classification of fibres, Fibre optics in communications, Application of optical fibres.

Modern Physics-

Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi-conductors and insulators.

Nanophase Materials: Introduction, properties, Top-down and bottom-up approaches,Synthesis - Ball milling, Chemical vapour deposition method, sol-gel methods, Applications of nano materials.

Text Books

1. Physics by David Halliday and Robert Resnick – Part I and Part II - Wiley.
2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S.Chand
3. Engineering Physics by R.K. Gaurand S.L. Gupta–Dhanpat Rai

Reference Books

1. Modern Engineering Physics by A.S. Vadudeva
2. University Physics by Young and Freedman

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AI1203 ELEMENTS OF ELECTRONICS ENGINEERING

Course Objectives

- Introduce students to basics of semiconductors, their classification and properties
- To provide theory of PN junction diode, its characteristics and applications
- To introduce basics of rectifying circuits and bipolar junction transistor
- To provide basics of transistor biasing, transistor amplifiers and field effect transistors

Course Outcomes

- By the end of the course, the student should be able to:
- Explain the basics of semiconductors and their classification
- Understand the theory of PN junction diode, rectifying circuits and bipolar junctiontransistor
- Explain the concepts of transistor biasing, transistor amplifiers and field effect transistors

SYLLABUS

Introduction to Electronics and Semiconductors: Energy band theory, Conduction in Insulators, Semiconductors and metals, Electron emission from metals, Classification of semiconductors, Carrier concentration in an intrinsic semiconductor, Properties of intrinsic semiconductor, Drift and diffusion currents.

Semi-Conductor Diode: Theory of PN junction diode, Open circuited PN junction, V-I characteristics of a PN diode, Diode current equation, Transition and diffusion capacitances, Break down in PN diode, Applications of PN diodes. Zener diode, Zener regulator, Tunnel diode, Schottky diode.

Rectifying circuits: Half wave and full wave rectifiers, Bridge rectifiers, Efficiency, Ripple and regulation of each rectifier, Capacitor filters.

Bipolar Junction Transistor: Introduction, construction, Operation of PNP and NPN Transistors – Transistor Circuit configurations- Characteristics of a CE configurations – h parameters, low frequency small signal equivalent circuit of a Transistor.

Transistor Biasing and thermal stabilization: Transistor Biasing, Stabilization, Different methods of transistor biasing – Fixed bias, Collector feedback bias – self bias – Bias compensation.

Transistor Amplifiers: CE, CB, CC amplifier configurations –Multistage amplifier – A Two Stage RC coupled amplifier – frequency response curve and bandwidth.

Field Effect Transistors: Junction Field Effect Transistors (JFET) – JFET characteristics, JFET Parameters, Small signal equivalent circuit – MOSFETS – Depletion and Enhancement MOSFETS.

Text Books:

1. Electronic Device and Circuits by Sanjeev Guptha.

Reference Books:

1. Electronic Device and Circuits Theory by Robert L. Boylested Electronic Device andCircuits by David. A. Bell

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AI1204 DATA STRUCTURES USING C

Course objectives

- Assess how the choice of data structures and algorithm design methods impacts theperformance of programs.
- Choose the appropriate data structure and algorithm design method for a specifiedapplication.
- Solve problems using data structures such as linear lists, stacks, queues, binary trees, heaps binary search trees, and graphs and writing programs for these solutions.

Course outcomes

- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs arerepresented in memory and used by algorithm.
- Demonstrate different methods for traversing trees.
- Compare alternative implementations of data structures with respect to performance.
- Discuss the computational efficiency of the principal algorithms for sorting andsearching

SYLLABUS

Introduction to Data Structures: Review of C Programming, Recursive Definition and Processes, Recursion in C, Simulation of Recursion, Efficiency of Recursion, Abstract Data Types, Meaning and Definition of Data Structures, Arrays.

Stacks: Stack as an Abstract Data Type, Primitive Operations, Implementing Stack Operations using Arrays, Infix, Postfix and Prefix: Definitions, Evaluation and Conversions.

Queues: Queue as an Abstract Data Type, Sequential Representation, Types of Queues, Operations, Implementation using Arrays.

Linked List: Operations, Implementation of Stacks, Queues and priority Queues using Linked Lists+, Circular Lists: Insertion, Deletion and Concatenation Operations, Stacks and Queuesas Circular Lists, Doubly Linked Lists.

Trees: Binary Trees - Definitions and Operations, Binary Tree Representation: Node Representation, Implicit array Representation, Binary Tree Traversal, Threaded Binary Trees and their Traversal, Trees and their Applications; Tree Searching: Insertion and Deletion of a node from a Binary Search Tree, Efficiency of Binary Search Tree operations.

Searching: Basic Searching Techniques: Dictionary as an Abstract Data Type, Algorithmic Notation, Sequential Searching and its Efficiency, Binary Search, Interpolation Search.

Sorting: General Background: Efficiency, Asymptotic Notations, Efficiency of Sorting, Bubble Sort and Quick Sort and their Efficiency, Selection Sorting, Binary Tree Sort, HeapSort, Insertion Sorts, Shell Sort, Address calculation Sort, Merge and Radix Sorts.

Graphs and Their Application: Definition of Graphs, Representation of Graphs, Transitive closure, Linked Representation of Graphs, Topological Ordering of nodes, Graph Traversal and Spanning Forests, Undirected Graphs and their Traversals, Applications of Graphs, Minimal Spanning Trees.

Textbooks

1. Data Structures Using C and C++ Yddish Langsam, Moshe J. Augenstein and Aaron M.Tanenbaum, Prentice Hall Of India (2nd Edition)
2. Data Structures, Algorithms and Applications with C++, Sahani Mc-Graw Hill.

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AI1205 DIGITAL LOGIC DESIGN

Course objectives

- To introduce the basic principles for design of combinational circuit and sequential circuits.
- To learn simple digital circuits in preparation for computer engineering.

Course Outcomes

A student who successfully fulfils 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 Boolean 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.
- An ability to define the following combinational circuits: multiplexer, de-multiplexers encoders/decoders, comparators, arithmetic-logic units; and to be able to build simple circuits.
- An ability to understand asynchronous and synchronous sequential circuits, like counters and shift registers.
- An ability to understand memories like RAM and ROM, Programmable Logic Array and Programmable Array Logic.

SYLLABUS

Binary Systems: Digital Systems. Binary Numbers. Number Base Conversions. Octal and Hexadecimal Numbers. Complements. Signed Binary Numbers. Binary Codes. Binary Storage and Registers. Binary Logic

Boolean Algebra and Logic Gates: Basic Definitions. Axiomatic Definition of Boolean Algebra. Basic Theorems and Properties of Boolean Algebra. Boolean Functions. Canonical and Standard Forms. Other Logic Operations. Digital Logic Gates. Integrated Circuits.

Combinational Logic Design, Gate-Level Minimization: The Map Method. Four Variable Map. Five-Variable Map. Product of Sums Simplification. Don't-Care Conditions. NAND and NOR Implementation. Other Two- Level Implementations. Exclusive-OR Function. Hardware Description Language (HDL).

Combinational Logic: Combinational Circuits. Analysis Procedure. Design Procedure. Binary Adder Subtractor. Decimal Adder. Binary Multiplier. Magnitude Comparator. Decoders. Encoders. Multiplexers. HDL For Combinational Circuits.

Sequential Logic Design, Synchronous Sequential Logic: Sequential Circuits. Latches Flipflops. Analysis of Clocked Sequential Circuits. HDL For Sequential Circuits. State Reduction and Assignment. Design Procedure.

Registers ad Counters: Registers. Shift Registers. Ripple Counters. Synchronous Counters. Other Counters. HDL for Registers and Counters.

Memory and Programmable Logic: Introduction. Random-Access Memory. Memory Decoding, Error Detection and Correction. Read-Only Memory. Programmable Logic Array. Programmable Array Logic. Sequential Programmable Devices.

Text Book

1. DigitalDesign,3rdEdition, M. Morris Mano, Pearson Education.

Reference Books

1. Digital Logic Design Principles, Norman Balabanian & Bradley Carlson, John Wiley&Sons (Asia) Pvt.Ltd.,2002
2. Fundamentals of Digital Logic with VHDL Design, Stephen Brown and ZvonkoVranesic, TataMcGraw-HillEdition,2002.

AI1206 LINUX ADMINISTRATION LAB

Course Objectives

- To understand LINUX operating system and its internals.
- To understand LINUX file system structure and its operations.
- To understand LINUX shell environment and its programming.
- To understand communication in LINUX and the corresponding primitives.

Course Outcomes

- The student learns about LINUX features for multiuser, multitasking capabilities.
- The student learns about file system organization, file and directory manipulation, setting file permissions, and disk free space administration.
- The student learns about writing shell scripts for different applications.
- The student learns about how users communicate with each other in LINUX environment.

SYLLABUS

1) Study and practice on file system / handling files with commands, syntax, usage,application.
2) Practice on vi editor.
3) Study and practice on redirection operators with relevant commands, syntax, usage, application.
4) Study and practice on filters with relevant commands, syntax, usage, application.
5) Study and practice on Backup with relevant commands, syntax, usage, application.
6) Study and practice on internet related commands, syntax, usage, application.
7) Study and practice on shells/shell programming with relevant programming constructs, syntax, usage, application.
8) Study and practice on awk with relevant commands, syntax, usage, application.
9) Study and practice on regular expressions and the grep family with relevant commands,syntax, usage, application.
10) Study and practice on compilation process of C programs under UNIX.

References:

1. Unix concepts and applications by Sumitabha Das, TMH Publications.
2. Shell programming by Yashwanth Kanetkar.

AI1207 ENGINNERING PHYSICS LAB

Course Objectives

- To enable the students to acquire skill, technique and utilization of the Instruments
- Draw the relevance between the theoretical knowledge and to imply it in a practicalmanner with respect to analyse various electronic circuits and its components.
- To impart the practical knowledge in basic concepts of Wave optics, Lasers and fibreoptics.
- To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge, spectrometers, travelling microscope, laser device, optical fibre, etc.

Course Outcomes

- Ability to design and conduct experiments as well as to analyse and interpret
- Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics
- The student will learn to draw the relevance between theoretical knowledge and themeans to imply it in a practical manner by performing various relative experiments.

SYLLABUS

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton'sRings.
2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.
3. Study the Intensity Variation of the Magnetic Field along axis of Current CarryingCircular Coil.
4. Determination of Cauchy's Constants of a Given Material of the Prism usingSpectrometer.
5. Determination of Refractive Index of Ordinary ray □o and Extraordinary □e ray.
6. Determination of Thickness Given Paper Strip by Wedge Method.
7. Calibration of Low Range Voltmeter.
8. Calibration of Low Range Ammeter.
9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.
10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.
11. Carey Foster's Bridge – Verification of laws of Resistance and Determination of Specific Resistance.
12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.
13. Photoelectric cell-Characteristics.
14. Planks Constants.
15. Laser- Diffraction.

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AI1208 DATA STRUCTURES LAB

Course Objectives

- To implement stacks and queues using arrays and linked lists.
- To develop programs for searching and sorting algorithms.
- To write programs using concepts of various trees.
- To implement programs using graphs.

Course Outcomes

- Student will be able to write programs to implement stacks and queues.
- Ability to implement various searching and sorting techniques.
- Ability to implement programs using trees and graphs.

SYLLABUS

List of Programs:

1. Write a C program for sorting a list using Bubble sort and then apply binary search.
2. Write a C program for implementing the operations of a queue.
3. Write a C program to implement the operations on priority queues.
4. Write a C to implement the operations on circular queues.
5. Write a C program to implement the operations on stacks.
6. Write a C program for evaluating a given postfix expression using stack.
7. Write a C program for converting a given infix expression to postfix form using stack.
8. Write a C program to implement the operations on single linked list.
9. Write a C program for demonstrate operations on double linked list.
10. Write a C program for the representation of polynomials using circular linked listand for the addition of two such polynomials
11. Write a C program to create a binary search tree and for implementing the in order, Pre order, post order traversal using recursion
12. a) Write a C program for finding the transitive closure of a digraph
    b) Write a C program for finding the shortest path from a given source to any vertexin a digraph using Dijkstra's algorithm.
13. a) Write a C program for finding the Depth First Search of a graph.
    b) Write a C program for finding the Breadth First Search of a graph

References:

1. Data Structures Using C and C++ Yddish Langsam,Moshe J. Augenstein and Aaron M.Tanenbaum, Prentice Hall Of India (2nd Edition)
2. Data Structures, Algorithms and Applications with C++, Sahani Mc-Graw Hill.

ANDHRA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND SYSTEM ENGINEERING

SCHEME AND SYLLABI

(With effect from 2022-23 admitted batch)

B. TECH Computer Science and Engineering (Artificial Intelligence and Machine Learning)

(Common with CSE and IT)

II Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI2101	ES	Discrete Mathematical Structures	4	0	30	70	100	3
AI2102	PC	Computer Organization and Architecture	4	0	30	70	100	3
AI2103	BS	Probability, Statistics and Queuing theory	4	0	30	70	100	3
AI2104	PC	Operating Systems	4	0	30	70	100	3
AI2105	PC	Object Oriented Programming Through Java	4	0	30	70	100	3
AI2106	PC	Computer Organization & Architecture Lab	0	3	30	70	100	1.5
AI2107	PC	Object Oriented Programming Through Java Lab	0	3	50	50	100	1.5
AI2108	PC	Operating Systems Lab	0	3	50	50	100	1.5
AI2109	SC	Intellectual Property Rights (Internal)	1	2	100	0	100	2
AI2110	MC	Environmental Science	0	0	-	100	100	0
Total credits								**21.5**

AI2101 DISCRETE MATHEMATICAL STRUCTURES

Course Objectives

- To understand mathematical arguments using logical connectives and quantifiers and verify the validity of logical flow of arguments using propositional, predicate logic and truth tables.
- To understand about permutations and combinations.
- To understand various types of relations and discuss various properties of the relations.
- To study the graphs, graph isomorphism and spanning trees.
- To study about Boolean algebra and Finite State Machines.

Course Outcomes

At the end of the course student will be able to

- Rewrite mathematical arguments using logical connectives and quantifiers and verify the validity of logical flow of arguments using propositional, predicate logic.
- Identify and give examples of various types of relations and describe various properties of the relations.
- Ability to solve problems using permutations and combinations.
- Determine isomorphism of graphs and spanning tree of a given graph using BFS/DFS algorithms. Also determine minimal spanning tree of a given graph.

SYLLABUS

The Foundations-Logic and Proofs: Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers Rules of Inference, Introduction to Proofs, Proof Methods and Strategy, Basic Structures-Sets, Functions, Sequences and Sums: Sets, Set Operations, Functions, Sequences and Summations.

The Fundamentals-Algorithms, the Integers and Matrices: Algorithms, The Growth of Functions, Complexity of Algorithms, The Integers and Division, Primes and Greatest Common Devisors, Integers and Algorithms, Applications of Number Theory, Matrices.

Induction and Recursion: Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms, Program Correctness.
Counting: The Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients, Generalized Permutations and Combinations, Generating Permutations and Combinations.

Advanced Counting Techniques: Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recursion Relations, Generating Functions, Inclusion-Exclusion, and Applications of Inclusion-Exclusion.
Relations: Relations and their properties, n-ary relations, applications, Representation, closure, equivalence relations, Partial orderings.

Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Colouring.

Trees: Introduction to Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees,

Boolean Algebra: Boolean Functions, Representing Boolean Functions, Logic Gates,Minimization of Circuits

Modelling Computation: Languages and Grammars, Finite-State Machines with Output, Finite-State Machines with No Output, Language Recognition, Turing Machines.

Text Book

1. Discrete Mathematics & Its Applications with Combinatorics and Graph Theory byKenneth H Rosen, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Reference Books

1. Discrete Mathematics for Computer Scientists & Mathematicians by Joe L. Mott,Abraham Kandel, Theodore P. Baker, Prentice-Hall, India.
2. Discrete Mathematics by Richard Johnson Baug, Pearson Education, New Delhi.
3. Discrete and Combinatorial Mathematics by Ralph. G. Grimaldi, Pearson Education,New Delhi.

AI2102 COMPUTER ORGANIZATION AND ARCHITECTURE

Course Objectives

- To study about structure and functional components of a computer.
- Understanding the hierarchical organization of a computer system which consists of instruction set of commands.
- Learn about the architecture of a computer from a programming view.
- To design a balance system that minimizes performance and utilization of all elements.

Course Outcomes

By the end of the course, the student should be able to:

- Demonstrate knowledge about major components of a computer such as processor, memory and I/O modules along with their interconnections internally with outsideworld.
- have detailed idea about architecture of central processing unit, functions of control unit, memory, I/O devices and their issues.
- Understand simple and multiple processor organization and their issues.

SYLLABUS

Register Transfer and Micro operations: 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 Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-ReferenceInstructions, Input- Output and Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic.

Micro programmed Control: Control Memory, Address Sequencing, Micro program Example, Design of Control Unit.

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC), Architecture and Programming of 8085 Microprocessor

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISK Pipeline, Vector Processing, Array Processors.

Input/output Organization: Peripheral Devices, I/O interface, Asynchronous data transfer, Modes of transfer, priority Interrupt, Direct memory access, Input-Output Processor (IOP), Serial Communication.

Memory Organization: Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Hardware.

Text Books

1. Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd., ThirdEdition, Sept.2008.
2. Computer Architecture and Organization, P.Chakraborty.
3. Microprocessor Architecture, Programming and Applications with the 8085by RameshS Gaonkar

Reference Books

1. Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd., EasternEconomy Edition, Sixth Edition, 2003.
2. Computer Organization and Architecture, Linda Null, Julia Lobur, Narosa PublicationsISBN81- 7319-609-5
3. Computer System Architecture", John. P.Hayes.

AI2103 PROBABILITY, STATISTICS AND QUEUING THEORY

Course objectives

- To provide foundations of probabilistic and statistical analysis
- To provide an understanding on concepts of probability, random variables, probability distributions, sampling, estimation, hypothesis testing, regression, correlation, multiple regression, hypothesis testing, sample test, queuing methods
- To explore applications of probabilistic and statistical tools to solve real world problems.

Course outcomes

After completion of the course the student should be able to:

- Define and explain basic concepts in probability theory and how to translate real-world problems into probability models
- Solve standard problems that include random variables, discrete and continuous probability distributions
- Perform Test of Hypothesis and construct a confidence interval to estimate population parameters
- Compute and interpret the results of Correlation Analysis, Multivariate Regression, Chi-Square test for Independence and Goodness of Fit
- Explain basic concepts in Markov processes, M/M/1 and M/M/C queueing systems.

SYLLABUS

Probability: Definitions of probability, Addition theorem, Conditional probability, Multiplication theorem, Bayes Theorem of Probability and Geometric Probability.

Random variables and their properties: Discrete Random Variable, Continuous Random Variable, Probability Distribution, Joint Probability Distributions their Properties, Transformation Variables, Mathematical Expectations, Probability Generating Functions.

Probability Distributions: Discrete Distributions: Binomial, Poisson Negative Binominal Distributions and Their Properties; **Continuous Distributions:** Uniform, Normal, Exponential Distributions And Their Properties.

Multivariate Analysis: Correlation, Correlation Coefficient, Rank Correlation, Regression Analysis, Multiple Regression, Attributes, Coefficient Of Association, Chi Square Test For Goodness Of Fit, Test For Independence.

Estimation: Sample, Populations, Statistic, Parameter, Sampling Distribution, Standard Error, Un-biasedness, Efficiency, Maximum Likelihood Estimator, Notion & Interval Estimation.

Testing of Hypothesis: Formulation of Null hypothesis, critic al region, level of significance, power of the test;

Sample Tests: Small Sample Tests: Testing equality of means, testing equality of variances, test of correlation coefficient, test for Regression Coefficient; Large Sample tests: Tests based on normal distribution

Queuing Theory: Queue description, characteristics of a queuing model, study state solutions of M/M/1: Model, M/M/1; N Model, M/M/C: Model, M/M/C: N Model, Case studies.

Text Books

1. Probability & Statistics for Engineers and Scientists, Walpole, Myers, Myers, Ye. Pearson Education.
2. Probability, Statistics and Random Processes T.Veerarajan Tata McGraw – Hill

Reference Book

1. Probability & Statistics with Reliability, Queuing and Computer Applications, Kishor S. Trivedi, Prentice Hall of India ,1999

AI2104 OPERATING SYSTEMS

Course objectives:

- To understand evolution of Operating System.
- To understand operating system as a layer of abstraction above physical hardware that facilitates usage convenience and efficient resource management of computer system resources.
- To learn design and implementation of policies and mechanisms for OS subsystem.
- To investigate case studies to understand the design philosophies / paradigm for popularmultiuser or single user operating system.

Course Outcomes:

- The student understands OS evolution, its structure and services provided by it.
- Learn process life cycle, process scheduling objectives, policies and mechanisms, process synchronization, inter process communication, deadlocks and other process subsystem related concepts.
- Learn memory hierarchy, allocation and deallocation policies and mechanism for main and auxiliary memory, file system design and implementation issues.
- investigate UNIX/ LINUX and Windows OS platforms w.r.t similarities and differences in design philosophies.

SYLLABUS

Introduction to Operating Systems: Over View of Operating Systems, Types of Operating Systems, Operating System Structures, Operating System Services, System Calls, Virtual Machines, Operating System Design and Implementation.

Process Management: Process Concepts, Operations on Processes, Cooperating Processes, Threads, Inter Process Communication, Process Scheduling, Scheduling Algorithms, Multiple- Processor Scheduling, Thread Scheduling.

Process Synchronization: The Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Critical Regions, Monitors.

Deadlocks: System Model, Deadlock Characterization, Methods For Handling Deadlocks, Deadlock Prevention, Avoidance, Deadlock Detection, Recovery from Deadlocks.

Memory Management: Logical versus Physical Address, Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, Virtual Memory, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped files.

File Systems, Implementation, and Secondary-storage Structure: Concept of a file, Access Methods, Directory Structure, Protection, File System Structure, Allocation Methods, Free Space Management, Directory Management, Device Drivers, overview of Mass-storage structure, Disk structure, disk attachment, disk scheduling, swap-space management.

Case study: Overview of LINUX, Windows Operating systems.

Text Book:

1. Operating Systems, Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, John Wiley Publ., Seventh Edition.
2. Operating Systems; A Practical Approach. Rajiv Chopra.

Reference Books:

1. Modern Operating Systems, Andrew S. Tanenbaum, ,2nd edition, 1995, PHI.
2. Operating Systems, William Stallings 5th Edition -PHI
3. Operating Systems: A Design-Oriented Approach', Charles Crowley, 'Tata Hill Co.,1998 edition.

AI2105 OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Course Objectives:

- This subject will help to improve the analytical skills of object-oriented programming
- Overall development of problem solving and critical analysis
- Formal introduction to Java programming language

Course Outcome:

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

- Show competence in the use of the Java programming language in the development of small to medium-sized application programs that demonstrate professionally acceptable coding and performance standard
- Understand the basic principles of the object-oriented programming
- Demonstrate an introductory understanding of graphical user interfaces, multi-threaded programming, and event-driven programming.

SYLLABUS

Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.

Objects and Classes: Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File, this reference

Inheritance and Polymorphism: Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.

Event and GUI programming: Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing

I/O programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files.

Multithreading in java: Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java, Introduction to JavaBeans and Network Programming.

Java Database Connectivity (JDBC): JDBC Product, Types of Drivers, Two-Tier Client/Server Model, Three-Tier Client/Server Model, Basic Steps of JDBC, Creating andExecuting SQL Statement, The Result Set Object, Working with Database MetaData Interface

Reference Books:

1 Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson.

2 Programming in Java, Sachin Malhotra & Saurabh Chaudhary, Oxford University Press.

3 Murach's Beginning Java 2, Doug Lowe, Joel Murach and Andrea Steelman, SPD.

4 Core Java Volume-I Fundamentals, Eight Edition, Horstmann & Cornell, Pearson Education.

5 The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, TMH.

6 Java Programming, D. S. Malik, Cengage Learning.

AI2106 COMPUTER ORGANIZATION & ARCHITECTURE LAB

Course Objectives

- to design and analyse the operational behaviour of IC gates, multiplexers, decoders,flip-flops, counters, shift registers, binary adders and subtractors and ALU.
- to implement assembly language programming using various trainers.
- to make students familiar with Pentium class PC architecture.

Course Outcomes

After completion of the course the student should be able to:

- analyse the operational behaviour of various digital logic units such as multiplexers, decoders, flip-flops, counters, shift registers, binary adders and subtractors and ALU.
- write assembly language code using various trainers.
- understand Pentium class PC architecture.

SYLLABUS

I - Cycle: Digital Logic Design
ExperimentsTTL Characteristics and TTL
IC Gates Multiplexers & Decoders
Flip-Flops
Counters
Shift Registers
Binary Adders &
SubtractorsA L U

II - CYCLE: 8085 Assembly Language Programming
8085 Assembly Language Programming according to theory course microprocessors-I usingthe following trainers:
Keyboard Monitor of 8085µP Trainer
Serial Monitor of 8085µP Trainer with Terminal
8085 Line Assembler of 8085µP Trainer with PC as Terminal
8085 Cross Assembler using In-Circuit Emulator (ICE) with 8085µP Trainer and PC asTerminal
Graded Problems are to be used according to the syllabus of computer organization
Pentiumclass pc architecture familiarization hardware & software parts demonstration

Reference Books

1. Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd., ThirdEdition, Sept.2008
2. Microprocessor Architecture, Programming and Applications with the 8085 by RameshS Gaonkar.

AI2107 OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB

Course Objectives:

- To develop programs using basic OOPS concepts such as classes and objects.
- To implement programs using Inheritance concepts.
- To implement programs using Exception handling.
- To develop programs using operator overloading concepts.

Course Outcomes:

- Student will be able to use OOPs concepts.
- Ability to apply Inheritance concepts to several problems.
- Ability to use Exception Handling concepts.

List of Programs:

1. Program to define a structure of a basic JAVA program
2. Program to define the data types, variable, operators, arrays and control structures.
3. Program to define class and constructors. Demonstrate constructors.
4. Program to define class, methods and objects. Demonstrate method overloading.
5. Program to define inheritance and show method overriding.
6. Program to demonstrate Packages.
7. Program to demonstrate Exception Handling.
8. Program to demonstrate Multithreading.
9. Program to demonstrate I/O operations.
10. Program to demonstrate Network Programming.
11. Program to demonstrate Applet structure and event handling.
12. Program to demonstrate Layout managers.

AI2108 OPERATING SYSTEMS LAB

Course Objectives:

- To learn about UNIX/LINUX operating system environment.
- To learn about system calls for UNIX/LINUX Operating System.
- To understand resource management policies and mechanisms and their performance evaluation.

Course Outcomes:

- The student learns about multiprogramming, and multitasking capabilities of UNIX/LINUX.
- The student develops skill in writing C programs using system calls for process management, inter process communication and other aspects.
- The student learns to simulate OS resource management aspects like process scheduling, page replacement, disk scheduling, free space management and others to evaluate performance.

Syllabus

Module I

1. OS lab familiarization, Home Assignment on Unix commands, Vi editor
2. Simple shell programming exercises
3. Shell programming using decision making constructs, loop constructs, file anddirectory manipulation
4. Simple C programs using command line arguments, system calls, library function calls,make utility
5. C programs using system call to create processes and study parent, child process mechanism
6. C programs to create process chaining, spawning
7. C programs to error handling using errno(), perror() function
8. C programs to use pipe system call for inter process communication

Module II

1. C programs to study process scheduling implementing FCFS, Shortest Job First, andRound Robin algorithms
2. C programs to study page replacement implementing FIFO, Optimal, and LRU pagereplacement algorithms
3. C programs to study deadlock avoidance and detection
4. C Programs to simulate free space management (first fit, best fit, worst fit).
5. C programs to study disk scheduling algorithms (i.e., SCAN, SSTF, LOOK, etc.,)

References:

1. Unix concepts and applications by Sumitabha Das, TMH Publications.
2. Unix programming by Stevens, Pearson Education.
3. Shell programming by Yashwanth Kanetkar.
4. Operating System Concepts by Silberschatz, and Peter Galvin.

AI2109 INTELLECTUAL PROPERTY RIGHTS

Course Objective:

- To introduce the students to Intellectual Property Rights (IPR) which is a key component in modern knowledge management processes
- To create consciousness on IPR in students at an early stage of their education so that they develop an appreciation for ethical and rightful use of existing knowledge
- To make them understand how to take ownership of knowledge they may develop as a result of their creative innovations, take ownership and either drive themselves inbecoming entrepreneurs or become responsible knowledge users in society
- To expose students some of the recent debates on the societal implications of IPR and its role in national/international trade and socio-economic development.

Course outcome:

Learners will be able to

- identify the types of intellectual property protection available for their research outcome
- conduct patent search and analyse patentability of the invention
- understand the basic structure of Patent document
- understand the registration and prosecution of different IPs
- understand the basics of IP commercialization and techno/commercial/legal issues in IPR commercialization

SYLLABUS

Introduction: Concept of property, Intellectual Property (IP) and Intellectual Property Rights (IPR), Importance of IP, Value creation through IP, Advantages of IP protection, Competitive advantage, Promotion of social good, Prevention of duplicates, counterfeit products and IP.

Evolution of IP system: Historical view of IP system in India and abroad, Legal basis and rationale behind development of IP system, WTO and TRIPS agreement, Role of WIPO.

Types of IPR: Major forms of IP in India and globally, Acts enacted in India related to IP.

Patent: Concept, Life of patent, Rights of Patentee, Criteria of patentability- novelty, non- obviousness, and utility, Non-patentable inventions.

Patent filing and prosecution: Prior art search, Process of obtaining a patent in India, Provisional and complete specification, Convention application, Patent Cooperation Treaty(PCT), Patent Infringement and Enforcement.

Trademark: Types of trademarks, Trademark and Brand, Trademark Registration, Trademark Infringement.

Copyright: Copyrights and related rights, Copyright registration, Copyright infringement, Section 52 of Indian Copyright Act.

Industrial Design: What is Industrial design, Design registration, Design infringement.

Trade Secret: What are Trade Secrets, How trade secrets are maintained in trade and business.

Other forms of IP: Semiconductor Integrated Circuits Layout Design, Geographical Indications, Protection of Plant Varieties & Farmers' right, Traditional knowledge.

IP commercialization: Licensing & Royalty; Technology Transfer; IP assignment, Compulsory License.

Emerging areas: Pat informatics, IP and bank loan, IP insurance, IP audit, IP valuation, IP management, Use of artificial intelligence in IP enforcement, Open innovation.

Text Books

1. Ganguli Prabuddha, Gearing up for Patents The Indian Scenario", Universities Press (1998)
2. Ganguli Prahuddha "Intellectual Property Rights-Unleashing the Knowledge Economy". Tata McGraw Hill (2001)
3. Geographical Indications of Goods Act 1990 Ganguli Piabaddha "Geographical Indications-its evolving contours accessible in http ips. nminsoda/files/2012/05/main book pdf (2009)

Reference Books

1. Ganguli Prabuddha and Jahade Siddharth, "Nanotechnology Intellectual Property Rights Research, Design, and Commercialisation", CRC Press, Taylor and Francis Group, USA (2012)
2. Beyond Intellectual Property: Toward Traditional Resource Rights for Indigenous Peoples and Local Communities [Paperback J,Darrell A. Posey and Graham Dotfield, IDRC Books; annotated edition (June (1996)
3. Netancl Neil Weinstock, Copyright's Paradox, Oxford University Press (2010)
4. The Indian Patents Act 1970 (as amended in 2005)
5. The Indian Copyright Act 1950 as amended in 2017)
6. Indian Trademarks Act 1999
7. The Indian Industrial Designs Act 2000
8. The Protection of Plant Varieties and Farmers' Right Act 2001
9. Inventing the Future: An Introduction to Patents for small and medium sized enterprises, WIPO publication No 917 www.wipo.int/ebookshop
10. Looking Good: An Introduction to Industrial Designs for Small and Medium sized Enterprises; WIPO publication No.498 www.wipo.int/ebookshop

AI2110 ENVIRONMENTAL SCIENCE

Course Objectives

The objectives of the Environmental Science course are to

- Familiarize the fundamental aspects of environment and the environmentalmanagement'
- Provide information of some of the important international conventions which will beuseful during the future endeavours after graduation.
- Make realize the importance of natural resources management for the sustenance of thelife and the society.
- Apprise the impact of pollution getting generated through the anthropogenic activitieson the environment
- Provide the concept of Sustainable Development, energy and environmentalmanagement
- Impart knowledge on the new generation waste like e-waste and plastic waste.

Course Outcomes

After completion of the course the students will have

- Knowledge on the fundamental aspects of environment and the environmentalmanagement
- The knowledge on the salient features of the important international conventions
- Understanding of the importance of natural resources management for the sustenanceof the life and the society.
- Familiarity on various forms of pollution and its impact on the environment.
- Understand the elements of Sustainable Development, energy and environmentalmanagement
- Knowledge on the new generation waste like e-waste and plastic waste.

SYLLABUS

Introduction: Structure and functions of Ecosystems-Ecosystems and its Dynamics-Value of Biodiversity-impact of loss of biodiversity, Conservation of bio-diversity. Environmental indicators - Global environmental issues and their impact on the ecosystems. Salient featuresof international conventions on Environment: Montreal Protocol, Kyoto protocol, Ramsar Convention on Wetlands, Stockholm Convention on Persistent Organic Pollutants, United Nations Framework Convention on Climate Change (UNFCCC),

Natural Resources Management: Importance of natural resources management-Land as resource, Land degradation, Soil erosion and desertification, Effects of usage of fertilizer, herbicides and pesticide-watershed management.

Forest resources: Use and over-exploitation, Mining and dams – their effects on forest ecosystems and the living beings.

Water resources: Exploitation of surface and groundwater, Floods, droughts, Dams: benefits and costs.

Mineral Resources: Impact of mining on the environment and possible environmental management options in mining and processing of the minerals. Sustainable resource management (land, water, and energy), and resilient design under thechanging environment.

Environmental Pollution: Local and Global Issues. Causes, effects and control measures. Engineering aspects of environmental pollution control systems.

Air pollution: impacts of ambient and indoor air pollution on human health. Water pollution: impacts water pollution on human health and loss of fresh water resources. Soil pollution andits impact on

environment. Marine pollution and its impact on blue economy. Noise pollution.

Solid waste management: Important elements in solid waste management- Waste to energy concepts. Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act and their amendments. Salient features of Environmental protection Act, 1986.

Sustainable Development: Fundamentals of Sustainable Development– Sustainability Strategies and Barriers – Industrialization and sustainable development. Circular economy concepts in waste (solid and fluid) management.

Energy and Environment: Environmental Benefits and challenges, Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Solar Energy: process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and applications, disposal of solar panel after their usage. Biomass energy:
Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in context of India.

Management of plastic waste and E-waste: Sources, generation and characteristics of various e- and plastic wastes generated from various industrial and commercial activities; Waste management practices including onsite handling, storage, collection and transfer. E-waste and plastic waste processing alternatives. E-Waste management rules and Plastic waste management rules, 2016 and their subsequent amendments.

Text Books:

1. Bharucha,Erach (2004). Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi.
2. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India
3. Masters, G. M., &Ela, W. P. (1991). Introduction to environmental engineering and science. Englewood Cliffs, NJ: Prentice Hall.
4. Enger, E. and Smith, B., Environmental Science: A Study of Interrelationships, Publisher: McGraw-Hill Higher Education; 12th edition, 2010.

Reference Books:

1. Sharma, P. D., & Sharma, P. D. (2005). Ecology and environment. Rastogi Publications
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Clark R.S. (2001). Marine Pollution, Clanderson Press Oxford (TB)
4. Jadhav, H & Bhosale, V.M. (1995). Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
5. MoEF&CC, Govt. of India, CPCB: E-waste management rules, 2016 and its amendments 2018.
6. MoEF&CC, Govt. of India, CPCB: Plastic waste management rules, 2016.

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ANDHRA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND SYSTEM ENGINEERING

SCHEME AND SYLLABI

(With effect from 2022-23 admitted batch)

B. TECH Computer Science and Engineering (Artificial Intelligence and Machine Learning)

(Common with CSE and IT)

II Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI2201	ES	Microprocessors	4	0	30	70	100	3
AI2202	PC	Design and Analysis of Algorithms	4	0	30	70	100	3
AI2203	PC	Database Management Systems	4	0	30	70	100	3
AI2204	PC	Formal Languages & Automata Theory	4	0	30	70	100	3
AI2205	HSS	Managerial Economics	4	0	30	70	100	3
AI2206	PC	Algorithms Lab through CPP.	0	3	50	50	100	1.5
AI2207	PC	Database Management Systems Lab	0	3	50	50	100	1.5
AI2208	SC	Web Technologies	1	2	50	50	100	2
AI2209	MC	Professional Ethics& Universal Human Values	0	0	0	100	100	0
AI2210	MC	NCC/NSS	0	2	-	-	-	0
Total credits								**20**
Internship-I								

AI2201 MICROPROCESSORS

Course Objectives:

- To discuss the architectures of 8085, 8086 microprocessors, their instruction sets and related ALP programs.
- To discuss interfacing semiconductor memories, interfacing peripheral to Intel 8086.
- To study interfacing data converters to 8086 and discuss about micro controller 8051 architecture.

Course Outcomes:

- Understand the basic architectures of 8085 and 8086 microprocessors.
- Ability to write ALP programs using instruction sets.
- Understand the various interfacing concepts and micro controllers.

SYLLABUS

Introduction to Microprocessors and Microcomputers: A Brief Architecture and Programming of 8085Microprocessor.

Architecture: Instruction Set and Programming of 8086Microprocessor

Interfacing Semiconductor Memories and I/O Devices: Semiconductor Memories: Classification Internal Organization& Functional Description, Interfacing SRAMs and EPROMs to8086, Interfacing Characteristics of I/Devices, I/O Device addressing methods, I/O Device Programming Methods.

Interfacing Peripherals to Intel8086 -1: Parallel I/O Interface- 8255, Serial I/O Interface – 8251, Timer Interface -8253/8254

Interfacing Peripheral to Intel 8086 - 2: Keyboard / Display Interface – 8279, Interrupt Controller Interface – 8259

Interfacing Data Converters to 8086: D/A Conversion Methods, A/D Conversion methods, Interfacing DAC, Interfacing ADC.

Introduction to Micro controllers: Intel 8051Architecture and Programming

Text Books:

1. Microprocessor Architecture, Programming, and Applications with the 8085 RameshS.Gaonkar, 4thEdition, PenramInternational,1999
2. The 80x86 Family, Design, Programming and Interfacing, John E.Uffenbeck,3rdEdition,Pearson Education Inc.,2002
3. KennethJ.Ayala, 8051 Microcontroller Architecture, Programming And Applications,2ndEdition, Penram International Publications,1999

Reference Books:

1. BARRYB.BREY, The Intel Microprocessors 8086 / 8088, 80186 / 80188, 80286, 80386 and 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium4, Architecture, Programming and Interfacing, 8th Edition, Pearson Education Inc.,2009
2. Walter A. Tribeland, Avtar Singh, The 8088 and 8086 Microprocessors, Programming, interfacing, Software, Hardware, and Applications, 4thEdition, Pearson Education Inc.,20033. Microprocessors and Interfacing, Programming and Hardware, 2ndEdition, Douglass V. Hall, TMH Edition,1999
3. Sanjay K Bose, Hardware and Software of Personal Computers, New AgeInternational (P)Ltd.,1991 Myke Predko, Programming and Customizing the 8051 Microcontroller, TMH,1999

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AI2202 DESIGN AND ANALYSIS OF ALGORITHMS

Course Objectives:

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

- Analyse the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations

Course Outcomes:

Students who complete the course will have demonstrated the ability to do the following:

- Argue the correctness of algorithms using inductive proofs and invariants.
- Analysis worst-case running times of algorithms using asymptotic analysis.
- Describe the divide-and-conquer paradigm and explain when an algorithmicdesign situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and conquer algorithms. Derive and solve recurrencesdescribing the performance of divide and-conquer algorithms.
- 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 analysis them.
- Describe the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize greedy algorithms, and analysis them.

SYLLABUS

Introduction: What is an Algorithm, Algorithm Specification, Pseudocode Conventions Recursive Algorithm, Performance Analysis, Space Complexity, Time Complexity, Amortized Complexity, Amortized Complexity, Asymptotic Notation, Practical Complexities, Performance Measurement.

Divide and Conquer: General Method, Defective Chessboard, Binary Search, Finding the Maximum and Minimum, Merge Sort, Quick Sort, Performance Measurement, Randomized Sorting Algorithms.

The Greedy Method: The General Method, Knapsack Problem, Job Sequencing with Deadlines, Minimum-cost Spanning Trees, Prim's Algorithm, Kruskal's Algorithms, An Optimal Randomized Algorithm, Optimal Merge Patterns, Single Source Shortest Paths.

Dynamic Programming: All - Pairs Shortest Paths, Multistage graphs, optimal binary search tree, String editing, 0/1 Knapsack, Reliability Design.

Backtracking: The General Method, The 8-Queens Problem, Sum of Subsets, Graph Colouring, Hamiltonian Cycles, Knapsack problem

Branch and Bound: Least cost (LC) Search, The 15-Puzzle, Control Abstraction for LC- Search, Bounding, FIFO Branch-and-Bound, LC Branch and Bound, 0/1 Knapsack Problem, LC Branch-and Bound Solution, FIFO Branch-and-Bound Solution, Traveling Salespersonproblem.

Limitations of Algorithm Power: Lower-Bound Arguments, Decision Trees, P, NP and NP – complete problems – Challenges of Numerical Algorithms. Limitations of Algorithms Power: Backtracking – Branch-and Bound– Approximation Algorithms for NP-hard Problems – Algorithms for solving Nonlinear Equations.

Text Books:

1. Fundamentals of computer algorithms E. Horowitz S. Sahni, Sanguthevar Rajasekaran, University Press.
2. Introduction to Algorithms by Thomas H. Corman, Charles E. Leiserson, Ronald R.Rivest & Clifford Stein, Prentice Hall of India, New Delhi, New Delhi.

Reference Books:

1. Data structures and algorithm analysis in C++ / Mark Allen Weiss, FloridaInternational University. — Fourth edition.
2. Introduction to Design & Analysis of Algorithms by Anany Levitin, PearsonEducation, New Delhi, 2003
3. Introduction to Algorithms by Thomas H. Corman, Charles E. Leiserson, Ronald R.Rivest & Clifford Stein, Prentice Hall of India, New Delhi, New Delhi.
4. The Design and Analysis of Computer Algorithms, Alfred V. Aho, John E.Hopcroft, Jeffrey D. Ullman

AI2203 DATABASE MANAGEMENT SYSTEMS

Course Objectives:

- To learn the evolution of DBMS Versus File systems, data models, and layers of abstraction.
- To understand conceptual and physical aspects of database design.
- To learn formal and commercial query language specifications.
- To understand concurrency control, recovery management, and other related issues.

Course Outcomes:

- The student will understand ER-modelling for conceptual database design and relational model.
- The student is introduced to formal and commercial query languages: RelationalAlgebra, calculus and SQL.
- The student will learn schema refinement and normalization.
- The student understands locking protocols concurrency control, and crash recoverymethods.

SYLLABUS

Introduction: File system versus a DBMS, Advantages of a DBMS, Describing and Storing Data in a DBMS, The Relational model, Levels of abstraction, Data Independence, Transaction management, Structure of a DBMS.

Introduction to Database Design and The Relational Model: Database Design and ER Diagrams, Entities, Attributes and Entity Sets, Relationships & Relationship Sets, Additional Features of the ER Model, Conceptual Design with ER Model, Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity Constraints, Querying Relational Data, Logical Database Design: ER to Relational, Introduction to Views,Destroying/ Altering Tables and Views.

Relational Algebra and SQL: Preliminaries, Relational Algebra, The form of a Basic SQL Query, UNION, INTERSECT and EXCEPT, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and Active Databases, Embedded SQL, Dynamic SQL, JDBC.

Database Design: Schema Refinement and Normal Forms, Introduction to Schema Refinement, Functional Dependencies, Reasoning about FD's, Normal Forms, Properties of Decomposition, Normalization, Other kinds of Dependencies.

Transaction Management: The ACID Properties, Transactions & Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control.

Concurrency Control: 2PL, Serializability and Recoverability, Introduction to Lock Management, Lock Conversions, Dealing with Deadlocks, Specialized Locking Techniques, Concurrency Control without Locking.

Crash Recovery: Introduction to ARIES, The Log, Other Recovery-Related Structures, The Write-Ahead Log Protocol, Check pointing, Recovering from a System Crash, Media Recovery.

Text Books:

1. Database Management Systems; Raghu Ramakrishnan, Johannes Gehrke 4th Edition,McGraw-Hill.

Reference:

1. Database System Concepts; A. Silberschatz, H. Korth 5th Edition, McGraw-Hill

AI2204 FORMAL LANGUAGES AND AUTOMATA THEORY

Course objectives:

- To introduce the concepts in automata theory and theory of computation to design grammars and recognizers for different formal languages.
- To employ finite state machines to solve problems in computing.
- To introduce finite state machines, context free grammars and Turing Machines and their properties as the basis for the formal expressivity of computer languages for solving linguistic decision problems.
- To understand the concepts of tractability and decidability, the concepts of NP- completeness and NP-hard problem and also the challenges for Theoretical Computer Science and its contribution to other sciences.

Course outcomes:

- Ability to think analytically and intuitively for problem-solving situations in related areas of theory in computer science
- Ability to describe the language accepted by an automata or generated by a regular expression or a context-free grammar;
- Ability to Understand the functioning of Finite-State Machines, Deterministic Finite- State Automata, Nondeterministic Finite-State Automata and Pushdown Automata and Turing Machines.

SYLLABUS

Introduction to Grammars and Languages: Definitions of alphabet, strings, language, grammar, types of grammar, types of machines, generation of languages from grammar, construction of grammar from the given description of languages, Chomsky Hierarchy oflanguages.

Finite State Machine (FSM): Definition of finite state machine, Representation of FSMs. Classification of FSM's and their construction, Conversion from NFA to DFA, Elimination of ε – transitions from NFA, Equivalence of two FSM's, optimization of finite state machine (Equivalence theorem method and Table filling method), Finite state machine with output: Moore and Mealy machines. Applications of FSM.

Regular Expression and Languages: Regular Expression, Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Properties of Regular Languages: Pumping Lemma for regular Languages, Application ofPumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, Equivalence and Minimization of Automata.

Context Free Grammars and Languages: Context Free Grammars, Parse Trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages, Normal Forms, Pumping Lemma for CFL, Closure properties of CFL, Decision properties for CFL.

Push down Automata: Definition of push down automata, The Languages of a PDA, push down automata, Equivalence of PDA's and CFG's, push down automata to context free grammar, context free grammar to push down automata, Deterministic Pushdown Automata.

Turing Machines: The Definition of Turing Machine, Turing Machine Model, Representation of Turing Machines, Language Acceptability by Turing Machines, Design of Turing Machines, Description of Turing Machines, Techniques for TM Construction, Variants of Turing Machines, Turing Machines and Type 0 Grammars.

Undecidability: A Language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE, Undecidable Problems About Turing Machines, Decidable & Undecidable Problems, Post Correspondence Problem.

Text books:

1. Introduction to automata theory, languages and computation, John.E.H.P croft/ RajeevMotwani & JD Ullman—pearson education- III edition
2. Theory of computation, K.L.P.Mishra and N.Chandrasekhar, PHI

Reference Books:

1. Theory of computation, formal languages and automata theory, G P Saradhi Varma,B.Thirupathi Rao –Sci Tech publications.

AI2205 MANAGERIAL ECONOMICS

Course Objectives:

- To bring about an awareness about the nature of Managerial Economics and its linkageswith other disciplines.
- To understand the Micro and Macro Environment of Business.
- To familiarize the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

Course Outcomes:

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

- Understand the various economic activities in business and industry.
- Analyse the real-world business problems.
- Make optimal business decisions for the effective and efficient management ofOrganisations.

SYLLABUS

Significance of Economics and Managerial Economics:

Economics: Definitions of Economics- Wealth, Welfare and Scarcity definitions Classification of Economics- Micro and Micro Economics.

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand and Utility Analysis:

Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations.

Theory of Production and Cost analysis:

Production - Meaning, Production function and its assumptions, use of production function in decision making; **Cost analysis** - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. Unavoidable costs, Economies and Diseconomies of scale.

Market Structures: Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition.

Pricing and Business Cycles:

Pricing Analysis: Pricing – Significance; Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and

Mark- down pricing of retailers.

Business cycles - Definition, Characteristics, Phases, Causes and Consequences; Measures to solve problems arising from Business cycles.

Text Books:

1. Sankaran,S., Managerial Economics, Marghan Publications, 2015, Chennai.
2. Aryasri, A.R., Managerial Economics and Financial Analysis, MC Graw HillEducation, New Delhi,2015.

Reference Books:

1. Dwivedi, D.N., Managerial Economics, Vikhas Publishing House Pvt. Ltd. 6thEdition, New Delhi,2004.
2. Dewett, K.K., Modern Economic Theory, S.Chand & Company Ltd., New Delhi,2005.

AI2206 ALGORITHMS LAB Through C++

Course objectives:

- The laboratory component will emphasize two areas:
- Implementation of algorithms covered in class: This will involve running the algorithms under varying input sets and measuring running times, use of different data structures for the same algorithm (wherever applicable) to see its effect on time and space, comparison of different algorithms for the same problem etc.
- Design of Algorithms: This will involve design and implementation of algorithms for problems not covered in class but related to topics covered in class.
- The exact set of algorithms to design and implement is to be decided by the instructor.In addition, there will be at least one significantly large design project involving some real world application. An efficient design of the project should require the use of multiple data structures and a combination of different algorithms/techniques.

Course Outcomes:

The student should be able to:

- Design algorithms using appropriate design techniques (brute-force, greedy, dynamic programming, etc.)
- Implement a variety of algorithms such assorting, graph related, combinatorial, etc., in ahigh level language.
- Analyze and compare the performance of algorithms using language features.
- Apply and implement learned algorithm design techniques and data structures to solvereal-world problems.

Programs List:

1. a) Create a CPP class called Student with the following details as variables within it.
   (i) Register_number
   (ii) Student_name
   (iii) Programme_name
   (iv) Phone _number
   Write a program to create nStudent objects and print the Register_number, Student_name, Programme_name, and Phone_number of these objects with suitable headings.

   b). Write a program to implement the Stack using arrays. Write Push (), Pop(), andDisplay() methods to demonstrate its working.

2. a). Design a superclass called Staff with details as StaffId, Name, Phone, Salary. Extend this class by writing three subclasses namely Teaching (domain, publications), Technical (skills), and Contract (period). Write a CPP program to read and display at least 3 staff objects of all three categories.

   b). Write a class called Customer to store their name and date_of_birth. The date_of_birth format should be dd/mm/yyyy. Write methods to read customer data as and display as using StringTokenizer class considering the delimiter character as "/".

3. a). Write a program to read two integers a andb. Compute a/b and print, when b is not zero. Raise an exception when b is equal to zero.

   b). Write a program that implements a multi-thread application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square of the number

and prints; third thread will print the value of cube of the number.

4. Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using CPP how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.
5. Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time takento sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using CPP how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.
6. Implement the Knapsack problem using (a) Dynamic Programming method (b) Greedy method.
7. Write a program-from a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm..
8. Find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. Use Union-Find algorithms in your program.
9. Find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
10. Write programs to
    (a) Implement All-Pairs Shortest Paths problem using Floyd's algorithm.
    (b) Implement Travelling Sales Person problem using Dynamic programming.
11. Design and implement in CPP, to find a subset of a given set S = {Sl, S2,.... ,Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S ={1, 2, 5, 6, 8} and d= 9, there are two solutions {1,2,6}and {1,8}. Display a suitablemessage, if the given problem instance doesn't have a solution.
12. Design and implement in CPP to find all Hamiltonian Cycles in a connected undirectedGraph G of n vertices using backtracking principle.

REFERENCES:

1. T. H. Cormen, C. L. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, MIT Press.
2. J. Kleinberg and E. Tardos, Algorithm Design, Addison-Wesley.
3. Harry R. Lewis and Larry Denenberg, Data Structures and Their Algorithms, Harper Collins.
4. A. Gibbons, Algorithmic Graph Theory, Cambridge University Press.
5. Michael T. Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis,and Internet Examples, John Wiley.
6. R. Sedgewick, Algorithms in C (Parts 1-5), Addison Wesley.
7. M. H. Alsuwaiyel, Algorithm Design Techniques and Analysis, World Scientific.
8. Gilles Brassard and Paul Bratley, Algorithmics: theory and practice, Prentice-Hall.
9. Udi Manber, Introduction to Algorithms: A Creative Approach, Addison-Wesley.
10. Sara Baase and Allen Van Gelder, Computer Algorithms: Introduction to Design andAnalysis, Addison-Wesley.

AI2207 DATABASE MANAGEMENT SYSTEMS LAB

Course Objectives

- To introduce to a commercial DBMS such as ORACLE.
- To learn and practice SQL commands for schema creation, data manipulation.
- To learn conceptual and physical database design based on a case study.
- To apply database design stages by studying a case study.

Course Outcomes

By the end of the course, the student should be able to:

- The student is exposed to a commercial RDBMS environment such as ORACLE.
- The student will learn SQL commands for data definition and manipulation.
- The student understands conceptual through physical data base design.
- The student takes up a case study and applies the design steps.

SYLLABUS

Features of a commercial RDBMS package such as ORACLE/DB2, MS Access, MYSQL & Structured Query Language (SQL) used with the RDBMS.

I. Laboratory Exercises Should Include:

a. Defining Schemas for Applications,
b. Creation of Database,
c. Writing SQL Queries,
d. Retrieve Information from Database,
e. Creating Views
f. Creating Triggers
g. Normalization up to Third Normal Form
h. Use of Host Languages,
i. Interface with Embedded SQL,
j. Use of Forms
k. Report Writing

II. Some sample applications are given below:

1. Accounting Package for Shops
2. Database Manager for Magazine Agency or Newspaper Agency,
3. Ticket Booking for Performances,
4. Preparing Greeting Cards & Birthday Cards
5. Personal Accounts - Insurance, Loans, Mortgage Payments, Etc.,
6. Doctor's Diary & Billing System
7. Personal Bank Account
8. Class Marks Management
9. Hostel Accounting
10. Video Tape Library,
11. History of Cricket Scores,
12. Cable TV Transmission Program Manager,
13. Personal Library.
14. Sailors Database
15. Suppliers and Parts Database

Reference Books

1. Database Management Systems; Raghu Ramakrishnan, Johannes Gehrke 4th Edition,McGraw Hill
2. Database System Concepts; A. Silberschatz, H. Korth 5th Edition, McGraw-Hill

AI2208 ` WEB TECHONOLOGIES

Course objectives

- To facilitate the graduates with the ability to visualize, gather information, articulate, analyze, solve complex problems, and make decisions. These are essential to address the challenges of complex and computation intensive problems increasing their productivity.
- To facilitate the graduates with the technical skills that prepare them for immediate employment and pursue certification providing a deeper understanding of thetechnology in advanced areas of computer science and related fields, thus encouraging to pursue higher education and research based on their interest.
- To facilitate the graduates with the soft skills that include fulfilling the mission, setting goals, showing self-confidence by communicating effectively, having a positive attitude, get involved in team-work, being a leader, managing their career and their life.

Course outcomes

- Able to understand the working principles of the computer system and its components, apply the knowledge to build, asses, and analyze the software and hardware aspects of it.
- Develops comprehensive skills of Programming Languages, Software process models, methodologies, and able to plan, develop, test, analyze, and manage the software and hardware intensive systems in heterogeneous platforms individually or working in teams.
- Able to use the professional, managerial, interdisciplinary skill set, and domain specific tools in development processes, identify the research gaps, and provide innovative solutions to them.

Syllabus

1. Design the following static web pages required for an online book store web site.
   a) HOME PAGE: The static home page must contain three frames.
   b) LOGIN PAGE
   c) CATOLOGUE PAGE: The catalogue page should contain the details of all thebooks available in the web site in a table.
   d) REGISTRATION PAGE

2. Write JavaScript to validate the following fields of the Registration page.
   a) First Name (Name should contains alphabets and the length should not be less than6 characters).
   b) Password (Password should not be less than 6 characters length).
   c) E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com)
   d) Mobile Number (Phone number should contain 10 digits only).
   e) Last Name and Address (should not be Empty).

3. Develop and demonstrate the usage of inline, internal and external style sheet using CSS

4. Develop and demonstrate JavaScript with POP-UP boxes and functions for the following problems:
   a) Input: Click on Display Date button using onclick( )
   functionOutput: Display date in the textbox
   b) Input: A number n obtained using promptOutput: Factorial of n number using alert
   c) Input: A number n obtained using prompt

Output: A multiplication table of numbers from 1 to 10 of n using alert
d) Input: A number n obtained using prompt and add another number using confirm
Output: Sum of the entire n numbers using alert

5. Write an HTML page that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next in the list. Add CSS to customize the properties of the font of the capital (colour, bold and font size).
6. Write an HTML page including any required JavaScript that takes a number from text field in the range of 0 to 999 and shows it in words. It should not accept four and above digits, alphabets and special characters.
7. Develop and demonstrate PHP Script for the following problems:
   a) Write a PHP Script to find out the Sum of the Individual Digits.
   b) Write a PHP Script to check whether the given number is Palindrome or not
8. Create an XML document that contains 10 users information. Write a Java Program, which takes User Id as input and returns the user details by taking the user information from XML document using DOM parser or SAX parser.
9. Implement the following web applications using (a) PHP (b) Servlets (c) JSP
   a) A web application that takes a name as input and on submit it shows a hello page where name is taken from the request. It shows the start time at the right top corner of the page and provides a logout button. On clicking this button, it should show a logout page with Thank You message with the duration of usage (hint: Use session to store name and time).
   b) Write a PHP Program to display current Date, Time and Day.
   c) A web application that takes name and age from an HTML page. If the age is less than 18, it should send a page with "Hello, you are not authorized to visit the site" message, where should be replaced with the entered name. Otherwise, it should send "Welcome to this site" message.
   d) A web application that lists all cookies stored in the browser on clicking "List Cookies" button. Add cookies if necessary.
10. Implement the web applications with Database using (a) PHP, (b) Servlets and (c) JSP.
11. Modify the above PHP program to use an xml instead of database
12. Write a program to design a simple calculator using
    (a) JavaScript
    (b) PHP
    (c) Servlet and
    (d) JSP.

References:

1. Internet and Web Technologies by Raj Kamal, Tata McGraw-Hill.
2. Programming the World Wide Web by Robert W. Sebesta, Pearson Education.

AI2209 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Course Objectives:

- To recognize the moral values that should guide the Engineering profession.
- To resolve moral issues concerning one's profession.
- To develop and exhibit a set of moral beliefs and attitudes that engineers should inculcate.
- To inculcate social values and morality in one's life.
- To develop awareness about Professional/Engineering Ethics and Human Values.

Learning Outcomes:

Students will be able to:

- Apply the conceptual understanding of ethics and values into everyday practice.
- Understand the importance of moral awareness and reasoning in life.
- Acquire professional and moral etiquette that an engineer requires.
- Develop the acumen for self-awareness and self-development.
- Develop cultural tolerance and integrity.
- Tackle real-life challenges with empathy.

SYLLABUS

HUMAN VALUES

Values - Respect - Caring - Sharing - Honesty- Courage - Self confidence - CommunalHarmony Morals - Virtues

PROFESSIONAL VALUES

Integrity - Discipline - Valuing time - Cooperation - Commitment - Code of conduct -Challenges in the workplace

PROFESSIONAL ETHICS

Overview - Engineering ethics - Moral issues - Profession - Models of professional roles - Responsibility

RESPONSIBILITIES AND RIGHTS

Safety and risk - Collegiality and loyalty - Confidentiality - Occupational crime - Humanrights - Employee rights - Intellectual property rights

GLOBAL ISSUES

Globalization - Environmental ethics - Computer ethics - Code of ethics - Multinationalcorporations - Engineers as advisors in Planning and Policy making

Textbook:

1. R.S. Nagarazan. *A Textbook on Professional Ethics and Human Values.* New AgeInternational Publishers. 2006.

Reference Books:

1. Premvir Kapoor. *Professional Ethics and Human Values.* Khanna Publishing House. 2019.
2. B.S. Raghavan. *Human Values and Professional Ethics.* S.Chand Publications. 2012.
3. R.R. Gaur & Others. *A Foundation Course in Human Values and Proff. Ethics*. ExcelBooks. 2009.
4. A. N. Tripathi. *Human Values*. New Age International (P) Limited. 2009
5. R. Subramanian. *Professional Ethics*. OUP India. 2013.

ANDHRA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND SYSTEMS ENGINEERING

SCHEME AND SYLLABI

(With effect from 2022-23 admitted batch)

B. TECH Computer Science and Engineering (Artificial Intelligence and Machine Learning)

III Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI3101	PC	Data Warehousing and Data Mining	4	0	30	70	100	3
AI3102	PC	Artificial Intelligence	4	0	30	70	100	3
AI3103	PC	Machine Learning Techniques	4	0	30	70	100	3
AI3104	PE	Professional Elective-I	4	0	30	70	100	3
AI3105	OE	Open Elective-I	4	0	30	70	100	3
AI3106	PC	Data Warehousing and Data Mining Lab	0	3	50	50	100	1.5
AI3107	PC	Machine Learning Techniques Lab	0	3	50	50	100	1.5
AI3108	SC	Skill Development Course-I: (Continuous Integration and Continuous Delivery using DevOps)	1	3	50	50	100	2
AI3109	INT	Internship-I	0	0	50	50	100	2
Summer Internship 2 Months (Mandatory) after 2nd year (to be evaluated during III year I Semester								
Total credits								**22**

AI3101 Data Warehousing and Data Mining

Prerequisites:

- Basic knowledge of probability and statistics.
- Basic Mathematics like Linear algebra.
- Knowledge of database management systems.

Course objectives:

The main objective of the course is to

- To understand the evolution of data warehousing and data mining systems
- To provide an understanding of data objects, similarity and dissimilarity metrics and
- preprocessing techniques.
- To impart knowledge about the basics of data warehousing and modelling using data
- cubes, OLAPs, AOI.
- To familiarize the concepts of mining frequent patterns based on Associations.
- To discuss about pattern mining using classification and clustering methods.

Course Outcomes:

By the end of the course student will be able to

- Understands data objects, attribute types, metrics, cleaning and transformation of data.
- Ability to represent and comprehend information with data warehousing technologies for multi dimensional modelling and generalization using Cubes, OLAPS and AOI.
- Grasp the concepts of Association mining using Apriori and FP- Growth.
- Learn about various approaches to supervised learning like classification approach.
- Learn about various approaches to unsupervised learning like clustering approach.

SYLLABUS

Introduction to Data Mining: Importance of Data Warehousing and Data Mining, Kinds of data, Kinds of patterns, Technologies, Applications, Major Issues in Data Mining Getting to know your data: Data Objects and Attributes Types, Statistical Descriptions of Data, Estimating Data Similarity and Dissimilarity, Data Visualization.

Data Preprocessing: Quality data, Data Cleaning, Data Integration, Data Reduction, Data Transformation, Discretization and Concept Hierarchy Generation.

Data Warehouse and OLAP Technology: Basic Concepts of Data warehouse, Data Modelling using Cubes and OLAP, DWH Design and usage, Implementation using Data Cubes and OLAPs, Data Generalization with AOI.

Mining Frequent Patterns Based on Associations and Correlations: Basic Concepts, Frequent Item set Mining Methods: Apriori Algorithm, Association Rule Generation, Improvements to A Priori, FP- Growth Approach, Pattern Evaluation Methods.

Classification and Prediction: Basic Concepts, Decision Tree Induction, Bayes Classification, Rule- Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy, Classification by Back Propagation, K-nearest neighbour classifier.

Cluster Analysis: Basic Concepts and issues in clustering, Requirements for Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Evaluation of Clustering Solutions.

Text Books:

1. Data Mining- Concepts and Techniques by Jiawei Han, Micheline Kamber and Jian
2. Pei–Morgan Kaufmann publishers –--3rd edition
3. Data Mining Techniques, A.K.Pujari, University Press.

References Books:

1. Data mining concepts byTan, Steinbech, and Vipin Kumar - Pearson Edu

AI3102 ARTIFICIAL INTELLIGENCE

Prerequisites: Discrete Mathematics, Data Structures and Algorithms

Course Objectives:

- To learn about AI problems, techniques and their modelling as state space search, problem characteristics, Production System categories.
- To learn different uninformed and heuristic search strategies for solving AI problems with examples
- To learn theorem proving with predicate logic, resolution, rule-based inference with forward and backward chaining
- Inheritable knowledge representation using slot-filler structures and dealing with different forms of uncertain and implicit knowledge
- To introduce essential concepts of plan generation, Natural Language understanding and Expert Systems.

Course Outcomes:

- By the end of the course the student understands, applies, evaluates and creates AI solutions as they are
- able to characterize and model AI problems in a state space search framework and identify appropriate production system category to solve them
- able to understand and evaluate pros & cons of different heuristic search strategies and apply appropriate heuristic search for specific problem solving scenario.
- able to represent domain knowledge in the form of predicates / rules and applies logic and inference for deducing the validity of a given assertion.
- able to create problem specific slot-filler knowledge structures and apply statistical, fuzzy and non-monotonic reasoning methods aptly to solve real world problems involving any type of uncertainty.
- able to understand basic concepts and approaches to natural language processing, plan generationand expert system development.

SYLLABUS

Introduction to Artificial Intelligence: Artificial Intelligence, AI Problems, AI Techniques, Defining the Problem as a State Space Search, Production Systems, control strategies, Uninformed search using BFS and DFS, Heuristic search, Problem Characteristics, Production system categories for AI problem solving

Heuristic Search Techniques: Issues in The Design of Search Programs, Generate-And- Test, Hill Climbing and its variants, Best-First Search, A* Algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis.

Knowledge Representation using Predicate Logic and Rules: Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Resolution in propositional logic, Resolution in predicate logic with Clause form, Unification & Resolution algorithm, Question answering, Procedural Vs Declarative Knowledge, Logic programming with Prolog, Forward Vs Backward Reasoning and combining them, Matching Techniques, Matching with variables, RETE Algorithm, Conflict resolution

Reasoning under Uncertainty: Introduction to Non-Monotonic Reasoning, Logics for Non monotonic reasoning, Depth first search with Dependency-directed backtracking, Justification based Truth Maintenance System, Statistical Reasoning: Bayes Theorem for probabilistic inference, Certainty Factors and Rule-Based Systems, Bayesian Belief Networks, Dempster Shafer Theory, Fuzzy Logic

Structured Representations of Knowledge: Semantic Nets, representing non-binary predicates, Partitioned Semantic Nets, Frames as sets and instances, Slots as full-fledged Objects, Property Inheritance through tangled hierarchies, Conceptual Dependency, Conceptual Dependency Graphs, Scripts, examples in natural language understanding, merits and demerits of strong slot filler structures.

Natural Language Processing: Steps in Natural Language Processing, Syntactic Processing and Augmented Transition Nets, Semantic Analysis and grammars, Discourse and pragmatic processing; Planning: Components of a Planning System, Goal Stack Planning, Non-linear Planning using Constraint Posting, Hierarchical Planning, Reactive Systems.

Experts Systems: Overview of an Expert System, Applications of expert systems, Components of an Expert Systems, Expert system development, Types of Expert Systems: Rule Based, Frame Based, NeuralNetwork based, Black Board Architectures, Case studies of successful expert systems, Expert System Shells, Knowledge Acquisition and Validation Techniques.

Text Books:

1. Artificial Intelligence, Elaine Rich and Kevin Knight, Tata McGraw -Hill Publications
2. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI publications

References:

1. Artificial Intelligence, George F Luger, Pearson Education Publications
2. Artificial Intelligence : A modern Approach, Russell and Norvig, Prentice Hal

AI3103 MACHINE LEARNING TECHNIQUES

Course Objectives:

- Identify problems that are amenable to solution by ANN methods, and which ML methods may be suited to solving a given problem.
- Formalize a given problem in the language/framework of different ANN methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).

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

- Explain the fundamental usage of the concept Machine Learning system
- Demonstrate on various regression Technique
- Analyze the Ensemble Learning Methods
- Illustrate the Clustering Techniques and Dimensionality Reduction Models in Machine Learning.
- Discuss the Neural Network Models and Fundamentals concepts of Deep Learning

Introduction- Artificial Intelligence, Machine Learning, Deep learning, Types of Machine Learning Systems, Main Challenges of Machine Learning.

End-to-End Machine Learning Project: Problem formulation, data collection, data visualization and preparation, selection and training a model, fine-tuning the model and launching the ML system. Dimensionality Reduction: the curse of dimensionality, main approaches for dimensionality reduction, principal component analysis, incremental, randomized, and kernel PCA algorithms.

Supervised Learning (Regression/Classification): Basic Methods: Distance based Methods, Nearest Neighbours, Decision Trees, Naive Bayes, Linear Models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Binary Classification: Multiclass/Structured outputs, MNIST.

Ensemble Learning and Random Forests: Introduction, Voting Classifiers, Bagging and Pasting, Random Forests, Boosting, Stacking.

Support Vector Machine: Linear SVM Classification, Nonlinear SVM Classification, SVM Regression, Naïve Bayes Classifiers.

Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Using Scikit-Learn, Randomized PCA, Kernel PCA.

Neural Networks and Deep Learning: Introduction to Artificial Neural Networks with Keras, Implementing MLPs with Keras, Installing TensorFlow 2, Loading and Preprocessing Data with TensorFlow.

Text Books:

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow,” 3rd Edition, O’Reilly Publications, 2022.

Reference Books:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill Edition, 2013.
2. Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, 2012.

AI3106 Data Warehousing and Data Mining Lab

Course Objectives: The main objective of the course is to

- To understand the mathematical basics quickly and covers each and every condition of data mining in order to prepare for real-world problems.
- The various classes of algorithms will be covered to give a foundation to further apply knowledge to dive deeper into the different flavors of algorithms.
- Emphasize hands-on experience working with all real data sets.
- Test real data sets using popular data mining tools such as WEKA, Python Libraries
- Develop ability to design various algorithms based on data mining tools.

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

- Extract knowledge using data mining techniques and enlist various algorithms used in information analysis of Data Mining Techniques.
- Perform various data preprocessing tasks on different datasets.
- Demonstrate the working of algorithms for data mining tasks such as association rule mining, classification for realistic data.
- Identify clusters for the realistic data using K-Means Clustering algorithm in Weka tool/Python.
- Implement and Analyze on knowledge flow application on data sets and Apply the suitable visualization techniques to output analytical results.

Software Requirements: WEKA Tool/Python.

List of Experiments

1. Explore machine learning tool "WEKA"
   - Explore WEKA Data Mining/Machine Learning Toolkit.
   - Downloading and/or installation of WEKA data mining toolkit.
   - Understand the features of WEKA toolkit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface.
   - Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, Classify panel, Cluster panel, Associate panel and Visualize panel)
   - Study the arff file format Explore the available data sets in WEKA. Load a data set (ex. Weather dataset, Iris dataset, etc.)
   - Load each dataset and observe the following:
     1. List the attribute names and they types
     2. Number of records in each dataset
     3. Identify the class attribute (if any)
     4. Plot Histogram
     5. Determine the number of records for each class.

2. Visualize the data in various dimensions. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets

- Explore various options available in Weka for preprocessing data and apply Unsupervised filters like Discretization, Resample filter, etc. on each dataset
- Load weather. nominal, Iris, Glass datasets into Weka and run Apriori Algorithm with different support and confidence values.
- Study the rules generated. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated.
- Derive interesting insights and observe the effect of discretization in the rule generation process.

3. Demonstrate performing classification on data sets
   - Load each dataset into Weka and run 1d3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kappa statistic.
   - Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix.
   - Load each dataset into Weka and perform Naïve-bayes classification and k-Nearest Neighbour classification. Interpret the results obtained.
   - Plot RoC Curves
   - Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.

4. Demonstrate performing clustering of data sets
   - Load each dataset into Weka and run simple k-means clustering algorithm with different values of k (number of desired clusters).
   - Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
   - Explore other clustering techniques available in Weka.
   - Explore visualization features of Weka to visualize the clusters. Derive interesting insights and explain.

5. Demonstrate knowledge flow application on data sets
   - Develop a knowledge flow layout for finding strong association rules by using Apriori, FP Growth algorithms
   - Set up the knowledge flow to load an ARFF (batch mode) and perform a cross validation using J48 algorithm
   - Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree

6. Illustrate Exploratory Data Analysis for Classification using Pandas or Matplotlib: Getting a quick statistical summary of the dataset, Checking Missing Values, Removing Duplicates, Showing Correlations, and Looking for Outliers using BoxPlots.

7. Implement and test Principle Component Analysis in Python

8. Write a program to implement Categorical Encoding: One-hot/Label/Ordinal Encodings.
9. Use sklearn to build a decision tree for IRIS data set and visualize the decision tree. Use the decision tree built to classify a new data point using both predict and predict_proba methods.

Need to demonstrate your understanding of sklearn's decision tree classifier by using both entropy and Gini-index.

10. Write a program of Naive Bayesian classification using Python programming language.
11. Write a Python program to generate frequent item sets / association rules using Apriori algorithm
12. Write a program of cluster analysis using simple k-means algorithm Python programming language.

AI3107 **Machine Learning Techniques Lab**

Prerequisites:

The students should have basic knowledge of Machine Learning and Python Programming

Course objectives:

- This course will enable students to learn and understand different data sets and machine learning algorithms

Course Outcomes:

1. Implement procedures for the machine learning algorithms
2. Develop Python programs for machine learning algorithms
3. Apply appropriate data sets to machine learning algorithms
4. Apply sklearn library to solve real world problems

List of Programs

1. Illustrate Exploratory Data Analysis for Classification using Pandas or Matplotlib: Getting a quick statistical summary of the dataset, Checking Missing Values, Removing Duplicates, Showing Correlations, and Looking for Outliers using BoxPlots.
2. Write a program to implement Categorical Encoding: One-hot/Label/Ordinal Encodings.
3. Use sklearn to build a decision tree for IRIS data set and visualize the decision tree. Use the decision tree built to classify a new data point using both predict and predict_proba methods. Need to demostrate your understanding of sklearn's decision tree classifier by using both entropy and Gini-index.
4. Use sklearn's k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. You need to print the attributes values for wrong predictions.
5. Implement and test Principle Component Analysis in Python (not allowed to use sklearn's PCA classes).
6. Solve real-world problems using Linear Regression.
7. Solve real-world problems using Logistic Regression.
8. Implement a binary classifier using stochastic gradient descent (SGD) to classify MNIST digits as SIX and Not-SIX.
9. Implement, visualize and test Support Vector Machines in Python (not allowed to use sklearn's Support Vector classes).
10. Develop a program for Bias, Variance, and Cross Validation. Run decision tree classification and random forest algorithms on a dataset and confirm that ensembling indeed improves performance significantly reducing the variance component. Also, print feature importances as found by the random forest classifier.
11. Use sklearn’s GradientBoostingRegressor and demonstrate the use of early stopping to find the optimal number of trees in the GBRT ensemble.
12. Apply expectation-maximization (EM) algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.

Text Book:

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn, Keras, and
2. TensorFlow,” 3rd Edition, O’Reilly Publications, 2022.

AI3108 Continuous Integration and Continuous Using Delivery Devops (Skill Development Course-I)

Prerequisite: Create account in GitHub

Course objectives:

- Understand DevOps Principles and Culture
- Define Continuous Integration (CI) and Continuous Delivery (CD) concepts
- Introduce build automation tools (e.g., Jenkins, GitLab CI/CD) and their features
- Discuss the importance of automated testing in CI/CD pipelines

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

- Understand the why, and how of DevOps doption
- Attain literacy on Devops
- Align capabilities required in the team what
- Create an automated CICD pipeline using a stack of tools

SYLLABUS

1. Explore Git and GitHub commands
2. Configure the web application and Version control using Git using Git commands and version controloperations.
3. Jenkins installation and setup ,explore the environment
4. Demonstrate continuous integration and development using Jenkins
5. Create and Build Web Application Using Jenkins
6. Create a pipeline project to demonstrate PostBuild actions using pipeline script.
7. Write a build script to build the application using a build automation tool like Maven and deploy the application to a web application server like Tomcat.
8. Explore Docker commands for content management
9. Develop a simple containerized application using Docker
10. Integrate Kubernetes and docker
11. Automate the process of running containerized application developed in experiment-9 using Kubernetes

Reference Books:

1. Learning Continuous Integration with Jenkins: A beginner's guide to implementing ContinuousIntegration and Continuous Delivery using Jenkins - Nikhil Pathania ,Packt publication[https://www.amazon.in/Learning-Continuous-Integration-Jenkins-Pathania/dp/1785284835]
2. Jenkins 2 – Up and Running: Evolve Your Deployment Pipeline for Next Generation Automation -Brent Laster, O'Reilly publication [https://www.amazon.in/Jenkins-2-Running-Brent-Laster/dp/ 1491979593]

Web Links:

(Courses mapped to Infosys Springboard platform)

1. https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01338269041100390473 5_shared/overv iew [Software Engineering and Agile software development]
2. https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_013501578194976768 10467 [Development & Testing with Agile: Extreme Programming]
3. https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01353898917192499226_shared [DevOps CICD]

ANDHRA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND SYSTEMS ENGINEERING

SCHEME AND SYLLABI

(With effect from 2022-23 admitted batch)

B. TECH Computer Science and Engineering (Artificial Intelligence and Machine Learning)

III Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI3201	PC	Computer Networks	4	0	30	70	100	3
AI3202	PC	Deep Learning Techniques	4	0	30	70	100	3
AI3203	PC	Big Data and Hadoop	4	0	30	70	100	3
AI3204	PE	Professional Elective-II	4	0	30	70	100	3
AI3205	OE	Open Elective-II	1	3	30	70	100	3
AI3206	PC	Computer Networks Lab						1.5
AI3207	PC	Deep Learning Lab	0	3	50	50	100	1.5
AI3208	PC	Big Data and Hadoop Lab	0	3	50	50	100	1.5
AI3209	SC	Skill Development Course-II: MEAN Stack Technologies	1	3	50	50	100	2
Total credits								**21.5**
Internship-II								

AI3201 Computer Networks

Prerequisite:

- Basics of Data communications and Networks

Course objectives:

- Understand state-of-the-art in network protocols, architectures, and applications.
- Process of networking research
- Constraints and thought processes for networking research
- Problem Formulation—Approach—Analysis—

Course Outcomes:

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

- Understand OSI and TCP/IP models
- Analyze MAC layer protocols and LAN technologies
- Design applications using internet protocols
- Understand routing and congestion control algorithms
- Understand how internet works

SYLLABUS

Introduction: Network Topologies WAN, LAN, MAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models

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Physical Layer - Fourier analysis – Bandwidth Limited Signals – The Maximum Data Rate of a Channel - Guided Transmission Media, Digital Modulation and Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing

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.

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., Wireless Lans-The 802.11 Architecture and Protocol Stack- The 802.11 Frame Structure-Services.

Design Issues-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 Algorithm, Congestion Control Algorithms-

Approaches to Congestion Control-Traffic Aware Routing-Admission Control-Traffic Throttling-Load Shedding

Transport Layer – The Internet Transport Protocols: Udp, the Internet Transport Protocols: Tcp **Application Layer –**The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery

Text Book:

1. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010
2. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education

Reference Books:

1. Larry L. Peterson and Bruce S. Davie, “Computer Networks - A Systems Approach” (5thed), Morgan Kaufmann/ Elsevier, 2011

AI3202 Deep Learning Techniques

Prerequisite: Basic Knowledge on Artificial Intelligence and Machine Learning

Course objectives:

- To identify problems that are amenable to solution by ANN methods.
- To formalize a given problem in the language/framework of different ANN methods.
- To apply deep learning techniques to various learning problems.
- To provide a basic exposition to the goals and methods of deep learning.

Course Outcomes:

- Understand the basic principles of artificial neural networks.
- Apply various techniques to address many issues in training deep neural networks.
- Apply deep learning models to computer vision problems and time series analysis.
- Understand various models of generative deep learning.
- Apply deep learning techniques in reinforcement learning.

SYLLABUS

Introduction to ANNs with Keras: Biological and artificial neurons, implementing multilayer perceptrons with Keras, fine-tuning neural network hyperparameters.

Training Deep Neural Networks: The vanishing/exploding gradients problems, Glorot and He initializations, batch normalization, reusing pretrained models, faster optimizers, avoiding overfitting through regularization.

Deep Computer Vision Using CNNs: The architecture of the visual cortex, convolutional layers, pooling layers, famous CNN architectures, object detection, fully convolutional networks, YOLO, semantic segmentation.

Time Series Analysis Using RNNs: Recurrent neurons and layers, training RNNs, forecasting a time series, stacking recurrent layers, using bidirectional RNNs, handling long sequences using LSTMs and GRUs.

Generative deep learning: Efficient data representations, stacked, convolutional, recurrent, denoising, sparse and variational autoencoders, generative adversarial networks.

Deep Reinforcement Learning: Essential theory of reinforcement learning, Markov decision processes, the optimal policy, essential theory of deep Q-learning networks, defining a DQN agent.

Text Books:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow," 3rd Edition, O'Reilly Publications, 2022.
2. Krohn et al, "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence," Pearson Education 2020.

Reference Books:

1. Francois Chollet, "Deep Learning with Python," 2nd Edition, Manning Publications, 2021.

AI3203 Big Data and Hadoop

Prerequisite:

- Students should have knowledge about basic programming languages
- Students should have knowledge about basic mathematics

Course Objectives:

- To optimize business decisions and create competitive advantage with Big Data analytics
- To learn to analyze the big data using intelligent techniques
- To introduce programming tools PIG & HIVE in Hadoop echo system

Course Outcomes:

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

- Illustrate big data challenges in different domains including social media, transportation, finance and medicine
- Use various techniques for mining data stream
- Design and develop Hadoop
- Identify the characteristics of datasets and compare the trivial data and big data for various applications
- Explore the various search methods and visualization techniques

SYLLABUS

Introduction: Introduction to big data: Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.

Introduction to Hadoop: Hadoop: History of Hadoop, the Hadoop Distributed File System, Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, Job Tracker, Task Tracker), Design of HDFS, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Shuffle and Sort, Task execution, Map Reduce Types and Formats

Writing MapReduce Programs: A Weather Dataset, Understanding Hadoop API for MapReduce Framework (Old and New), Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, RecordReader, Combiner, Partitioner

Pig: Hadoop Programming Made Easier

Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

Introduction to Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, Logical joins, Window functions, Optimization, Table partitioning, Bucketing, Indexing, Join strategies.

Apache spark- Advantages over Hadoop, lazy evaluation, In memory processing, DAG, Spark context, Spark Session, RDD, Transformations- Narrow and Wide, Actions, Spark RDD's operations-Count,

foreach(), Collect, join, Cache(), Data frames ,RDD to Data frames, Catalyst optimizer, Data Frame Transformations, Working with Nulls in Data, Working with Complex Types, Grouping.

Text Books:

1. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
2. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss
3. SPARK: The Definitive Guide, Bill Chambers & Matei Zaharia, O'Reilley, 2018 Edition

Reference Books:

1. Programming Hive, O'Reilley, E. Capriolo, D. Wampler, and J. Rutherglen, 2012
2. Programming Pig, O'Reilley, Alan Gates, 2011

AI3206 Computer Networks Lab

Prerequisites: Basic Knowledge on C Programming
Basic Knowledge on Mathematics, Basic Networks Concepts

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 farming methods such as
    i. i) Character stuffing ii) bit stuffing.
3. Write a Program to implement data link layer farming 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 – CRC12, CRC16 and CRC CCIP.
6. Write a Program to implement Sliding window protocol for Go back 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.
14. How to run Nmap scan
15. Operating System Detection using Nmap
16. Do the following using NS2 Simulator
    i. NS2 Simulator-Introduction

ii. Simulate to Find the Number of Packets Dropped
iii. Simulate to Find the Number of Packets Dropped by TCP/UDP
iv. Simulate to Find the Number of Packets Dropped due to Congestion
v. Simulate to Compare Data Rate& Throughput.

Text Book:

1. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010
2. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education

Reference Books:

1. Larry L. Peterson and Bruce S. Davie, "Computer Networks - A Systems Approach" (5thed), Morgan Kaufmann/ Elsevier, 2011

AI3207 Deep Learning Techniques Lab

Prerequisites:

The students should have basic knowledge of Machine Learning and Python Programming

Course objectives:

- Learn deep recurrent and memory networks,
- 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:

- Implement deep neural networks to solve real world problems.
- Apply convolution neural networks to solve computer vision problems.
- Apply recurrent neural networks to solve time series problems.
- Choose appropriate pre-trained model to solve real time problems.
- Interpret the results of different deep learning models.

List of Programs

1. Implement multilayer perceptron algorithm for MNIST Hand written Digit Classification.
2. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
3. Design a neural Network for classifying news wires (Multiclass classification) using Reuters dataset.
4. Design a neural network for predicting house prices using Boston Housing Price dataset.
5. Build a Convolution Neural Network for MNIST Hand written Digit Classification.
6. Build a Convolution Neural Network for simple image (dogs and Cats) Classification
7. Use a pre-trained convolution neural network (VGG16) for image classification.
8. Implement a deep Recurrent Neural Network for a time series analysis.
9. Implement a deep LSTM Network for a time series analysis.
10. Implement a deep GRU Network for a time series analysis.
11. Implement dimensionality reduction using an autoencoder.
12. Implement LSTM from scratch in Python.

AI3208 Big Data and Hadoop Lab

Prerequisite:

- Students should have knowledge about basic programming languages
- Students should have knowledge about basic mathematics

Course Objective

- This subject aims to introduce students to learn java collections and Hadoop mapreduce technique.
- Upon successful completion of this lab the students should be able to learn java collections framework, installing Hadoop in various modes, installing pig and hive, how to execute map reduce programs and how to write map reduce code to different applications and how to analyze structured and unstructured data using pig and hive

Course Outcomes:

- The students will learn to write, compiling & execute Map reduce programs.
- The student will learn pig latin scripts to sort, filter, group and join data.
- The student will be able to create tables indexes, functions, drop and alter table etc using hive.
- The student will be able to learn pyspark RDD, Transformations
- The student will be able to learn build Machine Learning model using pyspark ml library

SYLLABUS

Week-1 Implement the following file management tasks in Hadoop:

i) Adding files and directories.
ii) Retrieving files.
iii) Deleting files
iv)

Week-2 Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
Week-3 Write a Map Reduce program that mines weather data.
Week-4 Compute Average Salary and Total Salary by Gender for an Enterprise.
Week-5 Write a pig latin scripts to wordcount
Week-6 Write a pig latin scripts to sort, group, join, filter your data.
Week-7 Run Hive then use Hive to create, alter, and drop databases, tables
Week-8 i) Creating hive tables (External and internal)
(ii) Loading data to external hive tables from sql tables(or)Structured c.s.v using scoop
Week-9 (iii) Performing hive operations like filterations and updations
(iv) Performing Join (inner, outer etc)
Week-10 Implement the following pyspark operations

i) SparkSession
ii) SparkContext
iii) ways to Create RDD

Week-11 Perform the following pyspark transformations

i) Convert RDD to DataFrame
ii) PySpark Read CSV file into DataFrame
iii) drop() & dropDuplicates()
iv) PySpark orderBy() and sort()

v) map and flatMap
vi) PySpark Groupby, sort and join,

Week-12: Build any Machine Learning model using pyspark ml library.

Text Books:

1. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
2. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss
3. SPARK: The Definitive Guide, Bill Chambers & Matei Zaharia, O'Reilley, 2018 Edition

Reference Books:

1. Programming Hive, O'Reilley, E. Capriolo, D. Wampler, and J. Rutherglen, 2012
2. Programming Pig, O'Reilley, Alan Gates, 2011

AI3209 **Mean Stack Technologies**
(Skill Development Course-II)

Prerequisite:

- Understanding of HTML and CSS for building static web pages.
- Understanding of JavaScript fundamentals for both frontend (Angular) and backend (Node.js) development.
- Basic knowledge of databases, including an understanding of tables, records, and basic CRUD operations.

Course objectives:

- Understand the concept of full-stack development
- Identify the key components of the MEAN Stack: MongoDB, Express.js, AngularJS (or Angular), and Node.js.
- Implement routes, middleware, and error handling in an Express.js application.
- Implement CRUD operations to interact with the database.
- Implement dynamic and interactive user interfaces using Angular.

Course Outcomes:

- Build a basic web server using Node.js and work with Node Package Manager (NPM).
- Build a web server using Express.js
- Make use of Typescript to optimize JavaScript code by using the concept of strict type checking.
- Develop JavaScript applications using typescript and work with document database using MongoDB.
- Utilize Angular JS to design dynamic and responsive web pages.
- Apply the acquired knowledge and skills to complete a comprehensive MEAN Stack project.

SYLLABUS

1	**Course Name: Node.js**
	a. **Module Name:** How to use Node.js
	Verify how to execute different functions successfully in the Node.js platform.
	b. **Module Name:** Create a web server in Node.js
	Write a program to show the workflow of JavaScript code executable by creating web server in Node.js.
	c. **Module Name:** Modular programming in Node.js
	Write a Node.js module to show the workflow of Modularization of Node application.
	d. **Module Name:** Restarting Node Application
	Write a program to show the workflow of restarting a Node application.
	e. **Module Name:** File Operations
	Create a text file src.txt and add the following data to it. Mongo, Express, Angular, Node.
2	**Course Name: Express.js**
	a. **Module Name:** Defining a route, Handling Routes, Route Parameters, Query Parameters

	Implement routing for the AdventureTrails application by embedding the necessary code in the routes/route.js file.
	b. **Module Name:** How Middleware works, Chaining of Middlewares, Types of Middlewares
	In myNotes application: (i) we want to handle POST submissions. (ii) display customized error messages. (iii) perform logging.
	c. **Module Name:** Connecting to MongoDB with Mongoose, Validation Types and Defaults
	Write a Mongoose schema to connect with MongoDB.
	d. **Module Name:** Models
	Write a program to wrap the Schema into a Model object.
3	**Course Name: Express.js**
	a. **Module Name:** CRUD Operations
	Write a program to perform various CRUD (Create-Read-Update-Delete) operations using Mongoose library functions.
	b. **Module Name:** API Development
	In the myNotes application, include APIs based on the requirements provided. (i) API should fetch the details of the notes based on a notesID which is provided in the URL. Test URL - http://localhost:3000/notes/7555 (ii) API should update the details bas
	c. **Module Name:** Why Session management, Cookies
	Write a program to explain session management using cookies.
	d. **Module Name:** Sessions
	Write a program to explain session management using sessions.
	e. **Module Name:** Why and What Security, Helmet Middleware
	Implement security features in myNotes application
4	**Course Name: Typescript**
	a. **Module Name:** Basics of TypeScript
	On the page, display the price of the mobile-based in three different colors. Instead of using the number in our code, represent them by string values like GoldPlatinum, PinkGold, SilverTitanium.
	b. **Module Name:** Function
	Define an arrow function inside the event handler to filter the product array with the selected product object using the productId received by the function. Pass the selected product object to the next screen.
	c. **Module Name:** Parameter Types and Return Types
	Consider that developer needs to declare a function - getMobileByVendor which accepts string as input parameter and returns the list of mobiles.
	d. **Module Name:** Arrow Function
	Consider that developer needs to declare a manufacturer's array holding 4 objects with id and price as a parameter and needs to implement an arrow function - myfunction to populate the id parameter of manufacturers array whose price is greater than or equ
	e. **Module Name:** Optional and Default Parameters
	Declare a function - getMobileByManufacturer with two parameters namely manufacturer and id, where manufacturer value should passed as Samsung and id parameter should be optional while invoking the function, if id is passed as 101 then this function should

5	**Course Name: Typescript**
	a. **Module Name:** Rest Parameter
	Implement business logic for adding multiple Product values into a cart variable which is type of string array.
	b. **Module Name:** Creating an Interface
	Declare an interface named - Product with two properties like productId and productName with a number and string datatype and need to implement logic to populate the Product details.
	c. **Module Name:** Duck Typing
	Declare an interface named - Product with two properties like productId and productName with the number and string datatype and need to implement logic to populate the Product details.
	d. **Module Name:** Function Types
	Declare an interface with function type and access its value.
6	**Course Name: Typescript**
	a. **Module Name:** Extending Interfaces
	Declare a productList interface which extends properties from two other declared interfaces like Category,Product as well as implementation to create a variable of this interface type.
	b. **Module Name:** Classes
	Consider the Mobile Cart application, Create objects of the Product class and place them into the productlist array.
	c. **Module Name:** Constructor
	Declare a class named - Product with the below-mentioned declarations: (i) productId as number property (ii) Constructor to initialize this value (iii) getProductId method to return the message "Product id is <<id value>>".
	d. **Module Name:** Access Modifiers
	Create a Product class with 4 properties namely productId, productName, productPrice, productCategory with private, public, static, and protected access modifiers and accessing them through Gadget class and its methods.
7	**Course Name: Typescript**
	a. Module Name: Properties and Methods
	Create a Product class with 4 properties namely productId and methods to setProductId() and getProductId().
	b. Module Name: Creating and using Namespaces
	Create a namespace called ProductUtility and place the Product class definition in it. Import the Product class inside productlist file and use it.
	c. Module Name: Creating and using Modules
	Consider the Mobile Cart application which is designed as part of the functions in a module to calculate the total price of the product using the quantity and price values and assign it to a totalPrice variable.
	d. Module Name: What is Generics, What are Type Parameters, Generic Functions, Generic Constraints
	Create a generic array and function to sort numbers as well as string values.
8	**Course Name: Angular JS**
	a. Module Name: Angular Application Setup

	Observe the link http://localhost:4200/welcome on which the mCart application is running. Perform the below activities to understand the features of the application.
	b. Module Name: Components and Modules
	Create a new component called hello and render Hello Angular on the page
	c. Module Name: Elements of Template
	Add an event to the hello component template and when it is clicked, it should change the courseName.
	d. Module Name: Change Detection
	progressively building the PoolCarz application
9	**Course Name: Angular JS**
	a. Module Name: Structural Directives – ngIf
	Create a 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
	b. Module Name: Custom Attribute Directive
	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.
10	**Course Name: Angular JS**
	a. Module Name: Attribute Directives – ngStyle
	Apply multiple CSS properties to a paragraph in a component using ngStyle.
	b. Module Name: ngClass
	Apply multiple CSS classes to the text using ngClass directive.
	c. Module Name: Custom Attribute Directive
	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.
11	**Course Name: Angular JS**
	a. Module Name: Property Binding
	Binding image with class property using property binding.
	b. Module Name: Attribute Binding
	Binding colspan attribute of a table element to the class property.
	c. Module Name: Style and Event Binding
	Binding an element using inline style and user actions like entering text in input fields.
12	**Course Name: Angular JS**
	a. Module Name: Built in Pipes
	Display the product code in lowercase and product name in uppercase using built-in pipes.
	b. Module Name: Passing Parameters to Pipes
	Apply built-in pipes with parameters to display product details.
	c. Module Name: Nested Components Basics
	Load CourseslistComponent in the root component when a user clicks on the View courses list button.
13	**Course Name: Angular JS**
	a. Module Name: Passing data from Container Component to Child Component
	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

	AppComponent which should display the course details. When the user selects a course from the
	b. Module Name: Passing data from Child Component to ContainerComponent
	Create an AppComponent that loads another component called the CoursesList component. Create another component called CoursesListComponent which should display the courses list in a table along with a register .button in each row. When a user clicks on th
	c. Module Name: Shadow DOM
	Apply ShadowDOM and None encapsulation modes to components.
	d. Module Name: Component Life Cycle
	Override component life-cycle hooks and logging the corresponding messages to understand the flow.
14	**Course Name: Angular JS**
	a. Module Name: Template Driven Forms
	Create a course registration form as a template-driven form.
	b. Module Name: Model Driven Forms or Reactive Forms
	Create an employee registration form as a reactive form.
	c. Module Name: Custom Validators in Reactive Forms
	Create a custom validator for an email field in the employee registration form (reactive form)
15	**Course Name: Angular JS**
	a. Module Name: Custom Validators in Template Driven forms
	Create a custom validator for the email field in the course registration form.
	b. Module Name: Services Basics
	Create a Book Component that fetches book details like ID and name and displays them on the page in a list format. Store the book details in an array and fetch the data using a custom service.
	c. Module Name: RxJS Observables
	Create and use an observable in Angular.
16	**Course Name: Angular JS**
	a. Module Name: Server Communication using HttpClient
	Create an application for Server Communication using HttpClient
	b. Module Name: Communicating with different backend services using Angular
	HttpClient
	Create a custom service called ProductService in which the Http class is used to fetch data stored in the JSON files.
17	**Course Name: Angular JS**
	a. Module Name: Routing Basics, Router Links
	Create multiple components and add routing to provide navigation between them.
	b. Module Name: Route Guards
	Considering the same example used for routing, add a route guard to BooksComponent. Only after logging in should the user be able to access BooksComponent. If the user tries to give the URL of the Books component in another tab or window or if the user tries
	c. Module Name: Asynchronous Routing
	Apply lazy loading to BookComponent. If lazy loading is not added to the demo, it

	has loaded in 1.14 s. Observe the load time at the bottom of the browser console. Press F12 in the browser click the Network tab, and check the Load time
	d.Module Name: Nested Routes
	Implement Child Routes to a submodule.
18	**Course Name: MongoDB Essentials - A Complete MongoDB Guide**
	a. Module Name: Installing MongoDB on the local computer, Create MongoDB Atlas Cluster
	Install MongoDB and configure ATLAS
	b. Module Name: Introduction to the CRUD Operations
	Write MongoDB queries to perform CRUD operations on documents using insert(), find(), update(), remove()
19	**Course Name: MongoDB Essentials - A Complete MongoDB Guide**
	a. Module Name: Create and Delete Databases and Collections
	Write MongoDB queries to Create and drop databases and collections.
	b. Module Name: Introduction to MongoDB Queries
	Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate().

Text Book:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, ELadElrom, Apress O'Reilly.
3. Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1st edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media

Reference Books:

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech.
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning.

Web Links:

1. https://infyspringboard.onwingspan.com/en/app/toc/lex_17739732834840810000_shared/overvie w (HTML5)
2. https://infyspringboard.onwingspan.com/en/app/toc/lex_18109698366332810000_shared/overvie w (Javascript)
3. https://infyspringboard.onwingspan.com/en/app/toc/lex_32407835671946760000_shared/overvie w (Node.js & Express.js)
4. https://infyspringboard.onwingspan.com/en/app/toc/lex_9436233116512678000_shared/overview (Typescript)
5. https://infyspringboard.onwingspan.com/en/app/toc/lex_20858515543254600000_shared/overview (Angular JS)
6. https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01317716929471283211 3_shared/ove rview (MongoDB)

ANDHRA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND SYSTEMS ENGINEERING

SCHEME AND SYLLABI

(With effect from 2022-23 admitted batch)

B. TECH Computer Science and Engineering (Artificial Intelligence and Machine Learning)

IV Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
AI4101	PE	Professional Elective-III	4	0	30	70	100	3
AI4102	PE	Professional Elective-IV	4	0	30	70	100	3
AI4103	PE	Professional Elective-V	4	0	30	70	100	3
AI4104	OE	Open Elective-III	4	0	30	70	100	3
AI4105	OE	Open Elective-IV	4	0	30	70	100	3
AI4106	HSSE	HSSE Elective	4	0	30	70	100	3
AI4107	SC	Natural Language Processing Lab	1	3	50	50	100	2
AI4108	INT	Internship-II	0	0	50	50	100	2
Summer Internship 2 Months (Mandatory) after 3rd year (to be evaluated during IV year I Semester)								
Total Credits								**22**

AI4107 Natural Language Processing Lab

Prerequisite:

- Students should have knowledge about mathematics concepts
- Students should have knowledge about python programming and Machine Learning concepts

Course objectives

- To learn the fundamentals of natural language processing.
- To understand the use of CFG and PCFG in NLP.
- To understand the role of semantics of sentences and pragmatics.
- To apply the NLP techniques to IR applications

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

- Use the NLTK and spaCy toolkit for NLP Programming.
- Analyze various corpora for developing programs.
- Develop various pre-processing techniques for a given corpus.
- Develop programming logic using NLTK functions.
- Build applications using various NLP techniques for a given corpus.

LIST OF PROGRAMS

1. Installation and exploring features of NLTK and spaCy tools. Download Word Cloud and few corpora.

2. (i) Write a program to implement word Tokenizer, Sentence and Paragraph Tokenizers.
   (ii) Check how many words are there in any corpus. Also check how many distinct words are there?

3. (i) Write a program to implement both user-defined and pre-defined functions to generate
   (a) Uni-grams
   (b) Bi-grams
   (c) Tri-grams
   (d) N-grams
   (ii) Write a program to calculate the highest probability of a word (w2) occurring after another word(w1).

4. (i) Write a program to identify the word collocations.
   (ii) Write a program to print all words beginning with a given sequence of letters.
   (iii) Write a program to print all words longer than four characters.

5. (i) Write a program to identify all antonyms and synonyms of a word.
   (ii) Write a program to find hyponymy, homonymy, polysemy for a given word.

6. (i) Write a program to find all the stop words in any given text.
   (ii) Write a function that finds the 50 most frequently occurring words of a text thatare not stop words.
7. Write a program to implement various stemming techniques and prepare a chart with the performance of each method

8. Write a program to implement various lemmatization techniques and prepare a chart with the performance of each method.

9. (i) Write a program to implement Conditional Frequency Distributions (CFD) for any corpus.
   (ii) Find all the four-letter words in any corpus. With the help of afrequency distribution (FreqDist), show these words in decreasing order of frequency.
   (iii) Define a conditional frequency distribution over the names corpus that allows you to see which initial letters are more frequent for males versus females.

10. (i) Write a program to implement Part-of-Speech (PoS) tagging for any corpus.
    (ii) Write a program to identify which word has the greatest number of distinct tags? What are they, and what do they represent?
    (iii) Write a program to list tags in order of decreasing frequency and what do the 20 most frequent tags represent?
    (iv) Write a program to identify which tags are nouns most commonly found after? Whatdo these tags represent?

11. Write a program to implement TF-IDF for any corpus.

12. Write a program to implement chunking and chinking for any corpus.

13. (i) Write a program to find all the mis-spelled words in a paragraph.
    (ii) Write a program to prepare a table with frequency of mis-spelled tags for any given text.

14. Write a program to implement all the NLP Pre-Processing Techniques required to perform further NLP tasks.

Case Studies: (At Least any one Case Study has to be performed)

Case Study-1. Write a program to implement Named Entity Recognition (NER) for any corpus.
Case Study-2. Write a program to perform Auto-Correction of spellings for any text.

Reference Books:

1. Toolkit Steven Bird, Ewan Klein, and Edward Loper, “Natural Language Processing with Python– Analyzing Text with the Natural Language”.

Web References:

1. http://www.nptelvideos.in/2012/11/natural-languageprocessing.html

Software Engineering
Professional Elective
Syllabus

Prerequisite:

- Basic knowledge of Computer Science, C and Object-Oriented Programming.

Course objectives:

- To understand the phases of Software Development common process models.
- To obtain hands-on experience with elements of the agile process.
- To understand requirements engineering, analysis and design principles in a solicited manner.
- To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To discuss various software testing issues and solutions in unit, integration, regression, and system testing.
- To learn how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report.
- To understand software test automation problems and solutions.

Course Outcomes:

By the end of the course, the student should:

- Transform an Object-Oriented Design into high quality, executable code
- Compare conventional and agile software methods and produce the requirements in a suitable manner
- Produce the analysis and design for any real-time project and implement the basic testing procedures to generate test cases
- Test the applications manually by applying different testing methods and automation tools.
- Apply tools to resolve the problems in Real time environment

SYLLABUS

Introduction to Software Engineering: The Nature of Software, The Unique Nature of WebApps, 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.

Agile Process: 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,

Requirements Engineering and Design: Requirements Engineering, Eliciting Requirements, Developing Use Cases, Building the Requirements Model.
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 WebApps.

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, relating test life cycle to development life cycle Software Testing Methodology.

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. Testing Web based Systems: Challenges in testing for web-based software, quality aspects, web engineering, testing of web-based systems, Testing mobile systems.

Text Book:

1. Software Engineering a practitioner's approach, Roger S. Pressman, Seventh Edition, McGraw Hill Higher Education.
2. Software Testing: Principles and Practices - Naresh Chauhan, Oxford.

Reference Books:

1. Software Engineering, Ian Sommerville, Ninth Edition, Pearson.
2. Software testing techniques – Boris Beizer, Dreamtech, second edition.

Reinforcement Learning
Professional Elective
Syllabus

Prerequisite:

- Basics of optimization process and knowledge of dynamic programming.
- Basics of Machine learning and deep learning techniques.

Course Objectives:

By the end of the class students should be able to:

- Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.
- Knowledge on fundamentals of reinforcement learning and the methods used to create agents that can solve a variety of complex tasks

Course Outcomes

- Understand basics of RL.
- Understand RL Framework and Markov Decision Process.
- Analysing through the use of Dynamic Programming and Monte Carlo.
- Understand TD (0) algorithm, TD(λ) algorithm.
- Recognize current advanced techniques and applications in RL

SYLLABUS

Elements of Reinforcement Learning and scope, Tic-Tac-Toe, Multi-arm Bandits: n-Armed Bandit Problem. Incremental Implementation, Tracking Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandit, Associative Search

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

Reinforcement Learning prediction and control problems, Model-based algorithm. Monte Carlo-Prediction, Estimation of Action Values, Control, Control without Exploring Start, Temporal-Difference learning: TD Prediction, Advantages of TD Prediction Methods

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

Eligibility Traces: n-Step TD Prediction, Forward and Backward View of TD(λ), Equivalences of Forward and Backward Views, saras(λ), Watkin's Q(λ), Off-policy Eligibility Traces using Important Sampling, Variable λ.

Planning and Learning with Tabular Methods: Models and Planning, Integrating Planning, Acting and Learning, Prioritized Sweeping, Full vs. Sample Backups, Trajectory Sampling, Heuristic Search, Monte Carlo Tree Search.

Text Books:

1. “Reinforcement learning: An introduction,” First Edition, Sutton, Richard S., and Andrew G. Barto, MIT press 2020.
2. Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone parisi, Reinforcement Learning Algorithms: Analysis and Applications, 1st Edition, Springer, 2021.

Reference Books:

1. “Bandit algorithms,” First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020
2. Phil Winder, Reinforcement Learning: Industrial Applications of Intelligent Agent, 1st Edition, O’Reilly, 2020.

Modern Cryptography & Network Security
Professional Elective
Syllabus

Prerequisite: Basics Computer Networks and Security

Course Objectives:

- identify security risks and take preventive steps
- understand the forensics fundamentals
- The main objectives of this course are to explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests.
- Public key algorithms, design issues and working principles of various authentication protocols and various secure communication standards including Kerberos, IPSec, and SSL/TLS.

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

- Explain the Cybercrime Fundamentals
- Describe the types of attacks on networks
- Explain different security threats and countermeasures and foundation course of cryptography mathematics.
- Classify the basic principles of symmetric key algorithms and operations of some symmetric key algorithms and asymmetric key cryptography
- Revise the basic principles of Public key algorithms and Working operations of some Asymmetric key algorithms such as RSA, ECC and some more
- Design applications of hash algorithms, digital signatures and key management techniques
- Determine the knowledge of Application layer, Transport layer and Network layer security Protocols such as PGP, S/MIME, SSL, TSL, and IPSec .

SYLLABUS

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyber stalking, Cyber cafe and Cybercrimes, Bonnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

Basic Principles: Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography.

Symmetric Encryption: Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

Asymmetric Encryption: Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

Data Integrity: Digital Signature Schemes & Key Management: Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.

Network Security-I: Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS**, Network Security-II** : Security at the Network Layer: IPSec, System Security

Text Books:

1. Cryptography and Network Security, 3rd Edition Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill,2015
2. Cryptography and Network Security,4th Edition, William Stallings, (6e) Pearson,2006
3. Sunit Belapure Nina God bole "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY, 2011.

Reference Books:

1. Network Security and Cryptography, 1st Edition, Bernard Ménages, Cengage Learning,2018
2. Michael T. Simpson, Kent Backman and James E. Corley, "Hands on Ethical Hacking and Network Defence", Cengage, 2019.

Security and Privacy in Cloud
Professional Elective
Syllabus

Prerequisite:

- Students will have the skills to describe the architecture of cloud systems, understand the role of virtualization
- Students will be able to define cloud computing, describe its evolution, identify its essential characteristics
- Students will understand the principles of business continuity planning and disaster recovery within the cloud computing context.

Course Objectives

- Understand the Fundamentals of Cloud Computing:
- Explore Cloud Architecture and Technologies:
- Grasp Cloud Security and Privacy:
- Learn about Cloud Business Continuity and Disaster Recovery

Course Outcomes

- Demonstrate Understanding of Cloud Computing Concepts
- Apply Knowledge of Cloud Architecture and Virtualization
- Analyze and Implement Cloud Security Measures
- Plan for Business Continuity and Disaster Recovery in the Cloud
- Navigate Cloud Compliance and Security Standards

SYLLABUS

Cloud Computing Fundamentals- Definition, Evolution, Essential characteristics, Cloud Deployment Models, Cloud Service Models, Benefits, Cloud Architecture, Virtualization in Cloud, Cloud Data Centre, SLA, Cloud Applications.

Cloud Security Challenges, Cloud Information Security Objectives, Cloud Security Services, Secure Cloud Software Requirements, Cloud Security Policy Implementation, Infrastructure Security, Data Security and Storage, Privacy in Cloud.

Threats and Vulnerabilities to Infrastructure, Data, and Access Control; Risk Management and Risk Assessment in Cloud, Cloud Service Provider Risks, Virtualization Security Management in the Cloud, Trusted Cloud Computing, Identity Management and Access Control.

Cloud Computing and Business Continuity Planning/Disaster Recovery, Cloud Audit and Compliance: Internal Policy Compliance, Regulatory/External Compliance, Cloud Security Alliance.

Standards for Security: SAML OAuth, OpenID, SSL/TLS, Encrypting Data and Key Management, Creating a Cloud Security Strategy, The Future of Security in Cloud Computing.

Text Book:

1. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

Reference Books:

1. Tim Mather, SubraKumaraswamy, and ShahedLatif, ” Cloud Security and Privacy", Published by O’Reilly Media, Inc., 2009
2. Vacca, J. R. (Ed.). (2016). Cloud computing security: Foundations and challenges. Boca Raton, FL: CRC Press, Taylor and Francis Group.ISBN-13: 978-1482260953

Compiler Design
Professional Elective
Syllabus

Prerequisites:

- Proficiency in programming languages.
- Knowledge of data structures and algorithms.
- Understanding of discrete mathematics.
- Familiarity with computer architecture.
- Understanding of programming language theory.

Course objectives:

- To explain the basic understanding of grammars and language definition and introducing various phases of designing a compiler.
- To make the student to understand the concepts underlying the design and implementation of language processors and its mechanisms.
- To extend the knowledge of parser by parsing LL parser and LR parser.
- To enrich the knowledge in various phases of compiler ant its use, code optimization techniques, loop optimization techniques, machine code generation, and use of symbol table.

Course outcomes:

- Ability to understand grammars, language definitions and various phases of designing a compiler.
- Ability to understand Language processors and different parsers.
- Ability to learn the new code optimization techniques to improve the performance of a program in terms of speed & space.
- Ability to do usage of registers in efficient manner during the program execution.
- Ability to acquire the knowledge of modern compiler & its features.

Introduction: Introduction to Compilers and Language processors, Programming Language basics, Structure & Different Phases of a Compiler, Review of Compiler Structure, Structure of Optimizing Compilation, Compiler construction tools, Boot strapping, Cross compilers.

Finite Automata & Lexical Analysis: Introduction to Lexical Analysis, Lexical Analyzers, Approaches to design Lexical Analysers, Language for specifying lexical analyzers, Introduction to Finite automata, Regular Expressions & Languages, Recognition of Tokens, Transition Diagrams, Implementation of lexical analyzers, Lexical Analyzer Generator LEX.

Syntax Analysis: Syntactic Specification of Programming Languages, Context Free Grammars & Languages, Introduction to Parsers. Top-down parsing techniques: Brute force parsing, Recursive Descent Parsing, Predictive Parsing, Bottom–up Parsing: Shift reduce parsing, Operator parsing, LR (k) parsing.

Semantic Analysis and Intermediate Code Generation: Semantic Actions, Syntax Directed

Translations, Translation on the parse Tree, Implementation of Syntax Directed Translator, Intermediate Codes, Syntax Directed translation to Postfix code, Syntax Trees, Intermediate Code Generation, Three Addr5ess Code-Translation of Expressions, Type Checking & Type Conversions.

Code Optimization: Principal sources of Code Optimization, Loop Optimization, Basic Blocks & Flow Graphs, DAG Representation of Basic Blocks, Applications of DAG, Local Optimization, Unreachable Code Elimination, Dead Code Elimination, Data Flow Analysis, Data Flow Equations & Computations, Peep-Hole Optimization. Machine Dependent Optimizations, Overview of Informal Compiler Algorithm

Notation (ICAN), If Simplification, Loop Simplification, Loop Inversion, Branch Optimization and Prediction

Code Generation and Code Scheduling: Issues in Code Generation, Input to Code Generator, Instruction Selection, Register Allocation, Simple Target Machine Model, Program and Instruction Costs,Register allocation & Assignments, Code Generation Algorithm, Code Generators, Optimal Code Generation for Expressions, Code Generation From DAG.

Symbol Tables, Runtime Environment and Error Handling: Contents of a Symbol Table, Data Structures for Symbol Tables; Run time Environments, Implementation of a simple Stack allocation, Heap Management, Block Structured Languages; Error Detection & Recovery, Lexical Phase Errors, Syntactic & Semantic Errors, Error Handling Routines.

Text Books:

1. Principles of Compiler Design by Aho.D. Ullman, Lam and Ravi Sethi, Pearson Education Second Edition
2. Advanced Compiler Design and Implementation, Steven Muchnic, Elsevier Publications.

Reference Books:

1. Compiler Construction by Kenneth. C. Louden, Vikas Pub. House.
2. Compiler Design, A.A. Pentambekar, Technical Publications
3. Modern Compiler Design, Grune.D, Van Reeuwijk K, Bal H.E, Jacobs C J H, Lan gendoen K, Springer,

Augmented Reality and Virtual Reality
Professional Elective
Syllabus

Prerequisites: Mathematics, Physics, Programming and Problem Solving, Engineering Graphics, Solid Modeling and Drafting, Numerical & Statistical Methods, Mechatronics, Artificial Intelligence &Machine Learning, Computer Aided Engineering

Course Objectives:

- Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction
- Techniques related to VR/AR
- Review the Geometric Modeling Techniques
- Review the Virtual Environment
- Discuss and Examine VR/AR Technologies
- Use of various types of Hardware and Software in Virtual Reality systems
- Simulate and Apply Virtual/Augmented Reality to varieties of Applications

Course Outcomes:
On completion of the course the learner will be able to;

- UNDERSTAND fundamental Computer Vision, Computer Graphics and Human Computer Interaction Techniques related to VR/AR
- UNDERSTAND Geometric Modeling Techniques
- UNDERSTAND the Virtual Environment
- ANALYZE and EVALUATE VR/AR Technologies
- APPLY various types of Hardware and Software in Virtual Reality systems
- DESIGN and FORMULATE Virtual/Augmented Reality Applications

SYLLABUS

Unit 1 Introduction to Virtual Reality (VR):
Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.

Unit 2 Computer Graphics and Geometric Modelling
The Virtual world space, positioning the virtual observer, the perspective projection, human vision,stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection.

Unit 3 Virtual Environment
Input/Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Video based Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices)
Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems,

Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system
Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels,
Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

Unit 4 Augmented Reality (AR)
Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating ARsystems.

Unit 5 Development Tools and Frameworks
Human factors: Introduction, the eye, the ear, the somatic senses
Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems
Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML

Unit 6 AR / VR Applications
Introduction, Engineering, Entertainment, Science, Training, Game Development

Text Books:

1. Coiffet, P., Burdea, G. C., (2003), "Virtual Reality Technology," Wiley-IEEE Press, ISBN: 9780471360896
2. Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson, ISBN: 9789332578494

References Books:

1. Norman, K., Kirakowski, J., (2018), " Wiley Handbook of Human Computer Interaction," Wiley-Blackwell, ISBN: 9781118976135
2. LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), "3D User Interfaces: Theory and Practice," Pearson, ISBN: 9780134034324
3. Fowler, A., (2019), "Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#," Apress, ISBN: 9781484246672
4. Hassanien, A. E., Gupta, D., Khanna, A., Slowik, A., (2022), "Virtual and Augmented Reality for Automobile Industry: Innovation Vision and Applications," Springer, ISBN: 9783030941017

Object-Oriented Analysis and Design
Professional Elective
Syllabus

Prerequisite:

- Basics of Software Engineering
- Basics of Objects Oriented Programming Concepts.

Course objectives:

Become familiar with all phases of OOAD.

- Master the main features of the UML.
- Master the main concepts of Object Technologies and how to apply them at work and develop the ability to analyse and solve challenging problem in various domains.
- Learn the Object design Principles and understand how to apply them towards Implementation

Course Outcomes:

- Analyze the nature of complex system and its solutions.
- Illustrate & relate the conceptual model of the UML, identify & design the classes and relationships
- Analyze &Design Class and Object Diagrams that represent Static Aspects of a Software System and apply basic and Advanced Structural Modeling Concepts for designing real time applications.
- Analyze & Design behavioral aspects of a Software System using Use Case, Interaction and Activity Diagrams.
- Analyze & Apply techniques of State Chart Diagrams and Implementation Diagrams to model behavioral aspects and Runtime environment of Software Systems

SYLLABUS

Introduction: The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos, Designing Complex Systems. Case Study: System Architecture: Satellite-Based Navigation.

Introduction to UML: Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture, and Software Development Life Cycle. **Basic Structural Modeling**: Classes, Relationships, common Mechanisms, and diagrams. Case Study: Control System: Traffic Management.

Class & Object Diagrams: Terms, concepts, modeling techniques for Class & Object Diagrams**. Advanced Structural Modeling:** Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. Case Study: AI: Cryptanalysis.

Basic Behavioral Modeling-I: Interactions, Interaction diagrams Use cases, Use case Diagrams, Activity Diagrams. Case Study: Web Application: Vacation Tracking System

Advanced Behavioral Modeling: Events and signals, state machines, processes and Threads, time and space, state chart diagrams. **Architectural Modeling**: Component, Deployment, Component diagrams and Deployment diagrams Case Study: Weather Forecasting.

Text Book:

1. Grady BOOCH, Robert A. Maksimchuk, Michael W. ENGLE, Bobbi J. Young, Jim Conallen, Kellia Houston , "Object- Oriented Analysis and Design with Applications", 3rd edition, 2013, PEARSON.
2. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education.

Reference Books:

1. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education.
2. Pascal Roques: Modeling Software Systems Using UML2, WILEY- Dreamtech India Pvt. Ltd.
3. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies.
4. Appling UML and Patterns: An introduction to Object – Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education.

Image and Video Analytics
Professional Elective
Syllabus

Prerequisite:

- Students should have knowledge about Machine Learning concepts
- Students should have knowledge about Mathematics, Image Processing and Deep Learning concepts

Course objectives:

- To understand the basics of image processing techniques for computer vision.
- To learn the techniques used for image pre-processing.
- To discuss the various object detection techniques.
- To understand the various Object recognition mechanisms.
- To elaborate on the video analytics techniques

Course Outcomes:

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

- Understand the basics of image processing techniques for computer vision and video analysis.
- Explain the techniques used for image pre-processing.
- Develop various object detection techniques.
- Understand the various face recognition mechanisms.
- Elaborate on deep learning-based video analytics.

SYLLABUS

Computer Vision: Image representation and image analysis tasks – Image representations -digitization – properties – color images – Data structures for Image Analysis – Levels of image data representation – Traditional and Hierarchical image data structures.

Image pre-processing: Local pre-processing – Image smoothing – Edge detectors – Zero-crossings of the second derivative – Scale in image processing – Canny edge detection – Parametric edge models – Edges in multi-spectral images – Local pre-processing in the frequency domain – Line detection by local pre-processing operators – Image restoration.

Object detection using Deep Learning: Object detection– Object detection methods – Deep Learning framework for Object detection–bounding box approach-Intersection over Union (IoU)

Deep Learning Architectures: R-CNN-Faster-R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

Face recognition and **gesture** recognition**:** Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet-Gesture Recognition.

Video analytics: Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3.

Text Book:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013(UNIT-I and II)
2. Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras, Apress 2021 (UNIT-III,IV, V and VI)

Reference Books:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011.
2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.
3. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
4. E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.

Digital and Mobile Forensics
Professional Elective
Syllabus

Prerequisite:

- A foundational knowledge of cybersecurity concepts, understanding of computer networks, operating systems (including mobile platforms like Android and iOS), digital forensics tools and techniques, familiar mobile device architecture

Course objectives:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation.
- To understand how to be prepared for digital forensic readiness.
- To understand and use forensics tools for iOS devices.
- To understand and use forensics tools for Android devices.

Course outcomes:

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

- Have knowledge on digital forensics.
- Know about digital crime and investigations.
- Be forensic ready.
- Investigate, identify and extract digital evidence from iOS devices.
- Investigate, identify and extract digital evidence from Android devices.

SYLLABUS

Introduction To Digital Forensics Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase

Digital Crime And Investigation Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

Digital Forensic Readiness Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics

Ios Forensics Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud

Android Forensics Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

Text books:

1. Andre Arnes, “Digital Forensics”, Wiley, 2018.
2. Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.

Reference Books:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

Soft Computing
Professional Elective
Syllabus

Prerequisite: A strong mathematical background, Proficiency with algorithms, Programming skills in C, C++, or Java, MATLAB, etc., Critical thinking and problem solving skills.

Course objectives:

- To explain the role of Soft Computing in addressing the imprecision anduncertainty in real world scenarios.
- To explain fuzzy systems, fuzzy logic and its applications.
- To explain Artificial Neural Networks and various categories of ANN.
- Design hybrid system to revise the principles of soft computing in various applications.
- To explain Genetic algorithms and rough set

Course Outcomes:

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

- Ability to represent Uncertainty / imprecision data.
- Understand perceptrons and counter propagation networks.
- Ability to select a suitable method of Soft Computing to solve a particularproblem.
- Ability to build hybrid systems using Soft Computing techniques.
- Analyze the genetic algorithms and their applications.

SYLLABUS

Soft Computing: Introduction to Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Different Tools and Techniques, Usefulnessand Applications.

Fuzzy Sets and Fuzzy Logic: Introduction, Fuzzy Sets Versus Crisp Sets, Operations on FuzzySets, Extension Principle, Fuzzy Relations and Relation Equations, Fuzzy Numbers, Linguistic Variables, Fuzzy Logic, Linguistic Hedges, Applications,

Interference in fuzzy logic: fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzifications and Defuzzificataions, Fuzzy Controller, Fuzzy Controllers, Fuzzy Pattern Recognition, Fuzzy Image Processing, Fuzzy Database.

Artificial Neural Network: Introduction, Artificial Neuron and its model, activation functions,Neural network architecture: single layer and multilayer feed forward networks, re-current networks. Various learning techniques, perception and convergence rule, Auto-associative and hetro-associative memory, Hebb's Learning, Adaline, Perceptron.

Multilayer Feed Forward Network: Back Propagation Algorithms, Different Issues Regarding Convergence of Multilayer Perceptron, Competitive Learning, Self-Organizing, Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Evolutionary and Stochastic Techniques: Genetic Algorithm (GA), Genetic Representations, (Encoding) Initialization and Selection, Different Operators of GA, Analysis of SelectionOperations, Hypothesis of Building Blocks, Schema Theorem and Convergence of Genetic Algorithm, Simulated Annealing and Stochastic Models, Boltzmann Machine, Applications.

Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables and Applications. Hybrid Systems: Neural Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications

Text Books:

1. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, S.Rajsekaran and G.A. VijayalakshmiPai, Prentice Hall of India.
2. Rough Sets, Z.Pawlak, Kluwer Academic Publisher, 1991.
3. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997

References:

1. Artificial Intelligence and Intelligent Systems, N.P.Padhy, Oxford University Press.
2. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice Hall PTR.Addison-Wesley
3. Learning and Soft Computing, V. Kecman, MIT Press, 2001
4. Fuzzy Sets and Fuzzy Logic, Klir& Yuan, PHI, 1997

Software Project Management
Professional Elective
Syllabus

Prerequisite:

- Students should have knowledge about Software Engineering concepts
- Students should have knowledge about basic mathematics and programming concepts

Course Objectives:

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

- To understand the Software Project Planning and Evaluation techniques.
- To plan and manage projects at each stage of the software development life cycle (SDLC).
- To learn about the activity planning and risk management principles.
- To manage software projects and control software deliverables.
- To develop skills to manage the various phases involved in project management and people management.
- To deliver successful software projects that support organization ‘s strategic goals.

Course outcomes:

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

- Understand Project Management principles while developing software.
- Gain extensive knowledge about the basic project management concepts, framework and the process models.
- Obtain adequate knowledge about software process models and software effort estimation techniques.
- Estimate the risks involved in various project activities.
- Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.
- Learn staff selection process and the issues related to people management

SYLLABUS

Introduction to Software Project Management: Introduction to Project and Project Management, Reasons for IT project failure, Triple constraint of IT project management, Management spectrum of project, Overview of project life cycle models, Project manager skills and job description conceptualization and initiation of IT project, Business case.

Project Charter: Introduction, Project management process and their correlation with project life cycle phases, Introduction to Project Integration management and seven processes, Project Charter.

Project Scope Management: Introduction, Processes of scope management.

Project Human Resource Management: Introduction, Organizational structure – Function, Project and Matrix, Keys to managing people motivation theories and improving effectiveness, Project team selection.

Project Time and Cost Management: Introduction, Development of project schedule, CPM

and PERT, Activities their sequencing and dependencies, Project network diagrams, Development of Gantt Charts, Earned Value Management, Introduction to Constructive Cost Model (COCOMO).

Project Risk Management: Introduction, Risk Management Process, Risk Identification for IT projects, Qualitative and Quantitative approaches to Risk Analysis, Risk Strategies, Risk Monitoring and Control, Risk Response and Evaluation Project Quality Management.

Project Communication Management: Introduction, Project Communication Plan, Project metrics, Information distribution, Performance Reporting. Project Change Management: Introduction, Impact of change, Change as a process, Change Management plan, Dealing with resistance and conflict, Configuration management.

Project Procurement Management: Introduction, Processes Planning Purchases and Acquisition, Contracting, Request Seller Responses, Select Sellers, Contract Administration, Contract Closure, Outsourcing of products and services.

Project Leadership and Ethics: Introduction, Project Leadership, Modern approaches, Styles of leadership, Ethical leadership, Making sound ethical decisions in the situations of conflict. Closure of a Project: Introduction, Project implementation, Administrative closure, Project Evaluation.

Text Book:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

References:

1. Robert K. Wysocki ―Effective Software Project Management – Wiley Publication, 2011.
2. Walker Royce: ―Software Project Management- Addison-Wesley, 1998.
3. opalaswamy Ramesh, ―Managing Global Software Projects – McGraw Hill Education (India), Fourteenth Reprint 2013

Ethical Hacking
Professional Elective
Syllabus

Prerequisite:

- Students should have an understanding of computer networking, operating systems (especially Linux and Windows), programming languages (such as Python, C, or Java), and cybersecurity fundamentals

Course Objectives:

- The aim of the course is to introduce the methodologies and framework of ethical hacking for enhancing the security.
- The course includes-Impacts of Hacking; Types of Hackers; Information Security Models, Information Security Program, Business Perspective, Planning a Controlled Attack
- Framework of Steps (Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Deliverable and Integration)

Course Outcomes:

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

- To express knowledge on basics of computer based vulnerabilities
- To gain understanding on different foot printing, reconnaissance and scanning methods.
- To demonstrate the enumeration and vulnerability analysis methods
- To gain knowledge on hacking options available in Web and wireless applications.
- To acquire knowledge on the options for network protection. To use tools to perform ethical hacking to expose the vulnerabilities

SYLLABUS

Introduction to Hacking: Hacking, Types and phases of hacking, **Introduction to Ports & Protocols**: Ports, Protocols, Primary Network Types, **Virtualization & Introduction to Kali Linux:** Virtualization, Virtualization software, supported platforms, **Introduction to Penetration Testing:** Penetration test, Categories and Types of Penetration tests, Structure of Penetration Test Report

Footprinting: Footprinting, Types, Using ping and ns Lookup commands in Windows command line, **Scanning:** Scanning, Basics of Scanning, Basic Techniques of Scanning, Enumerating DNS using dns enum, Performing flag scan using hping3.

Hacking into System: System Hacking, Password Cracking, Default password databases, Manual and Automated Password Cracking, Process of System Hacking, Using Keyloggers, **Trojans & Backdoors:** Trojans, Working of Trojan, Infection Techniques, Attack, Lifecycle and Classification of Virus, Worms, Virus Construction Kit.

Sniffing, Packet Analysis & Session Hijacking: Sniffing, Packet Analysis, Types of Sniffing, Active and Passive Sniffing Techniques, Session Hijacking, **Social Engineering:** Social Engineering, Process, Identity Theft, Human and Computer Based Social Engineering

Cryptography: Cryptography, Digital Signature, Hash Functions, **Steganography:** Steganography Process, watermarking, Steganography Methods and Attacks, Steganography tools, **Vulnerability Assessment:** Vulnerability, The Open Web Application Security Project (OWASP), Prevention, Damn Vulnerable Web Application (DVWA), installation and testing of DVWA

Text Books:

1. Hacking: Be a Hacker with Ethics, Harsh Bothra, Khanna Publications, 2019
2. Ethical Hacking and Penetration Testing Guide, Rafay Baloch, 2014

Reference Books:

1. Kali Linux Wireless Penetration Testing Beginner's Guide, Vivek Ramachandran, Cameron Buchanan, Packt Publishing, 2015
2. SQL Injection Attacks and Defense, 1st Edition, Justin Clarke-Salt, Syngress Publication
3. Mastering Modern Web Penetration Testing, Prakhar Prasad, Packt Publishing, October 2016

Quantum Computing
Professional Elective
Syllabus

Prerequisite: Basic quantum mechanics, Linear algebra, Basic group theory (and generally basic abstract algebra), Basic probability and stochastic processes, Fourier transforms, Design and Analysis of Algorithms, Cryptography.

Course objectives:

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and its relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the basics of quantum information and the theory behind it.

Course Outcomes:

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

- Explain the basic concepts of quantum computing and the background of Quantum Mechanics.
- Illustrate in-depth overview of what matrices and operators perform operations on vectors, focusing on their applications in quantum.
- Model the circuits using quantum computation environments and frameworks.
- Demonstrate the quantum operations such as Tensor Products, Multi-Qubit Systems and error–correction.
- Choose effective quantum and cryptography algorithms operating on a fault-tolerant quantum computer can solve all kinds of quantum and classical problems.

SYLLABUS

Quantum Computing Basic Concepts: Introduction - Complex Numbers, Vector Space, and Dirac Notation, Inner Product, Linearly Dependent and Independent Vectors, Dual Vector. Basics of Quantum Mechanics - Limitations of Classical Physics, Photoelectric Effect, Classical Electromagnetic Theory, Postulates of Quantum Mechanics

Matrices and Operators: Matrices, Square Matrices, Diagonal (or Triangular) Matrix, Operators, Linear Operator, Commutator, Matrix Representation of a Linear Operator, Symmetric Matrix, Transpose Operation, Orthogonal Matrices, Identity Operator, Adjoint Operator, Hermitian Operator, Unitary Operators, Properties of Unitary Operators, Projection Operator.

Boolean Algebra, Logic Gates, and Quantum Information Processing: Boolean Algebra, Classical Circuit Computation Model, Universal Logic Gates, Quantum Computation, The Quantum Bit and Its Representations, Superposition in Quantum Systems, Quantum Register

Quantum Gates and Circuits: X Gate, Y Gate, Z Gate, (Square Root of NOT) Gate, Hadamard Gate, Phase Gate, T Gate, Reversible Logic, CNOT Gate, Controlled-U Gate, and Reversible Gates.

Tensor Products, Superposition: Tensor Products, Multi-Qubit Systems, Superposition

Quantum Error Correction: Classical Error-Correcting Codes, Quantum Error-Correcting Codes, Shor's 3-Qubit Bit-Flop Code, Error Correction, Bit-Flip Error Correction, Phase Error Correction, Shor's 9 Qubit Code.

Quantum Algorithms: Deutsch's Algorithm, Deutsch–Jozsa Algorithm, Grover's Search Algorithm, Details of Grover's Algorithm, Shor's Factoring Algorithm

Quantum Cryptography: Principles of Information Security, One-Time Pad, Public Key Cryptography, RSA Coding Scheme, Quantum Cryptography, Quantum Key Distribution.

Text Book:

1. Parag K Lala, Mc Graw Hill Education, First edition (2020), "Quantum Computing, A Beginners Introduction". Price: 1000
2. Chris Bernhardt, The MIT Press; Reprint edition (2020), "Quantum Computing for Everyone". Price: 1000

Reference Books:

1. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010. Price: 1000
2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
3. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

Computer Vision
Professional Elective
Syllabus

Prerequisite: Machine Learning, Deep Learning

Course objectives:

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- To enable students to study about computer vision on dealing with real world images and videos
- identify basic concepts, terminology, theories, models, and methods in the field of computer vision
- describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, motion, and object recognition.
- suggest a design of a computer vision system for a specific problem.

Course Outcomes:

- Identify basic concepts, terminology, theories, models, and methods in the field of computer vision.
- Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion, and object recognition.
- Choose appropriate computer vision methods for edge detection, object recognition, filtering etc.
- Develop and apply computer vision techniques for solving practical problems.
- Experiment with images in computer vision.

SYLLABUS

Introduction to Computer Vision: Introduction to Computer vision, Real time computer vision applications, Image representation and analysis.

Feature Engineering: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Feature modeling and analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Computer Vision applications: Classifiers – Deep Neural Network (DNN), Object tracking, Model based vision, Finding Templates and Recognition, Case study 1: Face recognition system, Case Study 2: Vehicle anomaly detection in video surveillance.

Feature detection and matching: Points and patches, Edges and contours , Contour tracking , Lines and vanishing points, Segmentation, Image alignment and stitching- Pairwise alignment, Image stitching, Global alignment , Compositing

Textbook:

1. Szeliski, Richard. Computer vision: algorithms and applications. Springer Nature, Second Edition, 2022.
2. E. R. Davies**,** Computer Vision Principles, Algorithms, Applications, Learning, Elsevier, 5th Edition, 2017.

Reference Books:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Fourth Edition, Pearson Education, 2018.
2. Richard Szeliski ,"Computer Vision: Algorithms and Applications" , Springer 2015

Cloud Computing
Professional Elective
Syllabus

Prerequisite:

- Students should have knowledge about networking concepts
- Students should have knowledge about security concepts

Course objectives:

- To define Cloud Computing and expose the students to the frontier areas of Cloud Computing
- To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
- To introduce various levels of services that can be achieved by cloud.
- To gain knowledge on virtualization techniques.
- To understand the working methodology of existing clouds, such as, Amazon, Google and Azure

Course Outcomes:

- Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
- Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
- Classify the Levels of Virtualization and mechanism of tools and Analyse Cloud Architectures.
- Assess Control Storage Systems.
- Get an idea and set up Private Clouds.

SYLLABUS

History of Computing Paradigms - Overview of Distributed Computing, Cluster computing, Grid computing, Ubiquitous Computing, Peer-to-Peer Computing. Distributed system Models and enabling Technologies.

Introduction to Cloud Computing - Cloud Computing and Service Models- Public, Private, and Hybrid Clouds, Cloud Ecosystem and Enabling Technologies, Infrastructure-as-a-Service (IaaS, Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS).

Virtual Machines and Virtualization - Implementation Levels of Virtualization, VMM Design Requirements and Providers, Virtualization Support at the OS Level, Middleware Support for Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management

Public Cloud Platform- Architectures and Programming: Google App Engine (GAE), Amazon Web Services (AWS), Microsoft Windows Azure. Service Oriented Architecture: REST, Publish Subscribe Model.

Storage Systems - Storage Models, File Systems, and Databases, Distributed File Systems, General Parallel File System, Google File Systems, Apache Hadoop, Locks and Chubby: A Locking Service, Transaction Processing and NoSQL Databases, Big Table, Mega Store.

Case Studies – The GrepTheWeb Application, Aneka Application of Maya Rendering Case Study.

Text Book:

1. Kai Hwang, Geoffrey C. Fox, Jack K. Dongarra, Distributed and Cloud Computing: From parallel processing to Internet of Things, Morgen Kauffmann 2013.
2. Cloud Computing Theory and Practice, Dan C. Marinescu.

Reference Books:

1. Cloud Computing: A Practical Approach Anthony T.Velte Toby J.Velte, Ph.D. Robert Elsenpeter
2. Cloud Computing Bible, Barrie Sosinsk.
3. Cloud computing - Course (nptel.ac.in)

Natural Language Processing
Professional Elective
Syllabus

Prerequisites:

- Programming Language Basics
- Basics in Mathematics
- Statistics

Course Objectives:

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines text representations and NLP algorithms using both the traditional symbolic and the more recent statistical and distributional approaches.
- Enable students to develop NLP models for text classification, information extraction, and dialog systems
- Provides a comprehensive study on NLP applications in a wide variety of domains

Course Outcomes:

- Understand the basic concepts and challenges of NLP and different stages of NLP Pipeline
- Understand and analyze various representational approaches starting from vectorization-based to distribution-based embeddings for processing natural language text
- Build and interpret machine learning and deep learning models for Text Classification
- Understand basic concepts of information extraction for building different variants of NER systems and the concepts and challenges underlying the development of dialog systems / chatbots
- Understand the approach and analyze the effectiveness of NLP applications in different domains.

SYLLABUS

INTRODUCTION TO NLP and NLP Pipeline:

NLP tasks and applications, building blocks of language, NLP challenges, Basic approaches to NLP-Heuristics based NLP, Machine Learning for NLP, Deep Learning forNLP. NLP Pipeline- Data Acquisition, Text Extraction and Cleanup, Pre-processing, Feature Engineering, Building the model, Evaluation.

TEXT REPRESENTATION

Vector space models, Basic Vectorization approaches, Distributed representations, Distributed representations beyond words and characters, Universal Text Representations, visualizing embeddings.

TEXT CLASSIFICATION:

Applications of text classification, Pipeline for building Text classification systems, One pipeline-many classifiers- Naïve Bayes, Logistic regression, SVM, Using Neural Embeddings in Text Classification, Deep Learning for Text Classification, Interpreting text classification models, Learning with no or less data and adapting to new domains, case study on corporate ticketing.

INFORMATION EXTRACTION:

Information Extraction-IE Applications, IE Tasks, General IE Pipeline, Keyphrase Extraction,Named Entity Recognition, Building an NER System, Building an NER System usingexisting library, using active learning, Named Entity Disambiguation and Linking, Relationship Extraction and other IE tasks

CHATBOTS:

Chatbots- Applications, Taxonomy of Chatbots, Pipeline for building Dialog Systems, Components of a Dialog system, other dialog pipelines with end-to-end approach, Deep Reinforcement learning for dialog generation, human-in-the-loop, case study on recipe recommender, open-ended generative chatbots

BRIEF OVERVIEW ON NLP APPLICATIONS:

Search and Information Retrieval- Components of Search Engine, Topic Modeling, Text Summarization, Recommender Systems for textual data, Machine Translation, Question- Answering Systems.

NLP APPLIED TO SOCIAL MEDIA AND E-COMMERCE:

Applications and challenges of NLP for Social Media, Issues related to NLP for social media data, NLP for supporting e-commerce acivities, Search in E-commerce, Building E-commerce catalog, Review analysis, recommendations for e-commerce

Text Books:

1. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta and Harshit Surana, "*PracticalNatural Language Processing*", O'Reilly Media Inc., 2021, ISBN: 978-93- 8588-918-9.

Reference Books:

1. Lewis Tunstall, Leandro von Werra, Thomas Wolf, "*Natural Language Processing with Transformers: Building Language Applications with Hugging Face*", O'Reilly Media Inc., 2022
2. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2ndEdition, Daniel Jurafsky, James H. Martin -Pearson Publication,2014.

Python for Data Science
Open Elective
Syllabus

Prerequisites:

- Programming Language Basics
- Basics in Mathematics
- Statistics

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.
- Produce Python code to statistically analyze a dataset.
- Critically evaluate data visualizations based on their design and use for communicating stories from data.

Course Outcomes:

- After the completion of the course, student will be able to
- Explain how data is collected, managed and stored for data science.
- Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.
- Implement data collection and management scripts using Python Pandas.
- Illustrate various plotting and Visualization techniques

SYLLABUS

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.
Overview of Python and Data Structures: Basics of Python including data types, variables, expressions, objects and functions. Python data structures including String, Array, List, Tuple, Set, Dictionary and operations them.

Numpy: The NumPy ndarray, A Multidimensional Array Object- Creating ndarrays, Data Types for ndarrays, Arithmetic with NumPy Arrays, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transposing Arrays and Swapping Axes , Pseudorandom Number Generation, Universal Functions: Fast Element-Wise Array Functions, Array-Oriented Programming with Arrays-Expressing Conditional Logic as Array Operations, Mathematical and Statistical Methods, Methods for Boolean Arrays, Sorting, Unique and Other Set Logic, File Input and Output with Arrays, Linear Algebra, Example: Random Walks- Simulating Many Random Walks at Once

Pandas: Introduction to pandas Data Structures- Series, DataFrame, Index Objects, Essential Functionality- Reindexing, Dropping Entries from an Axis, Indexing, Selection, and Filtering, Arithmetic and Data Alignment, Function Application and Mapping, Sorting and Ranking, Axis Indexes with Duplicate Labels, Summarizing and Computing Descriptive Statistics-Correlation and Covariance, Unique Values, Value Counts, and Membership.

Plotting and Visualization: A Brief matplotlib API Primer- Figures and Subplots, Colors, Markers, and Line Styles Ticks, Labels, and Legends Annotations and Drawing on a Subplot**,** Saving Plots to

File**,** matplotlib Configuration**,** Plotting with pandas and seaborn**-** Line Plots**,** Bar Plots**,** Histograms and Density Plots Scatter or Point Phots**,** Facet Grid's and Categorical Data**,** Other Python Visualization Tools

Data Preprocessing: Data Loading, Storage, and File Formats - Reading and Writing data in text format, binary data formats, interacting with html and web api, interacting with databases; Data Wrangling: Clean, Transform, Merge, Reshape - Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, String Manipulation; Data Aggregation and Group Operations – Group by Mechanics, Data Aggregation, Groupby Operations and and Transformations, Pivot Tables and Cross Tabulation

Text Books:

1. Python For Data Analysis (O Reilly, Wes Mckinney)
2. Learning Python , OReilly, Mark Lutz

Reference Books:

1. Python: The Complete Reference, Martin C. Brown, McGraw Hill Education
2. Head First Python, Paul Barry, O′Reilly

Renewable Energy Sources
Open Elective
Syllabus

Prerequisite:
This course presents the various sources of renewable energy such as solar, wind, geothermal energy,biomass & other potential energy and contribution towards energy profile of the nation.

Course Objectives:

- To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics.
- To understand the concept of Wind Energy Conversion & its applications.
- To study the principles of biomass and geothermal energy.
- To understand the principles of Ocean Thermal Energy Conversion (OTEC), motion of waves andpower associated with it.
- To study the various chemical energy sources such as fuel cell and hydrogen energy along withtheir operation and equivalent circuit.

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

- Analyze Solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solarEnergy Storage.
- Illustrate the components and working of Wind energy systems.
- Describe the biomass conversion technologies and working of Biomass plants.
- Outline the principle and working of Geothermal Energy.
- Explain the principle of Energy production from OTEC, Tidal and Waves.
- Summarize the concepts of Fuel cells and Hydrogen Energy.

SYLLABUS

Solar Energy: Introduction - Renewable Sources - prospects, Solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flatplate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.

Wind Energy: Introduction - Basic Principles of Wind Energy Conversion- Site selection considerations - Basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.

Biomass: Introduction - Biomass conversion technologies - Photosynthesis, factors affecting Bio digestion - classification of biogas plants - selection of site for a biogas plant

Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and Environmentalproblems.

Energy From oceans, Waves & Tides:

Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC inIndia.
Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices.
Tides: Basic principle of Tide Energy -Components of Tidal Energy.
Chemical Energy Sources:
Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells -Applications.
Hydrogen Energy: Introduction - Methods of Hydrogen production - Storage and Applications.
.
Text Books:

1. B H Khan Non-Conventional Energy Resources, Mc Graw Hill,2017.
2. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
3. John Twidell & Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.

Reference Books:

1. S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH,2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. Shoba Nath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

Data Communications
Open Elective
Syllabus

Prerequisite: Basic knowledge about mathematics basis on logic circuits and their applications in digital system.

Course objectives:

- To introduce the fundamental various types of computer networks.
- To explore the communication protocols and layered network architectures
- To demonstrate the TCP/IP and OSI models with merits and demerits
- To introduce UDP and TCP Models.
- To explore the various application layer protocols

Course Outcomes:

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

- Outline the functions of various layers of OSI/TCP reference model and functions of various Data communication Networks
- Understand about the various data link layer protocols.
- Explain the network layer protocols and demonstrate the mechanism of routing the data in network layer
- Explain significance of transport layer and know the various Flow control and Congestion control Mechanisms
- Understand the Functions of various Application layer Protocols**.**

SYLLABUS

Introduction to Data Communications: Components, Data Representation, Data Flow, Networks-Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards - Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture,

Data Link Layer: Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame.

The Network Layer: Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol(IP):Forwarding and Addressing in the Internet-Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6

Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control

Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.

Text Book:

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6thEdition , Pearson,2017
2. Data Communications and Networking Behrouz A.Forouzan4th Edition McGraw Hill Education,2017.

Reference Books:

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education, 2003.
3. Understanding Communications and Networks, 3rd Edition, W.A.Shay, Cengage Learning, 2003.

Block Chain Technologies
Open Elective
Syllabus

Prerequisite: Expertise in programming, basic knowledge of computer security, cryptography, networking, concurrent or parallel programming.

Course objectives:

- To understand the basic concepts block chain technology and to explore the driving force behind the crypto currency Bitcoin.
- To understand about the different methods of Decentralization using Block Chain and different Bitcoins and Alternative Coins.
- To understand about Ethereum and applications using Smart contracts and Block Chain Applications.
- To get familiarity with future currencies and to create own crypto token.

Course Outcomes:

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

- Explore the primitives of the distributed computing and cryptography related to blockchain
- Understand the types, benefits and limitation of block chain.
- Enumerate the Bitcoin features and its alternative options.
- Understand the modern currencies and its market usage.
- Implement and deploy the smart contracts in different environments like Ethereum.
- Usage of smart contracts in various real world application domains.

SYLLABUS

Block Chain and its History: History of blockchain, Types of blockchain, Blockchain Components – Permissioned Blockchain Permission less Blockchain – Consortium Blockchain – basics of Consensus Algorithms, Architecture & Properties of Blockchain.

Decentralization and Consensus Algorithms: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations, Distributed systems, Distributedledger, Merkle tree, structure of a block, Consensus

Algorithms: Proof of Work, Proof of Stack, Proof of Burn, Proof of Elapsed Time, Proof of Activity, Proof of Concept.

Bitcoin and Alternative Coins: Bitcoin, Transactions, Bitcoin payments , Bitcoin properties – Transaction life cycle – creation of coin –sending payments – double spending using blockchain – bitcoin anonymity – Ether: Ethercoin properties, Alternative Coins, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Ethereum and smart contracts: Ethereum Architecture, solidity programming basics, Smart Contract, Deploying Smart Contracts, Integration with UI.

Blockchain Applications: Blockchain-Outside of Currencies: Internet of Things, Government,

Health, Finance, Media, Secure Voting and Digital Identity, Real Estate, Education

Text Book:

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017
2. Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016
3. Blockchain Technology, Author- Chandramouli Subramanian, Asha A George, Abhilash K A, Meena Karthikeyan, University Press (India) Private Limited, 2021

Reference Books:

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Author- Daniel Drescher, Apress, First Edition, 2017

INTERNET OF THINGS
OPEN ELECTIVE
SYLLABUS

Course Objectives:

- Understand IoT conceptual framework and design standardization of IoT/M2M architectural layers and domains
- Learning the usage of messaging protocols between connected devices and the web
- Identify the functions and usage of data analytics and cloud services for IoT applications and business processes.
- Elucidate sensor technology for sensing the real world using analog and digital sensors
- Develop the codes, design and test the embedded devices for IoT and M2M using IDEs and development platforms

Course Outcomes:

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

- Understand the IoT Standards and design principles.
- Understand various web-communication protocols and their practical usage.
- Able to use IoT cloud-based services using the Xively, Nimbits.
- Able to learn various types of sensors and actuators, interfacing and use in IoT environment.
- Able to use number of device platforms of IDEs, such as Arduino, Intel Galileo, RPi, BB and mBed, provide development tools, libraries and framework, and are used for the development ofembedded Software.

SYLLABUS:

The Internet of Things: An Overview of Internet of things, Internet of Things Conceptual Frame work, IoT architectural View, Technology behind IoT, Sources of IoT, M2M Communication, Examples of IoTs, Design Principles for Connected Devices Internet Connectivity: IoT/M2M System Layers and Design Standardization.

Design for Web Connectivity.: Web communication protocols for connected devices, Message Communication protocols for connected devices, Web Connectivity for Connected-Devices Network using Gateway, SOAP, REST, HTTP RESTFUL, and Web Sockets, Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

Data Acquiring, Organizing, Processing and Analytics: Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise Systems. Analytics, Knowledge acquiring, managing and storing process.

Data Collection, Storage and Computing Using a Cloud Platform: Cloud Computing Paradigm for Data Collection, Storage and Computing. Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively, Nimbits and other platforms.

Sensor, Participatory Sensing, RFID, Wireless Sensor Networks: Sensors Technology, ParticipatorySensing, Actuator, Sensor Data Communication Protocols, RFID, WSN.

Prototyping and Designing the Software for IoT Applications: Prototyping embedded device Software, Devices, Gateways, Internet and Web/Cloud Services Software Development, Prototyping

Online Component APIs and Web APIs.

IoT Case Studies: Design Layers, Design Complexity and Designing Using Cloud PaaS. IoT Applications for Smart Homes, Cities, Environmental Monitoring and Agriculture. Connected Car and Its applications.

Text Books:

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press,2015

Reference Books:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally,Wiley
2. Getting Started with the Internet of Things,CunoPfister , Oreilly

Introduction to Psychology
Open Elective
Syllabus

Prerequisite: The course is designed to provide the student a basic understanding of the psychology of human behaviour. The students will be given exposure to concepts, terminology, principles, and theories that comprise an introductory course in psychology.

Course objectives:

- To help the students know the sources and processes of development of modern scientific psychology.
- To help the students develop a scientific temperament in studying and understanding human behavior.

Course Outcomes:

Students will be able to

- Define the term psychology and demonstrate command of the basic terminology,
- concepts, and principles of the discipline.
- Gain knowledge of scientific methodology–the variety of ways in which psychological
- data are gathered and evaluated / interpreted.
- Identify and compare the major perspectives in psychology: Recognize how each
- approach views human thought and behavior.
- Understand the physiological and biochemical links of human behavior.

SYLLABUS

Introducing Psychology

(i) Concept and definition of psychology, Roots of psychology, Psychology as a scientific discipline.

(ii) Key Perspectives in Psychology- Behavioral, Cognitive, Humanistic, Psychodynamic, and

Socio-cultural.

Methods in Psychology

(i) Natural Observation, Survey and Case Study - Nature, advantages and limitations.

(ii) Experimental and Correlational methods -Nature, advantages and limitations.

Biological Bases of Behavior

(i) Structure and functions of the neurons, Communication within and between neurons,

Chemical regulation of the endocrine glands.

(ii) Structure and functions of the Central nervous system and Autonomic nervous system

States of Mind

(i) Nature of consciousness; changes in consciousness- sleep-wake schedules

(ii) Extended states of Consciousness - Hypnosis, Meditation and Hallucinations

Text Books:

1. Baron, R. A. (2002). Psychology (5th Edition), New Delhi: Pearson Education.
2. Hilgard & Atkinson- Introduction to Psychology (2003) 14th Edition, Thomson Learning Inc.
3. Mohanty, N., Varadwaj, K. & Mishra, H.C. (2014). Explorations of Human Nature and
4. Strength: Practicals in Psychology, DivyaPrakashani, Samantarapur, Bhubaneswar.

Reference Books:

1. Morgan, C.T., King, R.A., Weisz, J.R., &Schopler, J. (2008). Introduction to psychology (7th
2. edition) Bombay: Tata-McGraw Hill.
3. Feldman, R.S. (2004). Understanding Psychology (6th Edition), New Delhi, Tata-McGraw Hill.

Industry 4.0
Open Elective
Syllabus

Prerequisite:

- Students should have knowledge about Sensors
- Students should have knowledge about robotics and IoT

Course Objective

- This course provides students with an introduction to Industry 4.0, its building blocks, its applications and advantages compared to conventional production techniques.
- Learners get a deep insight into components and technologies of industry 4.0 can be used to build up the production of the future.
- It is also important that the theory is deepened by means of roadmap technologies with phase wise developments.
- To impart knowledge of smart manufacturing, IIot for industry 4.0.

Course Outcomes
Students will be able to:

- Describe Industry 4.0 and scope for Indian Industry
- Demonstrate conceptual framework and road map of Industry 4.0
- Describe IIoT, cloud computing and big data, smart factories role in Industry 4.0
- Describe Robotic technology and Augmented reality for Industry 4.0
- Demonstrate obstacle and framework conditions for Industry 4.0

SYLLABUS

Introduction to Industry 4.0: Introduction, Idea of Industry 4.0, Various Industrial Revolutions, Origin concept of Industry 4.0,Industry 4.0 Production system, How is India preparing for Industry 4.0, Comparison of Industry Factory and Today's Factory.

Trends in Industry 4.0: Introduction, Main Concepts and Components of Industry 4.0, State of Art Technologies, Proposed Framework for Industry 4.0, Trends of Industrial Big Data and Smart Business Transformation.

Roadmap for Industry 4.0: Introduction, Proposed Framework for Technology Roadmap: Strategy Phase, Development Phase, Smart Manufacturing, Types of Smart Devices, Smart Logistics, Smart Cities, Predictive Analytics.

Advances in the Era of Industry 4.0: Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Things, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly, IIoT- Industrial IoT.

The Role of Industry 4.0 and Future Aspects: Introduction, Challenges & Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

Reference Books:

1. Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation".
2. Bartodziej, Christoph Jan,"The Concept Industry 4.0".
3. Klaus Schwab,"The Fourth Industrial Revolution".
4. Christian Schröde, "The Challenges of Industry 4.0 for Small and Medium-sized Enterprises".

List of Open Source Software/learning website:

1. www.nptel.ac.in/

Geographic Information System
Open Elective
Syllabus

Prerequisite:

- Students with a thorough understanding of GIS fundamentals, practical skills in data management and analysis, and the ability to apply GIS in various decision-making contexts.

Course objectives:

- Understand the Fundamentals of GIS
- Learn about GIS Data Structures and Models
- Explore Spatial Data Editing and Attribute Data Management
- Grasp Spatial Analysis Techniques

Course Outcomes:

- Demonstrate Comprehensive Knowledge of GIS
- Apply Data Structure and Model Concepts in GIS
- Perform Spatial Data Editing and Attribute Data Management:
- Conduct Advanced Spatial Analysis
- Utilize Geo-Statistical Analysis and Decision Support Systems:

SYLLABUS

Introduction to GIS

Basic concepts: Definition and history, Components of GIS, Recent trends and applications of GIS; Data structure and formats, Spatial data models – Raster and vector, Data base design- editing and topology creation in GIS, Linkage between spatial and non-spatial data, Data inputting in GIS. Rectification, Transformation Methods; Root Mean Square (RMS) Error.

Data Types and Data Models Data Types; Spatial Data; Non-Spatial Data, Data Input; Existing GIS Data, Metadata; Conversion of Existing Data, Creating New Data, Data Models; Vector Data Model; Raster Data Model; Integration and Comparison of Vector and Raster Data Mdels

Spatial Data Editing Types of Digitizing Errors, Causes for Digitizing Errors; Topological Editing and Non-topological Editing; Other Editing Operations; Editing Using Topological Rules.

Attribute Data and Data Exploration Attribute Data in GIS, Attribute Data Entry, Manipulation of Fields and Attribute Data, Data Exploration; Attribute Data Query, Raster Data Query, Map- Based Data Manipulation,

Spatial Analysis Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools, Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing, Classification scheme of Vector- Based and Raster- Based GIS Operation Raster- Based Techniques: Methods of reclassification, overlay analysis, Digital Terrain Analysis and Modeling- TIN and DEM, Surface representation and analysis, Slope and Aspect, Geographic Visualization Data Classification, Map Comparison,

Geo Statistical Analysis Techniques: Introduction to Spatial Interpolation: Control Points, Global Method- Trend surface analysis, regression model, local methods- Thiessen polygons, density estimation, Inverse Distance weighted Interpolation, Kriging- Ordinary Kriging and Universal Kriging, GIS and decision support system, Introduction to AHP, basic principal of AHP. Principal and components of multiple criteria decision making

Text Books:

1. kang-tsung Chang (2007), 'Introduction to Geographic Information Systems' Tata MCGraw Hill, New Delhi.
2. C.P.Lo and Albert K.W. Yeung (2006) "Concepts and Techniques of Geographic information Systems" Prentice Hall of India, New Delhi

Reference Books:

1. Burrough, Peter A. and Rachael McDonnell, (1998), 'Principles of Geographical Information Systems' Oxford University press, New York.
2. Magwire, D.J. Goodchild, M.F. and Rhind, D.M., (2005), 'Geographical Information Systems: Principles and Applications', Longman Group, U.K.
3. Burrough, P.A., 1986, Geographical Information System for land Resources System, Oxford Univ. Press, UK.

Business Analytics
Open Elective
Syllabus

Prerequisite:

- Students should have knowledge about probability &statistics
- Students should have knowledge about basic python or R programming

Course objective:

- To learn how to develop models to predict categorical and continuous outcomes, using statistical techniques.
- To implement Data Mining techniques such as Decision Tree, classification, Linear regression, Logistic regression and Bayesian NW models.
- To know the enterprise information systems and support systems in business organizations
- To know the visualization techniques to analyze data
- To Visualize the data for Business Intelligence decisions

Course outcomes:

After completion of course students would be

- Understand the process of business enterprises and their work flow for business Analytics
- Analyze probability and Random variable experiments
- Understand data analytics and decision support systems for Business enterprises
- Solving business problems and analyze the data using Machine Learning Techniques
- Implementing Data security and Ethics in business.

SYLLABUS

Introduction to Business Analytics: Why Business Analytics, benefits of implementing Business Analytics, Business Intelligence Vs Business Analytics. Four stages of Business Analytics model, process to implement business analytics, Business Analytics Techniques.

Probability: Axioms of probability, Conditional probability, Baye's theorem, Random Variable, commonly used distributions (continuous and discrete), Cumulative Distribution Function (CDF) and Probability Density Function (PDF) their properties; Joint distributions, Function of random variables. Independence of Random Variables, Correlation of Random Variables, Correlation coefficient, Exponential Family of Distributions, Population and Random Sampling, Sample mean, variance and standard deviation, Sampling from Normal distribution, t-distribution, F-distributions and Chi-square Distribution.

Data Analytics : What is data analytics, Types of data Analytics. Importing, cleaning, and transforming business data, Algorithmic thinking, Data visualization, grouping and aggregation, reshaping Statistical modeling and time series, Data exploration, Communication of results.

Enterprise Information Systems in Business: what is information systems, components of Information System, Role of Information System in Business. Types of Information Systems, Information System resources and Infrastructure; MIS and DSS in business and OLAP operations on business data, IS infrastructure-Hardware, software, and networks

Business Data Analysis and Visualization: Tabulation, bar diagram, Multiple Bar diagram, Pie diagram, Measure of central tendency: mean, median, mode, Measure of dispersion: variance, standard deviation, Coefficient of variation. Correlation, decision tree, construction of decision tree. Regression lines. Classification, Clustering and Multiple linear predictions, t-test, F-test, ANOVA one-way classification, chi square test, Time series: forecasting Method of least squares, moving average method.

Security and Ethical challenges in Business: Ethical responsibility of business professionals, business and technology ethics, ethical guidelines, cybercrime and piracy

Text Books:

1. Douglas C. Montgomery, Larry Faris Thomas and George C. Runger (2003) `Engineering Statistics" , 3rd edition, John Wiley & Sons.
2. Ger Koole, An Introduction to Business Analytics;
3. Ramesh Behl , James A.O'Brien George M. Marakas; Management Information Systems

References:

1. Probabillityand statistics; Murray R. Spiegel, John Schiller and R.Alu Srinivasan; Mcgrawhill
2. Practical statistics for Data Scientist , Peter Bruce & Andrew Bruce, O'Reeilly

Electric and Hybrid Vehicles
Open Elective
Syllabus

Prerequisite: Students must have knowledge about understanding of electric propulsion, regenerative braking, battery technology, internal combustion engines, powertrain integration, and hybrid system control strategies.

Course objectives:

- To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
- To know various architectures of hybrid electric vehicles
- To understand the power management of plug in electric vehicles.
- To study and understand different power converters used in electrical vehicles
- To familiarize with different batteries and other storage systems.

Course Outcomes:

- Summarize the concept of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV).
- Analyse the various drive train configurations of hybrid electric vehicles.
- Choose an effective motor for EV and HEV application and summarize drive train concept of plug in electric vehicles
- Analyse the power converters used in hybrid electric vehicles
- Summarize concept of energy storage systems using battery and other storage systems

SYLLABUS

Fundamentals of vehicle: components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles - advantages and applications of Electric and Hybrid Electric Vehicles.

Hybridization of Automobile: Architectures of HEVs - series and parallel HEVs - complex HEVs. Plug-in hybrid vehicle (PHEV) - constituents of PHEV - comparison of HEV and PHEV; Extended range hybrid electric vehicles (EREVs) - blended PHEVs - Fuel Cell vehicles and its constituents.

Special Machines for EV and HEVs: Characteristics of traction drive - requirement of electric motors for EV/HEVs. Induction Motor drives -their control and applications in EV/HEVs. Permanent magnet Synchronous motor: configuration - control and applications in EV/HEVs. Brushless DC Motors: Advantages - control of application in EV/HEVs. Switch reluctance motors: Merits limitations - control of SRM for EV/HEVs.

Power Electronics in HEVs: Boost and Buck-Boost converters - Multi Quadrant DC-DC converters - DC-AC Inverter for EV and HEV applications - Three Phase DC-AC inverters - Voltage control of DC-AC inverters using PWM - EV and PHEV battery chargers.

Energy Sources for HEVs : Energy Storage - Battery based energy storage and simplified models of battery - fuel cells – their characteristics and simplified models - super capacitor based energy storage - its analysis and simplified models - flywheels and their modeling for energy storage in EV/HEV - Hybridization of various energy storage devices.

Text Books

1. Ali Emadi - Advanced Electric Drive Vehicles - CRC Press - 2014.
2. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2003.

Reference Books:

1. MehrdadEhsani - YimiGao - Sebastian E. Gay - Ali Emadi - Modern Electric - Hybrid Electric and Fuel Cell Vehicles: Fundamentals - Theory and Design - CRC Press - 2004.
2. James Larminie - John Lowry - Electric Vehicle Technology Explained - Wiley - 2003.
3. H. Partab: Modern Electric Traction - DhanpatRai& Co - 2007.

NoSQL DATABASES
OPEN ELECTIVE
SYLLABUS

Course Objectives:

- Define NoSQL, its characteristics and history, and the primary benefits for using NoSQL data
- Define the major types of NoSQL databases including a primary use case andadvantages/disadvantages of each type
- Create wide-column, document, key-value, graph and object-oriented databases, add content, and run queries.
- Describe the NoSQL data architecture patterns
- Perform basic database administration tasks.
- Develop NoSQL desktop and cloud database solutions

Course Outcomes:

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

- Enumerate different features of NOSQL Databases
- Compare different data models
- Design a Key-Value Database for a real world problem
- Design a Document Database for a real world problem
- Design a Graph Database for a real world problem

SYLLABUS:

Introduction to NoSQL. The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters,The Emergence of NoSQL.

Aggregate Data Models, Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate-Oriented Databases.

More Details on Data Models, Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access, Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication, Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums

Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, When Not to Use, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets

Document Databases, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analyticsor Real-Time Analytics, E-Commerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure

Column-Family Stores, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters.

Graph Databases, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services Recommendation Engines

Text Books:

1. Sadalage, P. & Fowler, M., NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence. (1st Ed.). Upper Saddle River, NJ: Pearson Education, In, 2012.

Reference Books:

1. Gauravvaish, Getting started with NoSQL , PACKT publishing, ISBN: 978184969488
2. Redmond, E. & Wilson, J., Seven Databases in Seven Weeks: A Guide to Modern Databases andthe NoSQL Movement (1st Ed.), 2012
3. Raleigh, NC: The Pragmatic Programmers, LLC. ISBN-13: 978- 1934356920 ISBN-10: 1934356921

DATA SCIENCE
OPEN ELECTIVE
Syllabus

Course objectives:

- Knowhow and expertise to become a data scientist.
- Essential concepts of statistics and machine learning that are vital for datascience;
- Significance of exploratory data analysis (EDA) in data science.
- Critically explore and analyze data visualizations presented on the dashboards
- Suitability and limitations of tools and techniques related to data science process

Course Outcomes:

- Describe the steps involved in Data Science process and the technologies needed for a data scientist.
- Identify suitable ML techniques for data modelling and apply them for decision support.
- handle large datasets with distributed storage and processing system
- use appropriate tools for data collection, EDA and model building for specific types of data 5. build a prototype application of Data Science as a case study.

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SYLLABUS

Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science

Data Science process: Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them

Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML including semi-supervised learning

Handling large data: problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems

NoSQL movement for handling Bigdata: Distributing data storage and processing with Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling

Tools and Applications of Data Science: Introducing Neo4j for dealing with graph databases, graph query language Cipher, Applications graph databases, Python libraries like nltk and SQLite for handling Text mining and analytics, case study on classifying Reddit posts

Data Visualization and Prototype Application Development: Data Visualization options, Cross filter, the JavaScript Map Reduce library, creating an interactive dashboard with dc.js, Dashboard developmenttools, Applying the DS process for respective engineering problem solving scenarios as a detailed case study.

Textbook:

1. Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, "Introducing to Data Science using Python tools", Manning Publications Co, Dreamtech press, 2016
2. Prateek Gupta, "Data Science with Jupyter" BPB publishers, 2019 for basics

Reference Books:

1. Joel Grus, "Data Science From Scratch", OReilly, 2019
2. Doing Data Science: Straight Talk From the Frontline, 1 st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013

PYTHON PROGRAMMING (Skilled course)
OPEN ELECTIVE
SYLLABUS

Course objectives:

- familiarize students with key data structures in Python including lists and dictionaries and apply them in context of searching, sorting, text and file handling
- introduce students to calculation of statistical measures using Python such as measures of central tendency, correlation
- familiarize students with important Python data related libraries such as Numpy and Pandas and use them to manipulate arrays and data frames
- introduce students to data visualization in Python through creation of line plots, histograms, scatter plots, box plots and others
- Implementation of basic machine learning tasks in Python including pre-processing data, dimensionality reduction of data using PCA, clustering, classification and cross-validation

Course Outcomes:

After completion of the course the student should be able to:

- implement searching, sorting and handle text and files using Python data structures such as lists and dictionaries
- calculate statistical measures using Python such as measures of central tendency, correlation
- use Python data related libraries such as Numpy and Pandas and create data visualizations
- Use and generate Data Visualization techniques in Python.
- implement basic machine learning tasks pre-processing data, compressing data, clustering, classification and cross-validation.

SYLLABUS

1. Python Programs on lists & Dictionaries
2. Python Programs on Searching and sorting
3. Python Programs on Text Handling
4. Python Programs on File Handling
5. Python Programs for calculating Mean, Mode, Median, Variance, Standard Deviation
6. Python Programs for Karl Pearson Coefficient of Correlation, Rank Correlation
7. Python Programs on NumPy Arrays, Linear algebra with NumPy
8. Python Programs for creation and manipulation of Data Frames using Pandas Library
9. Write a Python program for the following.
   - Simple Line Plots,
   - Adjusting the Plot: Line Colours and Styles, Axes Limits, Labelling Plots,
   - Simple Scatter Plots,
   - Histograms,
   - Customizing Plot Legends,
   - Choosing Elements for the Legend,
   - Boxplot
   - Multiple Legends,

- Customizing Colorbars,
- Multiple Subplots,
- Text and Annotation,
- Customizing Ticks

10. Python Programs for Data pre-processing: Handling missing values, handling categorical data, bringing features to same scale, selecting meaningful features
11. Python Program for Compressing data via dimensionality reduction: PCA
12. Python Programs for Data Clustering
13. Python Programs for Classification
14. Python Programs for Model Evaluation: K-fold cross validation.

Reference Books:

1. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall
2. Chris Albon, ―Machine Learning with Python Cookbook-practical solutions from pre-processing to Deep learning‖, O'REILLY Publisher,2018
3. Mark Summerfield, Programming in Python 3--A Complete Introduction to the Python Language, Second Edition, Additson Wesley
4. Phuong Vo.T.H , Martin Czygan, Getting Started with Python Data Analysis, Packt Publishing Ltd
5. Armando Fandango, Python Data Analysis, Packt Publishing Ltd
6. Magnus Vilhelm Persson and Luiz Felipe Martins, Mastering Python Data Analysis, Packt Publishing Ltd
7. Sebastian Raschka & Vahid Mirjalili, ―Python Machine Learning‖, Packt Publisher, 2017

MOBILE COMPUTING
OPEN ELECTIVE
Syllabus

Course objectives:

- To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
- To explore both theoretical and practical issues of mobile computing.
- To provide an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications

Course Outcomes:

On successful completion of course learner will be able:

- To identify basic concepts and principles in mobile communication & computing, cellular architecture.
- To describe the components and functioning of mobile networking.
- To classify variety of security techniques in mobile network.
- To describe and apply the concepts of mobility management

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SYLLABUS

Basics of Android: Introduction to Android Operating System, Version of Android, Installing of software, Android example, Internal Details, Software Stack, Android Core Building Blocks, Android Emulator, AndroidManifest.xml, R.java file, Hide Title Bar, Screen Orientation.

User Interface Widgets: Working with Button, Toast, Custom Toast, Button, Toggle Button, Switch Button, Image Button, Check Box, Alert Dialog, Spinner, Spinner and other widgets, Auto Complete Text View, Rating Bar, Date Picker. Time Picker, Progress Bar, Activity life cycle and example, Intents-types, Fragment lifecycle and types.

Android Menu, Layouts and Views: Option Menu, Context Menu, Popup Menu, Types of layouts-Relative, Linear, Table, Grid. Types of views- Grid, Web, Scroll, Search, Tab Host, Dynamic List, Expanded List views.

Android services and Data storage: web service, Android services, Android Service API, lifecycle and examples. Shared preferences, Soap Vs Restful web service, Internal storage, External storage, Sqlite Databases, Storing data into external oracle database.

Multimedia and Animation: Playing audio and video, creating audio player ,Alarm manager, gallery, Animation API, Drawable class, Rotate, Fade, Zoom animations, XML &JSON -XML Parsing SAX, XML Parsing DOM , XML Pull Parser , JSON Parsing.

Speech API and Telephony API, Web services: Text To Speech API, Example, managing speech and pitch, Speech to text. Telephony manager, Get calls state, call tracker, make phone call and send SMS, Email. Web Service introduction, SOAP vs RESTFUL web services, external oracle data base connections.

Content Providers and Notifications: Fundamentals of content providers, Content URI, Creation of custom content provider. Notification API, Notification Builder, Issuing notifications, Notification Compact builder, Examples

Textbook:

1. Beginning Android 4 Application Development- WEI-MENG LEE, Wiley India Pvt.ltd

Reference Books:

1. Introduction to Android Application Development: Android Essentials,4/E, Joseph Annuzzi, Jr.LaurenDarcey, Shane Conder, Pearson Education publishers
2. Professional Android 4 Application Development, Reto Meier, Wiley India Pvt.ltd
3. Android Application Development, Pradeep Kothari, Dreamtech publications
4. http://developer.android.com/guide/index.html

AI CHATBOTS
OPEN ELECTIVE
Syllabus

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:

On successful completion of course learner will be able:

- 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.

SYLLABUS

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)

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

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

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.

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

Textbook:

1. Abhishek Singh, Karthik Ramasubramanian, Shrey Shivam, “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 Srini, 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, Karthik Ramasubramanian and Shrey Shivam, Building an Enterprise Chatbot (1 ed.), Springer, 2019. ISBN 978-1484250334.

Human Resource Management
HSS Elective
Syllabus

Prerequisite: Basic knowledge of recruitment, training, performance management, compensation, and employee relations

Course Objective: The Objective of this course is to familiarize students with the different aspects of managing human resources in the organisation through the phases of acquisition, development and retention.

Course Outcomes

- To develop an understanding about the functions of HRM
- To demonstrate the basic understanding of different tools used in HR planning and Job analysis
- To relate with various stages of Recruitment and training of employees
- To develop an understanding about basics of Performance appraisal
- To evaluate the importance of welfare programs and initiatives in promoting the employees

SYLLABUS

Introduction: History & Evolution of HRM, Concept, Scope, Characteristics, Objectives, & importance of HRM, Personnel management vs. HRM

Human Resource Planning: Objectives, Need and importance, process of human resource planning, Problems of human resource planning; Job Analysis: Introduction, uses of Job analysis, Process of Job analysis, Job description and Job specification.

Recruitment: Introduction to recruitment, factors governing recruitment, process and sources of recruitment; Selection: Meaning of selection, Steps in selection process, Selection tests and interviews; Placement & Induction: Concept of placement, Concept of induction, concept of transfer, concept of promotion, Promotion policy

Training: Concept and importance of training, types of training, methods of training, designing of training program, evaluation of training effectiveness; Career planning and development: Concept, objectives and process; Job evaluation: Concept and essentials of Job evaluation, methods of Job evaluation

Performance appraisal: Concept, importance, methods- traditional and modern methods, Job evaluation vs. performance appraisal

Maintenance: Communication and counselling, Welfare, Health and Safety, Separation: Turnover, Retirement, Lay off, Retrenchment, Discharge, Dismissal and V.R.S.

Text Books:

1. Aswathappa, K., Human resources and Personnel Management, Tata McGraw Hill Pub. Co., Ltd., New Delhi.

2. Parvin Durai, Human Resource Management, Pearson India.
3. Subba Rao P., Essentials of Human Resource Management and Industrial Relations, Himalaya Publishing, Mumbai.

References:

1. Flippo, Edwin B., Personnel Management, McGraw Hill Publishing Company, Singapore.
2. Michael Armstrong, Handbook of Human Resource Management Practice (11th Edition), Kogan Page, London, 2009.
3. Gary Dessler, Human Resource Management, Pearsons Education, Delhi, 2004.
4. John Storey, Managing Human Resources: Preparing for the 21st Century, Beacon Booms, New Delhi, 2007.
5. Seema Sanghi, Human Resource Management, McMillan, Delhi, 2011.

Operations Research
HSS Elective
Syllabus

Course Objective:

- Formulate a real-world problem as a mathematical programming model
- Understand the theoretical workings of the simplex method for linear programming andperform iterations of it by hand
- Understand the relationship between a linear program and its dual, including strong duality and complementary slackness
- Solve specialized linear programming problems like the transportation and assignment problems
- Solve network models like the shortest path, minimum spanning tree, and maximum flow problems

Course Outcomes:

- Students will be able to describe characteristics and scope of OR.
- Students will be able to define and formulate mathematical problems.
- Students will be able to select optimal problems solving techniques for a given problem using LP.
- Students will be able to formulate and solve transportation, travelling sales man andtransshipment problems.
- Students will be able to formulate and solve optimization problems related to job/ workassignments.
- Students will be able to demonstrate and solve simple models of Game theory.
- Students will be able to evaluate optimum solution using dynamic programming fordifferent applications.

SYLLABUS

Overview of Operations Research: Types of OR Models, Phases of Operations Research–OR Techniques, Introduction to Linear Programming, Formulation of Linear Programming Problem, Graphical Solution; Graphical Sensitivity Analysis.

Standard Form of LPP: Basic Feasible Solutions, Unrestricted Variables, Simplex Algorithm, Artificial Variables, Big M Method, Two Phase Simplex Method, Degeneracy,
Alternative Optimal, Unbounded Solutions, Infeasible Solutions, Primal and Dual Problems and Their Relations, Dual Simplex Method

Transportation Problem: LPP, Initial Solutions, North West Corner Rule, Lowest Cost Method, Vogel's Approximation Method, Optimum Solutions of TPP, Degeneracy in Transportation, Transportation Algorithms

Assignment Problem: Assignment Problem as LPP, Hungarian Method, Travelling Salesman Problem, Solutions of TSP, Sequencing Problems, N-Jobs Two Machine Problems, N Jobs K Machines Problems,Two-Jobs M- Machine Problems, Crew Scheduling Problems

Network Representation of a Project: CPM and PERT, Critical Path Calculations, Time – Cost

Optimizations, PERT Analysis and Probability Considerations, Resource Analysis in Network Scheduling.

Replacement Problems: Individual and Group Replacement Policy, Reliability & System Failure Problems, Inventory-Factors Effecting Inventory-EOQ, Inventory Problems with and Without Shortages, Inventory Problems with Price Breakups, Multi Item Deterministic Problems. Probabilistic Inventory Problems

Game Theory: Two Person Zero Sum Games, Mixed Strategy Games and Their Algorithms.

Textbooks:

1. Operations Research, KantiSwaroop, P.K. Gupta, ManMohan, Sulthan Chand & Sons Education
2. Operations Research–An Introduction, HandyATaha–Pearson Education

References:

1. Taha.H.A, Operations Research : An Introduction, McMilan publishing Co., 1982. 7 th ed.
2. Ravindran A, Philips D.T & Solberg.J.J, Operations Research: Principles and practice, John Wiley & Sons, New York, 1987.
3. Frank S. Budnick, Dennis Mcleavey and Richard Mojena, Principles of Operations Research forManagement. All India Traveler Book seller, Delhi.
4. Gillet.B.E., Introduction to Operations Research - A Computer oriented algorithmic approach, McGraw Hill, 1987.
5. Joseph.G.Ecker& Michael Kupper Schimd, Introduction to Operations Research, John Wiley & Sons, 1988.
6. Hillier.F.S & Liberman.G.J, Operations Research, Second Edition, Holden Day Inc, 1974.
7. Kanti Swarup, Gupta.P.K. & Man Mohan, Operations Research, S.Chand& Sons

INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP
HSS ELECTIVE
SYLLABUS

Course Objectives:

- To familiarize the students with the concepts of Management.
- To relate the concepts of Management with industrial organizations.
- To explain the factors affecting productivity and how productivity can be increased inan Industrial undertaking.
- To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:

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

- Understand the roles, skills and functions of management.
- Distinguish the different types of business organizations.
- Identify the factors involved in Production Operations Management.
- Diagnose organizational problems and take suitable decisions.
- Establish good Human Resource Management practices.
- Acquire necessary knowledge and skills required for organizing and carrying out

SYLLABUS

Basic Concepts of Management: Definition, Nature and Importance; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;

Forms of Business Organizations: Introduction, Types of Business organizations: Private Sector- Individual Ownership, Partnership, Joint stock companies and Co-Operative organizations**;** Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint Sector Management.

Production and operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

Entrepreneurship: Definition, Characteristics and Skills, Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid ofEntrepreneurship Development, Idea generation: Sources and Techniques; Stages in Project formulation; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

Textbooks:

1. Sharma,S.C, and Banga, T.R., Industrial Organization & Engineering Economics,Khanna Publishers, Delhi, 2000.
2. Vasant Desai , (The Dynamics of Entrepreneurial Development and Management

(Planning for future Sustainable growth),HImalayan Publishing House, 2018.

Reference Books:

1. Aryasri , A.R., Management Science, McGraw HIll Education (India PrivateLimited , New Delhi 2014.
2. Sheela, P. , and Jagadeswara Rao**,** K., Entrepreneurship, Shree Publishing House,Guntur, Andhra Pradesh, 2017.

FINANCIAL MANAGEMENT FOR ENGINEERS
HSS ELECTIVE
SYLLABUS

Course Objectives:

- To provide awareness and understanding of the ways finance helps in reaching business objectives.
- To familiarise with the form, content and analysis of financial statements and theaccounting principles and techniques.
- To Identify signals pointing to deterioration in financial condition and analyse thereasons for variances between the actual and budgeted results
- To facilitate in the improvement of organizations‘ performance by pointing out the importance of cost control, breakeven and variance analysis.
- To equip with the ability to communicate comfortably with Financial Executives anddiscuss the financial performance of the organization effectively..

Course Outcomes:

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

- Ability to Analyse financial statements
- Understanding costs and methods to reduce them
- Taking decisions regarding the price of the products services, or both
- Skill to practice different Budgeting Systems in organisations

SYLLABUS

UNIT-I

Accounting concepts and systems - Elements of Financial Statements - Trading, Profit & Loss Statement- Cash Flow Statements - Notes to Accounts - Profits vs. Cash Flows

UNIT-II

Analysis of Financial Statements - Financial Analysis - Financial Ratios and their Interpretations covering: Profitability Ratios; Liquidity Ratios; Return on Capital Ratios; - Management of Working Capital: Capital and Its Components - Working Capital Cycle - Working Capital Financing.

UNIT-III

Management Decision Making: Cost concepts and its application in Decision Making - Types of cost – Direct & Indirect, Fixed & Variable - Cost Sheet - Cost Volume Profit Analysis - Understanding Cost behaviour – Cost concepts and its application in Decision Making - Relevance of Activity Based Costing- Marginal Costing - Make or Buy - Shut down or continue - Sell or process further - Domestic vs. Export Sales

UNIT-IV

Budgets and Budgetary Control: Different types of Budgets (Departmental, Function based, Cash, Master) - Budgeting systems (ABC / ZBB / Rolling/ Incremental / Planning) - Variance Analysis - Capital Budgeting and Investment Appraisals - Meaning of Capital Budgeting - Relevance of Capital Budgeting - Techniques of Capital Budgeting - Payback Period - Accounting Rate of Return - Net Present Value - Internal Rate of Return - Discounted Payback Period

UNIT-V

Means of Finance: Financial Instruments - Shares, Debentures, Derivatives - Share Capital Vs. Term Loans- Leasing - Financial Markets - Capital Markets - Stock Exchanges.

Reference Books:

1. Finance for Non-Finance People by Sandeep Goal (2017), Publisher: Taylor and Francis.
2. Finance for Non-Finance Managers by B.K. Chatterjee (1988), Jaico PublishingHouse, Sold by Amazon
3. Finance for Nonfinancial Managers: Finance for Small Business, Basic Finance Concepts (Accounts and Finance) by Murugesan Ramaswamy (2021), Repro Books-On-Demand

Generative AI Models

Honors Course

SYLLABUS

Course Objectives:

This course aims at enabling students,

- Understand and apply the fundamentals of Generative AI and large language models.
- Implement GPT architecture for text generation and dialogue systems.
- Fine-tune BERT for downstream NLP tasks and explore advanced Transformer architectures.
- Evaluate real-world applications, challenges, and emerging trends in Generative AI.

Course Outcomes:

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

- Understand large language models' architecture and pre-training techniques.
- Apply the GPT model for natural language processing tasks.
- Apply the BERT model for natural language processing tasks.
- Implement Generative Adversarial Networks (GANs) for image generation tasks using TensorFlow
- Analyzing the performance and limitations of large language models.

SYLLABUS

Introduction to Large Language Models:

Overview of Generative AI and Large Language Models. Basics of attention mechanisms and Transformer architecture. Pre-training techniques and transfer learning strategies.

GPT Models and Applications:

Study of GPT architecture and variants. Applications of GPT models in text generation and dialogue systems. Case study-based implementation of GPT-based tasks. GPT-based chatbot enhances E-Shop's customer support service

BERT and Advanced Techniques:

Understanding BERT architecture and pre-training objectives. Fine-tuning BERT for downstream NLP tasks. Exploration of advanced Transformer architectures and techniques

Text Generation with Generative AI: Introduction to Text Generation, LSTM-based Text Generation, Transformer-based Text Generation, Fine-Tuning Language Models, and Text Generation Applications

Image Generation with Generative AI: Introduction to Image Generation, Implementing GANs for Image Generation Training and Fine-Tuning GANs, Generating Images with VAEs, Advanced Techniques in Image Generation, and Image and Video Generation Applications.

Applications and Future Directions:

Real-world applications of large language models. Challenges and limitations of current approaches. Emerging trends and future directions in Generative AI.

Text Books:

1. Generative AI for Everyone: Understanding the Essentials and Applications of This Breakthrough Technology". Altaf Rehmani.
2. Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models , Joseph Babcock and Raghav Bali, 2024

Reference Books:

1. Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras by Josh Kalin.
2. Generative AI in Software Development: Beyond the Limitations of Traditional Coding Jesse Sprinter, 2024.
3. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
4. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal.

e-sources:

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching programming-course s/?v=c86ee0d9d7ed
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-languagemodels/?v=c86ee0d9d7ed

HIGH PERFORMANCE COMPUTING

Honors Course

SYLLABUS

Course Objectives:

The objective of the subject is to

- Introduce the basic concepts related to HPC architecture and parallel computing
- To discuss various computational techniques for studying soft matter systems.
- To apply these concepts to examine complex biomolecular/materials systems that generally require large-scHPC platform with hybrid CPU-GPU architectures –

Course Outcomes: After completion of this course

- Design, formulate, solve and implement high performance versions of standard single threadedalgorithms.
- Demonstrate the architectural features in the GPU and MIC hardware accelerators.
- Design programs to extract maximum performance in a multicore, shared memory executionenvironment processor.
- Analyze Symmetric and Distributed architectures.
- Develop and deploy large scale parallel programs on tightly coupled parallel systems using themessage passing paradigm.

Syllabus

Graphics Processing Units-Introduction to Heterogeneous Parallel Computing, GPU architecture, Thread hierarchy, GPU Memory Hierarchy.

GPGPU Programming-Vector Addition, Matrix Multiplication algorithms. 1D, 2D, and 3D Stencil Operations, Image Processing algorithms – Image Blur, Gray scaling. Histogramming, Convolution, Scan, Reduction techniques.

Many Integrated Cores-Introduction to Many Integrated Cores. MIC, Xeon Phi architecture. Thread hierarchy. Memory Hierarchy. Memory Bandwidth and performance considerations.

Shared Memory Parallel Programming- Symmetric and Distributed architectures. OpenMP Introduction. Thread creation, Parallel regions. Worksharing, Synchronization.

Message Passing Interface-MPI Introduction, Collective communication, Data grouping for communication.

Text Books:

1. Programming Massively Parallel Processors A Hands-on Approach, 3e Wen-Mei W Hwu, David BKirk, Morgann Kaufmann,2013.
2. Using OpenMP, Scientific and Engin edition, Barbara Chapman, Gabriele Jost, Ruud van der Pas,MIT Press, 2008.

Reference Books:

1. Intel Xeon Phi Coprocessor Architecture and Tools, RezaurRahman, Apress Open, 2013.
2. Using MPI, Gropp, Lusk, Skjellum, The MIT press, 2014.
3. Recent publications in IPDPS, PACT, and similar.

SOCIAL NETWORK ANALYSIS

Honors Course
SYLLABUS

Course Objectives:

- Formalize different types of entities and relationships as nodes and edges and represent this information as relational data
- Plan and execute network analytical computations
- Use advanced network analysis software to generate visualizations and perform empiricalinvestigations of network data
- Interpret and synthesize the meaning of the results with respect to a question, goal, or task

Course Outcomes:

After completing the course student should:

- Know basic notation and terminology used in network science
- Be able to visualize, summarize and compare networks
- Illustrate basic principles behind network analysis algorithms
- Develop practical skills of network analysis in R programming language
- Be capable of analyzing real work networks

SYLLABUS

Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily.

Random graph models: Random graphs and alternative models, Models of network growth, Navigation in social Networks, Cohesive subgroups, Multidimensional Scaling, Structural equivalence, roles and positions.

Network topology and diffusion, Contagion in Networks, Complex contagion, Percolation and information, Navigation in Networks Revisited.

Small world experiments, small world models, origins of small world, Heavy tails, Small Diameter, Clustering of connectivity, The Erdos Renyi Model, Clustering Models.

Network structure -Important vertices and page rank algorithm, towards rational dynamics in networks, basics of game theory, Coloring and consensus, biased voting, network formation games, network structure and equilibrium, behavioral experiments, Spatial and agent-based models.

Text Books:

1. S. Wasserman and K. Faust. “Social Network Analysis: Methods and Applications”, CambridgeUniversity Press.
2. D. Easley and J. Kleinberg, “Networks, Crowds and Markets: Reasoning about a highlyconnected world” , Cambridge University Press, 1st edition,2010

Reference Books:

1. Maarten van Steen. “Graph Theory and Complex Networks. An Introduction”, 2010.
2. Reza Zafarani, Mohammed Ali Abbasi, Huan Liu. “Social Media Mining: An Introduction”.Cambridge University Press 2014.
3. Maksim Tsvetovat and Alexander Kouznetsov. “Social Network Analysis for Startups”. O’ReillyMedia, 2011.

e-Resources:

1) https://www.classcentral.com/course/edx-social-network-analysis-sna-9134
2) https://www.coursera.org/learn/social-network-analysis

SPEECH PROCESSING

Honors Course

SYLLABUS

Course Objectives:

The main objective of the course is to understand the basic principles of sound and speech production and perception, speech recognition, synthesis and dialogue systems

Course Outcomes:

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

- Understand the speech production and perception process.
- Analyze speech signals in time and frequency domain.
- Design and implement algorithms for processing speech signals.

SYLLABUS

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The process of Speech Production, Acoustic Phonetics, Articulatory Phonetics, The Acoustic Theory of Speech Production-Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals.

Time Domain Models for Speech Processing: Introduction- Window considerations, Short time energy and average magnitude Short time average zero crossing rate, Speech Vs Silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

Linear Predictive Coding (LPC) Analysis: Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Comparison between the Methods of Solution of the LPC Analysis Equations, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

Homomorphic Speech Processing: Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder. Speech Enhancement: Nature of interfering sounds, Speech enhancement techniques: Single Microphone Approach : spectral subtraction, Enhancement by re- synthesis, Comb filter, Wiener filter, Multi microphone Approach

Automatic Speech & Speaker Recognition: Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System, Continuous digit Recognition System. Hidden Markov Model (HMM) for Speech: Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS. Speaker Recognition: Recognition techniques, Features that distinguish speakers, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System.

Text Books:

1. L.R. Rabiner and S. W. Schafer, "Digital Processing of Speech Signals", Pearson Education.
2. Douglas O'Shaughnessy, "Speech Communications: Human & Machine", 2nd Ed., Wiley India,2000.

3. L.R Rabinar and R W Jhaung, “Digital Processing of Speech Signals”, 1978, Pearson Education.

Reference Books:

1. Thomas F. Quateri, “Discrete Time Speech Signal Processing: Principles and Practice”, 1st Edition.,PE.
2. Ben Gold & Nelson Morgan, “Speech & Audio Signal Processing”, 1st Edition, Wiley

DATA VISUALIZATION
Honors Course
SYLLABUS

Course Objectives:

- Understand and apply principles of mapping data onto visual aesthetics, including scales, coordinate systems, and color use in visualization
- Develop skills to effectively visualize distributions, associations, and time series data, using appropriate plots and visualization techniques
- Analyze and represent uncertainty in data visualizations, including trends, probabilities, and the uncertainty of point estimates and curve fits
- Apply the principle of proportional ink and avoid common pitfalls in color use to create clear, accurate, and accessible visualizations.

Course Outcomes:

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

- 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

SYLLABUS

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

VISUALIZING DISTRIBUTIONS: Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heatmaps, 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

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 Treemaps, Nested Pies, Parallel Sets. Visualizing Associations Among Two or More Quantitative Variables-Scatterplots, 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

VISUALIZING UNCERTIANITY: Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition, Visualizing Geospatial Data-Projections, Layers, Choropleth Mapping, Cartograms, Visualizing Uncertainty-Framing

Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots

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, 2D Histograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information, Using Nonmonotonic Color Scales to Encode Data Values, NotDesigning 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, Apress, 2018

Reference Books:

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