Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Curriculum for
Third Year B. Tech.
(Computer Engineering)
2020 Pattern

Department of
Computer Engineering

Vision and Mission of the Department

- **Vision**

  "Excellence in the field of Computer Engineering for rendering services to the industry and society".

- **Mission**

  - To empower our students for substantial contribution to economical, technological, entrepreneurial and social progress of the society.
  - To strive for excellence at different levels and diverse dimensions in the field of computer engineering.
  - To encourage students to pursue research and advanced studies for better adaptability towards globalization.

Program Specific Outcomes (PSOs)

At the end of program, students should be able to

- **PSO a:** Use knowledge to write programs and integrate them with the hardware/software products in the domains of embedded systems, data Science, networking and web technology.
- **PSO b:** Participate in planning and implement solutions to cater to business – specific requirements, displaying team dynamics and professional ethics.

Program Outcomes (POs)

At the end of program, students should be able to:

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

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

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

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

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

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

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

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

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

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

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

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

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Department of Computer Engineering

Third Year B.Tech.

Pattern 2020

Syllabus Structure

Bansilal Ramnath Agarwal Charitable Trust's

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Department of Computer Engineering

T.Y. B.TECH. COMPUTER ENGINEERING, SEMESTER V (PATTERN 2020)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/OR /TW		
CSUA31201	Language Processor and Compiler Construction*	TH	3	0	2	20	30	20	30	25	125	4
CSUA31202	Data Science and Machine Learning*	TH	3	0	2	20	30	20	30	25	125	4
CSUA31203	Computer Networks – I	TH	3	0	2	20	30	20	30	25	125	4
CSUA31204	Software Engineering and Project Management	TH	3	-	-	20	30	20	30	-	100	3
CSUA31205	Professional Elective I*	TH	3	0	2	20	30	20	30	25	125	4
CSUA31206	Project - I	CE	1	-	2	-	-	-	-	25	25	2
M2	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total		16	0	10	100	150	100	150	125	625	21

***Indicates PR/OR**

Professional Elective-I	
CSUA31205A	Computer Graphics
CSUA31205B	Business Intelligence and Data Analytics
CSUA31205C	Internet of Things
CSUA31205D	Artificial Intelligence

BoS Chairman **Dean Academics** **Director**

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Department of Computer Engineering

T.Y. B.TECH. COMPUTER ENGINEERING, SEMESTER VI (PATTERN 2020)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
CSUA32201	Design and Analysis of Algorithms	TH	3	0	2	20	30	20	30	25	125	4
CSUA32202	Professional Elective-II*	TH	3	0	2	20	30	20	30	25	125	4
CSUA32203	Cloud Computing	TH	3	0	2	20	30	20	30	25	125	4
CSUA32204	Professional Elective-III*	TH	3	0	2	20	30	20	30	25	125	4
IOEUA32205	Open Elective-I	TH	3	-	-	20	30	20	30	-	100	3
CSUA32206	Project - II	CE	1	-	2	-	-	-	-	25	25	2
M2	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total		16	0	10	100	150	100	150	125	625	21

***Indicates PR/OR**

Professional Elective-II		**Professional Elective-III**		**Open Elective- I**	
CSUA32202A	Augmented and Virtual Reality	**CSUA32204A**	Blockchain Technology	**IOEUA32205A**	Engineering Economics and FinTech
CSUA32202B	Advanced Machine Learning	**CSUA32204B**	Robotic Process Automation		
CSUA32202C	Digital Forensics	**CSUA32204C**	Edge Artificial Intelligence		
CSUA32202D	Agile Methodology and DevOps	**CSUA32204D**	Software Design Architecture		

BoS Chairman **Dean Academics** **Director**

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SEMESTER– V

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Department of Computer Engineering

CSUA31201 : Language Processor and Compiler Construction

Teaching Scheme

Credits : 4
Lectures : 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
PR/OR: 25 Marks

Prerequisites :

- Computer Organization and Architecture.
- Processor Architecture and Interfacing.
- Data Structures
- Theory of Computation: DFA, NFA, Regular expressions, Grammars.

Course Objectives :

- To introduce language processing fundamentals and assemblers.
- To explain design of macro processors.
- To introduce compiler design process
- To explain working of syntax analyser.
- To explain importance of semantic analysis and intermediate code representation
- To introduce different code optimization methods

Course Outcomes :

After completion of the course, student will be able to

1. Develop hypothetical assembler.
2. Illustrate macro processors, linkers and loaders.
3. Implement lexical analyser using LEX tool.
4. Build parser using YACC tool.
5. Construct the intermediate code representations.
6. Demonstrate code optimization and code generation concept.

Unit I : Introduction To Systems Programming And Assemblers

Introduction: Need of System Software, Components of System Software, Language Processing Activities, Fundamentals of Language Processing, Interpreter

Assemblers: Elements of Assembly Language Programming, A simple Assembly Scheme, Pass structure of Assemblers, Design of Two Pass Assembler.

Unit II : Macroprocessors, Loaders And Linkers

Macro Processor: Macro Definition and call, Macro Expansion, Nested Macro Calls and definition, Advanced Macro Facilities, Design of two-pass Macro Processor.

Loaders: Loader Schemes, Compile and Go, General Loader Scheme, Absolute Loader Scheme, Subroutine Linkages, Relocation and linking concepts, Self-relocating programs, Relocating Loaders, Direct Linking Loaders, Overlay Structure. Linkers.

Unit III : Introduction To Compilers

Phase structure of Compiler and entire compilation process. Lexical Analyzer: The Role of

the Lexical Analyzer, Input Buffering. Specification of Tokens, Recognition Tokens, Design of Lexical Analyzer using Uniform Symbol Table, Lexical Errors.
LEX: LEX Specification, Generation of Lexical Analyzer by LEX.

Unit IV : Parsers

Role of parsers, Classification of Parsers: Top down parsers- recursive descent parser and predictive parser (LL parser), Bottom up Parsers – Shift Reduce parser, LR parser.
YACC specification and Automatic construction of Parser (YACC).

Unit V : Semantic Analysis And Intermediate Code Generation

Need, Syntax Directed Translation, Syntax Directed Definitions, Translation of assignment Statements, iterative statements, Boolean expressions, conditional statements, Type Checking and Type conversion.
Intermediate Code Formats: Postfix notation, Parse and syntax trees, Three address code, Quadruples and triples.

Unit VI : Code Generation And Optimization

Code Generation: Code generation Issues. Basic blocks and flow graphs, A Simple Code Generator.
Code Optimization: Machine Independent: Peephole optimizations: Common Sub-expression elimination, Removing of loop invariants, Induction variables and Reduction in strengths, Use of machine idioms, Dynamic Programming Code Generation.
Machine dependent Issues: Assignment and use of registers

Text Books :

1. D. M. Dhamdhere, Systems Programming and Operating Systems, Tata McGraw-Hill, ISBN 13:978-0-07-463579-7, Second Revised Edition
2. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, Addison Wesley, ISBN:981–235–885 - 4, Low Price Edition
3. John R. Levine, Tony Mason & Doug Brown, "Lex & Yacc", O'Reilly

Reference Books :

1. J. J. Donovan, Systems Programming, McGraw-Hill, ISBN 13:978-0-07-460482-3, Indian Edition

List of Assignments :

Note: Students can implement following assignments using LEX/YACC, C/C++, JAVA, Python. Lab instructor can frame suitable assignment list from the following list.

1. Generate Symbol table, Literal table, Pool table & Intermediate code along with error table for first pass of a two-pass Assembler for the given source code.
2. Implement second pass of a two-pass Assembler and generate machine language code for the given intermediate code.
3. Design suitable data structures & implement first pass of a two-pass Macro processor
4. Design suitable data structures & implement second pass of a two-pass Macro processor
5. Write a program to implement a lexical analyzer for parts of speech.
6. Write a program to evaluate arithmetic expression, built-in functions and variables using Yacc specification.
7. Write a program to generate three address code for simple expression.

8. Write a program to apply various code optimization techniques for given three address code.
9. Write a program to generate assembly language code for given three address code.

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CSUA31202 : Data Science and Machine Learning (DSML)

Teaching Scheme

Credits : 4
Lectures : 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation (CE): 20 Marks
In-Semester Examination (ISE): 30 Marks
Skills & Competency Exam.(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
PR/OR: 25 Marks

Prerequisites :

- Probability and Statistics

Course Objectives :

- Understand the data science life cycle
- Learn the statistical methods data pre-processing
- Learn and apply unsupervised approach for prediction.
- Learn and apply Supervised models for prediction
- Interpret classification outcome
- Learn effective data visualization

Course Outcomes :

After completion of the course, student will be able to

1. Describe the Data Science Process and explore components interaction.
2. Apply statistical methods for pre-processing and extracting meaning from data to the application dataset.
3. Apply specific unsupervised machine learning algorithm for a particular problem.
4. Apply specific supervised machine learning algorithm for a particular problem.
5. Analyse the outcome in terms of efficiency.
6. Analyse and organize data using visualization tools.

Unit I : Introduction to Data Science

Introduction: Big data overview, state of the practice in Analytics- BI Vs Data Science, Current Analytical Architecture, drivers of Big Data, Emerging Big Data Ecosystem and new approach. Philosophy of Exploratory Data Analysis, The Data Science Process, A Data Scientist's Role Data Analytic Life Cycle: Overview, phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6-Operationalize. Case Study. Statistical description and inference of Data (Flipped Classroom)

Unit II : Preprocessing and Extracting meaning from Data

Identifying Missing values and approaches, Noisy Data Extraction, Data Cleaning as a process , Data reduction, Data Transformation and Discretization : Data Transformation by Normalization, Discretization by Binning Discretization by Histogram Analysis

Discretization by Cluster, Decision Tree, and Correlation and Regression analysis reasons to choose and cautions

Unit III : Unsupervised Modelling
Cluster Analysis: Basic Concepts and Methods, Partitioning Methods: k-Means: A Centroid-Based Technique, k-Medoids: A Representative Object-Based Technique, Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering

Unit IV : Supervised Models:
Classification Decision trees- Overview, general algorithm, decision tree algorithm, evaluating a decision tree using Gini Index and Entropy ,Naïve Bayes – Bayes Theorem and Algorithm, Naïve Bayes Classifier, smoothing, diagnostics. Diagnostics of classifiers, additional classification methods.

Unit V : Model Evaluation and Selection
Metrics for Evaluating Classifier Performance Model Selection Using Statistical Tests of Significance Comparing Classifiers Based on Cost–Benefit and ROC Curves, Confusion Matrix, F-Measure, Precision, Recall

Unit VI : Data Visualization (Case study)
Basic principles, ideas, types and tools for data visualization, Visualization of Numerical Data, Visualization of Non-Numerical Data, The Visualization Dashboard

Text Books :

1. David Dietrich, Barry Hiller, "Data Science & Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X
2. Data Mining Concepts and Techniques, 3rd edition, Morgan Kaufman
3. Cathy O'Neil and Rachel Schutt. "Doing Data Science, Straight Talk From The Frontline", O'Reilly.

Reference Books :

1. U Dinesh Kumar, "Business Analytics", Wiley Tom Mitchell
2. "Machine Learning", McGraw Hill Publication, ISBN : 0070428077 9780070428072

Suggested List of Assignments: (Not limited to those mentioned below)

1. Perform the following operations using R/Python on suitable data sets, read data from different formats(like csv, xls),indexing and selecting data, sort data, describe attributes of data, checking data types of each column, counting unique values of data, format of each column, converting variable data type (e.g. from long to short, vice versa), identifying missing values and fill in the missing values
2. Perform the following operations using R/Python on the data sets Compute and display summary statistics for each feature available in the dataset. (e.g. minimum value, maximum value, mean, range, standard deviation, variance and percentiles · Data Visualization-Create a histogram for each feature in the dataset to illustrate the feature distributions. · Data cleaning · Data integration · Data transformation · Data model building(e.g. Classification)
3. Write a program to do: A dataset collected in a cosmetics shop showing details of customers and whether or not they responded to a special offer to buy a new lip-stick is shown in table below.

Use this dataset to build a decision tree, with Buys as the target variable, to help in buying lip-sticks in the future. Find the root node of decision tree. According to the decision tree you have made from previous training data set, what is the decision for the test data: [Age < 21, Income = Low, Gender = Female, Marital Status = Married]?

4. Write a program to do following: We have given a collection of 8 points. P1=[0.1,0.6] P2=[0.15,0.71] P3=[0.08,0.9] P4=[0.16, 0.85] P5=[0.2,0.3] P6=[0.25,0.5] P7=[0.24,0.1] P8=[0.3,0.2]. Perform the k-mean clustering with initial centroids as m1=P1 =Cluster#1=C1 and m2=P8=cluster#2=C2. Answer the following 1] Which cluster does P6 belongs to? 2] What is the population of cluster around m2? 3] What is updated value of m1 and m2?
5. Visualize the data using R/Python by plotting the graphs for assignment no. 1 and 2. Use Scatter plot, bar plot, Box plot and Histogram OR Perform the data visualization operations using Tableau for the given dataset. Consider suitable data set.
6. Identify problem statement. Use Semi or unstructured data set. Define 3 to 4 objectives. Perform 1. Data Interpretation, 2. Data preprocessing, 3. Data Modeling (perform classification, Prescriptive Analysis (if required and fits for the data set)), and 4.data visualization. (Mini project is to be performed in a group of 3 to 4 students).

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CSUA31203 : Computer Networks – I

Teaching Scheme

Credits : 4
Lectures : 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CIE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
TW: 25 Marks

Prerequisites :

- NA

Course Objectives :

- To study the fundamentals of networking.
- To understand functionalities of Physical layer.
- To understand the functionalities of Data Link Layer and Network Layer.
- To study various protocols at Transport and Application Layer.
- To learn Integrity checks and Authentication algorithms.
- To learn various types of Cryptographic algorithm.

Course Outcomes :

After completion of the course, student will be able to

1. Explore network design issues.
2. Recognize the functions of OSI layers & TCP/IP protocol stack.
3. Describe and Demonstrate the functionality of Data Link Layer and Network Layer.
4. Describe the functionality of Transport and Application Layer.
5. Examine the protocols for integrity and authentication.
6. Make use of various Cryptographic algorithm.

Unit I : Introduction to Computer Network

Network, Network Topologies.
Transmission Media and Switching: Guided Media: Twisted-Pair, Coaxial and Fiber-Optic Cable Unguided Media: Radio Waves, Microwaves, Infrared IEEE standard and connectors for media. (RJ45, RJ11, BNC, SC/ST etc.) Circuit-switched Networks: Three Phases, Efficiency, Delay, Packet switching: Datagram networks, Virtual circuit networks, Brief introduction of Digital Subscriber Line: ADSL, HDSL, SDSL, VDSL (DMT), Cable modem.

Unit II : Physical Layer

LANs, WANs, and the Internet, PAN, Ad-hoc and WLAN Network, Network Architectures: Client-Server; Peer To Peer; Network as a Platform, Network Topologies, OSI Model, TCP/IP protocol suite; Layer Details, Addressing: Physical &logical Addresses, Port Addresses, Specific Addresses. Connecting devices: Hubs (Passive, active, Intelligent),

Switches (Layer-2, Layer-3 and Managed), Bridges, Routers, Gateway.

Unit III : Data Link Layer and Network Layer

Data Link Layer Protocols, Media Access Control. Address Resolution Protocol. Types of Errors: Redundancy, Detection Versus Correction, Forward Error Correction Versus Retransmission. Network Layer Protocols, Routing, Routers, Configuring a Router. IP Addressing: IPv4 Network Addresses, IPv6 Network Addresses, Connectivity Verification. Subnetting IP Networks: Subnetting an IPv4 Network, Addressing Schemes, Address Schemes, Design consideration for IPv6.

Unit IV : Transport Layer and Application Layer

Transport Layer: Transport Layer Protocols, Role of transport layer, Responsibilities of Transport layer, Transport layer reliability. TCP and UDP: TCP communication Process, Reliability and flow control, UDP Communication, applications of TCP and UDP. Application Layer: Application Layer Protocols, Application layer protocols interaction with end-user applications, Presentation and Session layers. Well-Known Application Protocols and Services.

Unit V : Integrity checks and Authentication algorithms

MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications.

Unit VI : Principles of Public Key Cryptosystems

RSA algorithm - security of RSA - key management, Diffie–Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography –Elgamel encryption - Message Authentication and Hash Function: Authentication requirements -authentication functions - message authentication code - hash functions - birthday attacks –security of hash functions and MACS.

Text Books :

1. Fourouzan B., "Data Communications and Networking", 5th edition, McGraw-Hill Publications.
2. Stallings William., "Data and Computer Communications", Sixth Edition, Prentice Hall of India.
3. Andrew S. Tanenbaum ,"Computer Networks", Pearson
4. Atul Kahate, "Cryptography and Network Security", McGraw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4.
5. Dr. V.K. Pachgare, "Cryptography and Network Security", PHI, 2nd Edition, 2015.

Reference Books :

1. CCNA Basics and Fundamentals-Cisco
2. CCNA Routing and Switching 200-125 Official Cert. Guide Library
3. Cisco CCNA Command Guide- An Introductory Guide for Complete Beginners

Suggested List of Assignments:

1. Configure Initial Switch and Router Settings using Packet Tracer.
2. Subnet an IPv4 Network.
3. Configure Secure Passwords and SSH using Packet Tracer.
4. Design and Build a Small Business Network using Packet Tracer.
5. Socket Programming using TCP/IP.
6. Write a python code to implement Diffie–Hellman and MD5.
7. Write a python code to implement RSA Encryption and Decryption.

CSUA31204 : Software Engineering and Project Management

Teaching Scheme

Credits : 3
Lectures : 3 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks

Prerequisites :

- NA

Course Objectives :

- To learn and understand the principles of Software Engineering
- To understand the nature of software complexity in various application domains, disciplined way of software development and software lifecycle process models
- To know methods of capturing, specifying, visualizing and analyzing software requirements
- To understand project planning, execution, tracking, audit and closure of project
- To understand risk and software configuration management of the project
- To learn the concepts of software development and operations

Course Outcomes :

After completion of the course, student will be able to

1. Select a proper process model for a software project development.
2. Demonstrate agile development process for suitable software applications.
3. Prepare Software Requirements Specification (SRS) of a system.
4. Estimate cost and schedule of the software project.
5. Implement SCM process and RMMM plan.
6. Use advanced tools of software development and operations.

Unit I : Introduction to Software Engineering

Nature of Software, Software Process, Software Engineering Practice, software Myths, Generic Process model, Process Models: Waterfall Model, Incremental Models, Evolutionary Models, Concurrent, Specialized Process Models, Personal and Team Process Models,

Unit II : Requirements Engineering

Requirements Engineering, Initiating the process, Eliciting Requirements, Building the Requirements Model, Negotiating, validating requirements, Requirements Analysis, Scenario-Based Analysis, Requirements Modeling strategies, Flow-Oriented Modeling, Class based modeling, SRS.

Unit III : Design Engineering

Design Process, Design Concepts, The Design Model: Data Design, Architectural, interface Design Elements.
Architectural Design: Software Architecture, Architectural Styles, Architectural Design, User

Interface Design: Rules, User Interface Analysis and Design, Applying Interface Design Steps, Issues, Web App Interface Design Principles

Unit IV : Project Management Framework

Overview of project Management, Project Organization, Planning a s/w project , Project management life cycle ,Risk management ,Identification of Risks , Risk Analysis ,Risk Planning & Monitoring

Unit V : S/w Project Estimation and Scheduling

Project Estimation , Different methods of estimation (COCOMO model, Delphi cost estimation etc.) , Function point analysis, PERT & Gantt Charts , Introduction to Microsoft Project, CM planning, Change Management , Version and Release Management, Configuration Management Tools

Unit VI : S/W Team Management

Characteristics of Performance management, High performance Directive and collaborative styles , Team Structure , Team Communication ,Managing customer expectations ,Group Behavior, User role in project management ,User role in various stages of S/W Development, User role in System implementation

Text Books :

1. Roger Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill
2. Ian Sommerville, " Software Engineering", Addison and Wesley

Reference Books :

1. Rajib Mall, "Fundamentals of Software Engineering, Prentice Hall India
2. Pankaj Jalote, "An Integrated Approach to Software Engineering, Springer
3. Carlo Ghezzi, ""Fundamentals of Software Engineering", Prentice Hall India
4. Software Project management Edwin Bennatan
5. Software Engineering concepts Richard Fairley
6. Software Project Management S.A. Kelkar
7. System Analysis and Design Methods Whitten, Bentley and Dittman

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CSUA31205A: Professional Elective – I
Computer Graphics

Teaching Scheme

Credits : 4

Lectures : 3 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks

In-Semester Examination(ISE): 30 Marks

Skills & Competency Exam(SCE): 20 Marks

End Semester Examination(ESE): 30 Marks

PR/OR: 25 Marks

Prerequisites :

- Knowledge of Programming, Basic Data Structures and Mathematics

Course Objectives :

- To acquaint the learner with the basic concepts of Computer Graphics
- To learn the various algorithms for generating and rendering graphical figures
- To get familiar with mathematics behind the graphical transformations and projections.
- To understand and apply various methods and techniques related to illumination, shading and hidden surfaces.
- To understand the concepts related to Segmentation, Animation and Virtual Reality.
- To illustrate the concepts related to Curves, Fractals and Color Models.

Course Outcomes:

After completion of the course, student will be able to

1. Apply mathematics and logic to develop computer programs for elementary graphic operations.

2. Develop scientific and strategic approach to solve complex problems in the domain of Computer Graphics.

3. Apply the basic principles of 2 and 3-Dimensional transformations and projections of computer graphics.

4. Apply the logic to develop complex objects with Light sources, Shading and Hidden surfaces.

5. Apply the logic to develop Animation and Gaming programs.

6. Apply the logic to develop Curves, Fractals and Color Models.

Unit I : Graphics Primitives and Scan Conversion

Concepts, applications of computer graphics, pixel, frame buffer, resolution, aspect ratio.
Plotting Primitives: Scan conversions, lines, line segments, vectors, pixels and frame buffers, vector generation.
Display Files: display file structure, algorithms, and display file interpreter. Primitive

operations on display file.
Scan Conversion: Line and line segments, line drawing algorithms: Digital Differential Analyzer (DDA), Bresenhams, Line styles: thick, dotted and dashed. Circle drawing algorithm: Bresenham. Character generating methods: stroke and bitmap method.

Unit II : Polygons and Clipping Algorithms

Introduction to Polygon, Types: Convex, Concave and Complex. Representation of polygon, Inside test, Polygon filling algorithms – Flood fill, Seed fill, Scan line fill.
Windowing and clipping: Viewing transformations, 2-D clipping: Cohen – Sutherland algorithm, Polygon clipping: Sutherland Hodgeman algorithm.

Unit III : 2-D, 3-D Transformations and Projections

2-D Transformations: Introduction, Matrices, Translation, Scaling, Rotation, Homogeneous coordinates and matrix representation, Rotation about an arbitrary point, inverse, and shear transformation.
3-D Transformations: Introduction, 3-D geometry, primitives, 3-D transformations and matrix representation, rotation about an arbitrary axis, 3-D viewing transformations.
Projections: Parallel Projection (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective Projection (Vanishing Points – 1 point, 2 point and 3 point)

Unit IV : Illumination, Shading and Hidden Surfaces

Illumination Models: Light Sources, Ambient Light, Diffuse reflection, Specular Reflection, and the Phong model, Combined diffuse and Specular reflections with multiple light sources.
Shading Algorithms: Gauraud and Phong Shading.
Hidden Surfaces: Introduction, Back face detection and removal, Algorithms: Depth buffer (z), Depth sorts (Painter), Area subdivision (Warnock), BSP tree.

Unit V : Segment, Animation and Graphics Tools

Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility. Animation: Introduction, Design of animation sequences, Animation languages, Key- frame, Morphing, Motion specification.
Graphics Tools: Introduction to graphics tool: OpenGL, WebGL & usage of at least one tool of computer graphics (3D studio, Maya, Blender, Unity, or Similar open-source tools).

Unit VI : Curves, Fractals and Color Models

Curves: Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier curve, Fractals: Introduction, Classification, Applications, Fractal generation: snowflake, Triadic curve, Hilbert curve.
Color models and applications: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY, YIQ, color Selection and applications.

Text Books :

1. S. Harrington, "Computer Graphics", 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 –100472 – 6.
2. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.
3. Donald D. Hearn, ―Computer Graphics with Open GL‖, 4th Edition, ISBN-13: 9780136053583

Reference Books :

1. D. Hearn, M. Baker, "Computer Graphics – C Version", 2nd Edition, Pearson Education, 2002, ISBN 81 – 7808 – 794 – 4.
2. D. Rogers, J. Adams, "Mathematical Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8.
3. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice", 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.

List of Assignments :

1. Write C++/JavaScript/Java program to draw line using DDA and Bresenham's algorithm.
2. Write C++/JavaScript/Java program to draw circle using Bresenham's algorithm.
3. Write C++/JavaScript/Java program to draw 2-D object and perform following basic transformations, a) Scaling b) Translation c) Rotation.
4. Write C++/JavaScript/Java program to fill polygon using Scan Line Fill algorithm.
5. Write C++/JavaScript/Java program to draw a polygon and fill it with desired colour using Seed fill algorithm.
6. Design a Bouncing ball animation using Maya / Blender/Unity.
7. Write C++/JavaScript/Java program to simulate any one of the scenes using CG algorithms- (Mini Project)
    1. Vehicle Locomotion.
    2. Airplane Landing.
    3. Any Game with locomotion.
    4. Academic Animation (such as Stack Operation, Queue Operation, Tower of Hanoi, Graph Traversal etc.)

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CSUA31205B: Professional Elective – I
Business Intelligence and Data Analytics

Teaching Scheme
Credits : 4
Lectures : 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme
Continuous Evaluation(CE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
PR/OR: 25 Marks

Prerequisites :
- Database Management System
- Data Structures

Course Objectives :
- To learn the basics of the Business intelligence Process
- To understand the Decision making support system.
- To learn the design of data warehouse
- To learn modelling a web based social business problem
- To design a dashboard using visualization technique.
- To understand different analytics techniques

Course Outcomes:
After completion of the course, student will be able to
1. Understand the Business intelligence concept for projects.
2. Apply Decision support system techniques for BI applications.
3. Apply the data warehouse for business intelligence.
4. Understand the knowledge of emerging and critical area in social media analytics.
5. Apply contemporary visualization techniques and tool for real/distinguished time applications.
6. Understand analytical techniques for different case studies.

Unit I : Business Intelligence Concepts
Introduction to data, Information and Knowledge, Operational and Informational data, Introduction to Business Intelligence, BI architecture and its components, BI opportunities, Benefits of BI, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization.

Unit II : Decision Making and Support System
Concept of Decision Making system and its importance, Decision making process, Common strategies and approaches of decision makers, Decision support system(DSS) : Role of DSS, its main components, its various techniques, Types and classification, Applications of DSS, Role of Business intelligence in DSS.

Unit III : Data Warehouse
Introduction, Data Warehouse Modelling: Data Cube and OLAP Data Warehouse Design and

Usage, Distributed Data-warehouse and materialized view, Different types of OLAP and their applications, Difference between OLAP and OLTP, Big Data Lakes.

Unit IV : Web and Social Media Analytics

Introduction of unstructured data, Preprocessing of unstructured data, Challenges in processing of unstructured data, Applications, Introduction of Text Mining and Web Mining, Social Media Platforms, Performance and evaluation measures, Basic & Advanced Web Metrics Google Analytics, Campaign analytics IP .

Unit V : Visualization

Introduction to Tableau, Basic charts and Dashboards, Dashboard design and principal, Integrate Tableau with Google sheet.

Unit VI : Recent application / Case studies

Finance and Risk Analytics: Why Credit Risk-Using a market case study, Comparison of Credit Risk Models, Overview of Probability of Default (PD),Modelling PD Models , types of models, Steps tomake a good model, Marketing analytics, ERP and Business Intelligence, BI Applications in CRM, finance, Banking, Supply Chain and Logistics Analytics: Introduction to Supply Chain, Dealing with Demand uncertainty, Designing Optimal Strategy using Case Study, Inventory Control & Management.

Text Books :

1. Raghu Ramkrishnan, Johannes Gehrke, Database Management Systems, Second Edition
2. William Inmon, "Building the Data Warehouse", Wiley publication 4th edition
3. Introduction to business Intelligence and data warehousing, IBM, PHI.
4. Introduction to Information Retrieval. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schuetze, Cambridge University Press, 2007

Reference Books :

1. Data Mining: Concepts and Techniques, Han, Elsevier ISBN:9789380931913
2. Business Intelligence – Data Mining and Optimization for Decision Making – Carlo Vercellis – Wiley Publications.

List of Assignments:

Note : Lab instructor can frame suitable assignment list referring to the following list.

1. Design Decision support system for any application such as banking application, where a bank loan officer verifying the credit of a loan applicant or an engineering firm that has proposal on several projects and wants to know if they can be competitive with their costs.
2. Choose a set of business processes like Sales, Customer Services, Accounting, Production, Marketing processes etc. for any organization and design star, snow flake and fact constellation schema. Also using ETL tool,extract data from various sources and perform transform and load operations on data.
3. Perform text preprocessing with creation of inverted index for unstructured data (text). Consider suitable data set.
4. Study and implement opinion mining / sentiment analysis for sample online/offline application
5. Perform Visual analytics using Tableau /R/Python/Excelfor the given use case in assignment 1 and 2.

6. Create a dashboard using device designer for assignment 1 and 2.
7. Integrate tableau with Google sheet and plot various graph like tableplot, histogram, boxplot for the suitable data
8. For the given use case perform sorting, using measure, Sorting using header and legends, grouping using data window and calculate static and dynamic grouping.
9. Design an inventory control management system using python/R for given case study.
10. Design a risk analysis model using Python/R to predict market risk using stock case study.

CSUA31205C: Professional Elective – I
Internet of Things (IOT)

Teaching Scheme

Credits : 4
Lectures : 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CIE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
PR/OR: 25 Marks

Prerequisites :

- NA

Course Objectives :

- To understand fundamentals of IoT
- To gain knowledge of IoT proctols
- To implementing small IoT systems using building blocks of IoT
- To comprehend fundamentals of security in IoT
- To learn how secure infrastructure for IoT is implemented
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies

Course Outcomes :

After completion of the course, student will be able to

1. Illustrate the fundamentals of IoT
2. Compare the distinguished IoT protocols
3. Design small IoT Systems using building blocks of IoT
4. Illustrate the security issues in IoT
5. Summarize the concepts of Cloud & Fog Computing
6. Develop cloud based IoT application

Unit I : Introduction to IoT

IoT: Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges, Applications.

Unit II : Protocols for IoT

IoT Protocols Organization, IoT Data Protocols: CoAP, MQTT, AMQP, DDS, IPv6, ZigBee, Bluetooth, Wifi, 6LowPAN, Comparison of Traditional Networking Protocols and IoT Protocols

Unit III : IoT& M2M

Machine to Machine, Difference between IoT and M2M,IoT Physical Devices and Endpoints: Basic building blocks of and IoT device, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to

Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python

Unit IV : Security in IoT

IoT Security: Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modelling, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT

Unit V : Cloud Computing and Fog Computing

Introduction to Cloud Computing, Cloud of things, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture. Challenges and issues in cloud Computing. Fog Computing, Need of Fog computing, Fog Computing Architecture. Edge Computing, Edge computing benefits and challenges.

Unit VI : IoT Case Studies

Case Studies: Home Automation, Weather Monitoring System, Air quality Monitoring, Smart Irrigation, Smart cities, Health Care, Manufacturing industry, Transportation

Text Books :

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012. ISBN : 9781439892992
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011. ISBN: 978-3-642-19156-5

Reference Books :

1. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012, 9781119958345
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012, ISBN:978-1-119-99435-0
3. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010.ISBN : 978-0-470-90356-8
4. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014, ISBN: 978-1-118-43063-7

List of Assignments:

1. Study of Arduino and Raspberry Pi.
2. Installation of Raspbian OS on Raspberry Pi
3. LED Blinking assignment using Arduino and Raspberry pi.
4. Interfacing Ultrasonic sensors with Ardinuo and Raspberry pi.
5. Interfacing LM35 sensor with Arduino
6. Interfacing BMP 380 with Raspberry Pi.
7. Interfacing of Camera Module with Raspberry Pi
8. Implement a cloud based miniproject in IoT - SCE

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CSUA31205D: Professional Elective – I
Artificial Intelligence

Teaching Scheme

Credits: 4

Lectures: 3 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks

In-Semester Examination(ISE): 30 Marks

Skills & Competency Exam(SCE): 20 Marks

End Semester Examination(ESE): 30 Marks

PR/OR: 25 Marks

Prerequisites :

- Data Structures
- Probability and Statistics

Course Objectives :

- To understand the various characteristics of Intelligent agents.
- To learn the different search strategies in AI.
- To learn how to represent knowledge in solving AI problems.
- To introduce the concepts of Expert Systems and Machine Learning.
- To know about the various applications of AI.
-

Course Outcomes:

After completion of the course, student will be able to

1. Understand different types of AI Agents and environment.
2. Implement various AI search algorithms.
3. Understand fundamentals of knowledge representation and working knowledge of reasoning in presence of incomplete and uncertain information.
4. Apply knowledge representation, reasoning and machine learning techniques to real world problems.
5. Apply AI techniques for real world application
6. Understand AI cloud environments

Unit I : Introduction

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Environment, Environment Types, Problem Solving Approach to Typical AI problems

Unit II : Problem Solving Methods

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games

Unit III : Knowledge Representation & Inference

Logical Agents, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic, First-Order Logic, Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic

Inferences: Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster – Shafer theory.

Unit IV: Learning

Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Inductive logic programming, Statistical learning methods, Learning with complete data, Perceptron Learning, Learning with hidden variable, EM algorithm, Instance based learning, Neural networks - Reinforcement learning, Passive reinforcement learning, Active reinforcement learning, Generalization in reinforcement learning.

Unit V: AI Applications

Sequential and time series analysis, Speech Recognizer, Natural Language Processing, Chatbots, Perceptron based classifier

Unit VI: Artificial Intelligence on Cloud

Amazon Web Services (AWS) : Amazon SageMaker, Alexa, Lex, and Polly – Conversational agents, Amazon Comprehend – natural language processing, Amazon Rekognition – image and video, Amazon Translate, Amazon Machine Learning, Amazon Transcribe – transcription, Amazon Textract – document analysis, Microsoft Azure :Microsoft Azure Machine Learning Studio, Azure Machine Learning Service, Azure Cognitive Services Google Cloud Platform (GCP) :AI Hub Google Cloud AI Building Blocks

Text Books :

1. Stuart Russell, Peter Norvig, Artificial intelligence : A Modern Approach, Prentice Hall, Fourth edition, 2020
2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann, 1998.
3. https://cse.iitkgp.ac.in/~pallab/artificial_intelligence_autumn_2020/index.html

Reference Books :

1. https://london.ac.uk/sites/default/files/study-guides/introduction-tonatural-language-processing.pdf
2. Artificial Intelligence with Python -Second Edition-Alberto Artasanchez Prateek Joshi-Packt Publishing Ltd.

List of Assignments:

1. Implement DFS, BFS, A* algorithm for 8-puzzle problem .
2. Solving a problem with constraints

3. Building a bot to play Tic-Tac-Toe
4. Perform parsing of family tree using knowledge- base
5. Build a reinforcement learning agent
6. Extract statistics from Time series data
7. Build a sentiment analyser for given data
8. Build a speech recognizer system
9. Create a Chabot application for any real world scenario

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CSUA31206: Project-I

Teaching Scheme
Credits : 2
Lectures : 1 Hrs/week
Practical : 2 Hrs/week

Examination Scheme
Summative Assessment(TW):25 Marks

Prerequisites :
- Java, Object Oriented Programming, Software Engineering

Course Objectives :
- To adapt the usage of modern tools and recent software.
- To evaluate problems and analyze data using current technologies
- To learn how to employ Integrated Development Environment(IDE) for implementing and testing of software solution
- To acquire contemporary skills to make the students employable in computer engineering domain

Course Outcomes:
After completion of the course, student will be able to
1. Utilize current technologies in a wide variety of business and organizational contexts using modern tools
2. Identify Integrated Development Environment (IDE) for implementing and testing of software solution.
3. Apply best practices for building applications.
4. Make use of contemporary skills to make them employable.

MODULE –I : JS, Angular, React JS

Unit 1 : Javascript Development
- Fundamentals Of JavaScript
- JavaScript for Beginning Web Developers
- JavaScript for Absolute Beginners
- Fundamentals of jQuery
- Fundamentals of Ajax Development
- Create a node.js Real Time Chat Application
- Advanced JavaScript

Unit 2 : Angular
- What is a SPA? What is Angular?
- Preparing for TypeScript
- Angular-4 new features
- Building with A4 Components
- Bootstrap Scaffolding
- Angular 4 Binding and Events
- Dependency Injection and services

- Directives
- Pipes
- Forms
- HTTP, Promises, and Observables
- Testing

Unit 3 : React.js

- Welcome to Starting with React
- React Components
- React State and Props
- React Event Handling
- Routing in React React flux
- Styling React

Module –II : Android Programming

Unit 1 : First Android App

What is Android, First Android app, How to run and debug applications (Emulator vs. Real device), Android project structure, XML files, Enhancing the first app, Basic Android concepts, Activity, Menus, Intents, Context

Unit 2 : Using more Android capabilities

intelliJIDEA / Android Studio, Permissions, working with files, Working with the network, Debugging Android apps, Providing feedback to the user o Vibration o Sounds o Flash, Raw camera usage, Touch gestures, Location, Status bar notifications, Localization, Services

Unit 3 : Graphics

Animations, 2D graphics, 3D graphics and OpenGL

Unit 4 : Web Services

Soap and Rest overview, Working with SOAP, Working with Rest, Google's external libraries, Google Maps, Monetizing apps, Ads, Publishing and uploading app to Google Play

Text Books:

1. Harvey & Paul Deitel & Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", Fifth Edition, Pearson Education, 2011.
2. Achyut S Godbole and Atul Kahate, "Web Technologies", Second Edition, Tata McGraw Hill, 2012.
3. Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference", Third Edition, Tata McGraw Hill, 2013.
4. David Flanagan, "JavaScript: The Definitive Guide, Sixth Edition", O'Reilly Media, 2011
5. Bear Bibeault and Yehuda Katz, "jQuery in Action", January 2008
6. Neil Smyth, "Android Studio 2 Development Essentials", Payload Media, ISBN: 1532853319
7. John Horton, "Android Programming for Beginners", ISBN 10:1785883267
8. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda, "ng-book, The Complete Book on Angular 4" September 2016

Reference Books:

1. Web link for Angular4.0: https://angular.io/

2. Ebook link for JavaScript - https://github.com/jasonzhuang/tech_books/tree/master/js
3. Reto Meier, "Professional Android 4 Application Development", Wrox, ISBN-10: 1118102274; ISBN-13: 978-1118102275
4. Greg Nudelman, "Android Design Patterns :Interaction Design Solutions for Developers", ISBN-10: 1118394151; ISBN-13: 978-1118394151

List of Assignments:

With intent to get some project development exposure, students must apply Technical, Behavioural, Process concepts learnt in the course by executing real-life project and working in teams. (Project team will ideally comprise of 3 to 4 members)

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CSUA32201: Design and Analysis of Algorithms

Teaching Scheme

Credits: 4

Lectures: 3 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks

In-Semester Examination(ISE): 30 Marks

Skills & Competency Exam(SCE): 20 Marks

End Semester Examination(ESE): 30 Marks

PR/OR: 25 Marks

Prerequisites :

- Discrete Mathematics
- Data Structures
- Theory of Computation

Course Objectives :

- To study the analysis of algorithms
- To study the greedy and dynamic programming algorithmic strategies
- To study the backtracking and branch and bound algorithmic strategies
- To study the concept of hard problems through understanding of intractability and NP-Completeness
- To study some advance techniques to solve intractable problems
- To Study multithreaded and distributed algorithms

Course Outcomes:

After completion of the course, student will be able to

1. Analyze algorithms for their time and space complexities in terms of asymptotic performance.

2. Apply greedy and dynamic programming algorithmic strategies to solve a given problem

3. Apply backtracking and branch and bound algorithmic strategies to solve a given problem

4. Identify intractable problems using concept of NP-Completeness

5. Use advance algorithms to solve intractable problems

6. Solve problems in parallel and distributed scenarios

Unit I : Introduction

Analysis of Algorithms, Best, Average and Worst case running times of algorithms, Mathematical notations for running times O, Ω, Θ, Master's Theorem

Problem solving principles: Classification of problem, problem solvingstrategies, classification of time complexities (linear, logarithmic etc.).

Divide and Conquer strategy: General strategy, Quick Sort and Merge Sort w.r.t. Complexity

Unit II : Greedy Method & Dynamic Programming

Greedy Method: General strategy, the principle of optimality, Knapsack problem, Job Sequencing with Deadlines, Huffman coding. Dynamic Programming: General Strategy, 0/1 Knapsack, OBST, multistage graphs

Unit III : Backtracking, Branch and Bound

Backtracking: The General Method 8 Queen's problem, Graph ColoringBranch and Bound: 0/1 Knapsack, Traveling Salesperson Problem.

Unit IV : Intractable Problems and NP-Completeness

Time-Space trade off, Tractable and Non-tractable Problems, Polynomial and non-polynomial problems, deterministic and non-deterministic algorithms P-class problems, NP-class of problems, Polynomial problem reduction, NP complete problems- Vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle

Unit V : Approximation and Randomized Algorithms, Natural Algorithms

Approximation algorithms, Solving TSP by approximation algorithm, approximating Max CliqueConcept of randomized algorithms, randomized quicksort algorithms , Natural Algorithms–Evolutionary Computing and Evolutionary Algorithms, Introduction to Genetic Algorithm, Simulated Annealing

Unit VI : Parallel and Concurrent Algorithms

Parallel Algorithms: Sequential and parallel computing, RAM&PRAM models, Amdahl's Law, Brent's theorem, parallel algorithm analysis, multithreaded matrix multiplication, Concurrent Algorithms: Dining philosophers problem

Text Books :

1. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203- 1131-2
2. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press, ISBN: 978 81 7371 6126, 81 7371 61262

Reference Books :

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press; ISBN 978-0-262-03384-8
2. Parag Himanshu Dave, Himanshu Bhalchandra Dave, "Design And Analysis of Algorithms", Pearson Education, ISBN 81-7758-595-9
3. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press, ISBN: 978-0-521-61390-3
4. Michael T. Goodrich, Roberto Tamassia , "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley, ISBN 978-81-265-0986-7
5. Dan Gusfield, "Algorithms on Strings, Trees and Sequences", Cambridge University Press,ISBN:0-521- 7035-7

List of Assignments:

Note: Perform the following lab assignments using C++/Java/Python

1. Implement Quick Sort using divide and conquer strategy.
2. Implement 0/1 knapsack using Dynamic Programming.
3. Implement 8 queens problem using Backtracking
4. Implement Travelling Salesman problem using branch and bound technique.
5. Implement Travelling Salesman problem using Genetic Algorithm
6. Implement Concurrent Dining Philosopher Problem.
7. Implement multithreaded matrix multiplication.

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CSUA32202A:Professional Elective -II
Augmented and Virtual Reality

Teaching Scheme

Credits: 4

Lectures: 3 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks

In-Semester Examination(ISE): 30 Marks

Skills & Competency Exam(SCE): 20 Marks

End Semester Examination(ESE): 30 Marks

PR/OR: 25 Marks

Prerequisites:

- Discrete Mathematics, Data Structures, Theory of Computation, Computer Graphics

Course Objectives:

- To learn the basic concept and framework of virtual reality.
- To learn fundamental of computer graphics and Visual Computation in Virtual Reality.
- To make students aware of the technology for managing large scale VR environment in real time.
- To learn the concepts of Haptic & Force Interaction in Virtual Reality systems.
- To provide students with an introduction to the VR system framework and development tools.
- To learn the basic concept and framework of Augmented Reality.

Course Outcomes:

After completion of the course, student will be able to

1. To understand the basic concept and framework of virtual reality
2. To understand the concept of computer graphics and its implication on perception and rendering.
3. To understand the technology for multimodal user interaction and perception in VR Decide and apply algorithmic strategies to solve a given problem
4. Explain the concepts of Haptic & Force Interaction in Virtual Reality systems.
5. To apply VR Development Tools in real time environment.
6. To understand concepts of Augmented Reality.

Unit I: Introduction

Introduction to Virtual Reality Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality.

Multiple Modals of Input and Output Interface in Virtual Reality, Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based3D Menus & 3DScanner etc; Output --Visual / Auditory / Haptic Devices.

Unit II: Visual Computation in Virtual Reality

Fundamentals of Computer Graphics; Real time rendering technology; Principles of Stereoscopic Display; Software and Hardware Technology on Stereoscopic Display

Unit III: Environment Modeling in Virtual Reality

Geometric Modelling; Behaviour Simulation; Physically Based Simulation

Unit IV: Haptic & Force Interaction in Virtual Reality

Concept of haptic interaction; Principles of touch feedback and force feedback; Typical structure and principles of touch/force feedback facilities in applications

Unit V: VR Development Tools

Frameworks of Software Development Tools in VR; Modelling Tools for VR; X3D Standard; Vega, MultiGen, Virtoolsetc

Unit VI: Augmented Reality

System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.

Text Books:

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2. Alan B Craig, William R Sherman and Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009.
3. Gerard Jounghyun Kim, Designing Virtual Systems: The Structured Approach, 2005

Reference Books :

1. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, 3D User Interfaces, Theory and Practice, Addison Wesley, USA, 2005.
2. Oliver Bimber and Ramesh Raskar, Spatial Augmented Reality: Meging Real and Virtual Worlds, 2005.
3. Burdea, Grigore C and Philippe Coiffet, Virtual Reality Technology, Wiley Interscience, India, 2003.
4. John Vince, Virtual Reality Systems, Addison Wesley, 1995
5. Howard Rheingold, Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society, Simon and Schuster, 1991.
6. William R Sherman and Alan B Craig, Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics). Morgan Kaufmann Publishers, San Francisco, CA, 2002
7. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013

List of Assignments:

1. Design a Cube Runner game which shows motion of cube in forward direction and can move left and right and show the haptic force feedback when it gets hit to any of the surface.
2. Create one Cube and show all three properties like material Texture and shaders. Create a material and provide physics property like gravity torque etc. to it.
3. Create a terrain and run a spherical object on the terrain.
4. Design & Animate a Game Character using unity.

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CSUA32202B: Professional Elective-II
Advanced Machine Learning

Teaching Scheme

Credits: 4
Lectures: 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
PR/OR: 25 Marks

Prerequisites :

- Machine Learning, Probability and Statistics

Course Objectives :

- To understand human learning aspect and relate it with machine learning concepts.
- To understand nature of the problem and apply machine learning algorithm.
- To find optimized solution for given problem.
- Learn to implement train, and validate neural network,and improve understanding of the on-going research in computer vision and multimedia field.

Course Outcomes:

1. Apply specific feature engineering techniques for a particular problem.
2. Summarize the basic concepts of Deep Learning
3. Understand data, training parameters, network structure, and other strategies to increase performance and capability.
4. Describe and compare different architectures of Convolutional Neural Networks.
5. Describe and Analyze the working of Recurrent Neural Networks.
6. Analyze and suggest the appropriate auto-encoder approach for the various types of problem.

Unit I: Introduction and Feature Engineering

Introduction-Classic and adaptive machines, Relationship between Artificial Intelligence, Machine Learning, and Data Science, Definition and Features of Machine Learning, Machine Learning Approaches, Machine Learning Techniques, Applications of Machine Learning.

Feature Engineering-Creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Principle Component Analysis (PCA)-nonnegative matrix factorization, Sparse PCA, Kernel PCA.

Unit II: Introduction to Deep Learning

History of Deep Learning McCulloch Pitts Neuron, Thresholding Logic, Activation functions, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs),Representation

Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks

Unit III: Gradient Descent and Regularization

Gradient Descent-Gradient Descent(GD),Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp

Regularization-Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout

Unit IV : Convolutional Neural Networks

Convolutional Neural Networks-Convolutional Neural Networks ,Architectures, convolution / pooling layers, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Back propagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks. Case Study

Unit V : Recurrent Neural Networks

Recurrent Neural Networks – Recurrent Neural Networks, Back propagation through time (BPTT),Vanishing and Exploding Gradients, Truncated BPTT,GRU, LSTMs, Case Study

Unit VI : Autoencoders

Introduction of encoders and decoders, applications of encoder and decoder models, Introduction to autoencoders, link between PCA and autoencoders, regularization in autoencoders, denoising autoencoders, sparse autoencoders, contractive autoencoders.

Text Books :

1. Goodfellow, I., Bengio,Y., and Courville, A., DeepLearning, MITPress,2016.
2. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited**,** ISBN-10:1785889621,ISBN-13:978-1785889622
3. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioners Approach", O"REILLY, SPD, ISBN: 978-93-5213-604-9, 2017

Reference Books :

1. Tom Mitchell "Machine Learning", McGraw Hill Publication, ISBN: 00704280779780070428072
2. Nikhil Buduma, "Fundamentals of Deep Learning", O'REILLY publication, second edition 2017, ISBN:1491925612

List of Assignments:

1. Write a program to do: Download the appropriate dataset and preprocess it using feature engineering techniques.
2. Write a program to implement Principal Component Analysis.
3. Write a program to implement Gradient Descent.
4. Implement Convolutional Neural Network for Image Classification.
5. Implement Recurrent Neural Network for Sentiment Analysis.

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Department of Computer Engineering

CSUA32202C: Professional Elective-II
Digital Forensic

Teaching Scheme

Credits: 4

Lectures: 3 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks

In-Semester Examination(ISE): 30 Marks

Skills & Competency Exam(SCE): 20 Marks

End Semester Examination(ESE): 30 Marks

PR/OR: 25 Marks

Prerequisites :

- Computer Networks-I

Course Objectives :

- To acquaint with the digital forensic investigation process
- To learn the process of data acquisition in a digital crime scene
- To understand the various file system analysis
- To understand the various evidence on the network
- To identify the various evidence on the Internet
- To understand and apply the digital forensic concepts

Course Outcomes:

At the end of the course students will be able to

1. Outline the digital forensic investigation process(Remember)
2. Understand the process of data acquisition in a digital crime scene(Understand)
3. Analyse the evidence from the file system(Analyze)
4. Interpret the various evidence on the network (Understand)
5. Identify the various evidence on the Internet (Understand)
6. Use the digital forensic concepts (Apply)

Unit I: Introduction To Computer Forensics

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Incident and Incident Response(IR) methodology – Forensic duplication and investigation. Preparation for IR

Unit II: Data Acquisition

Understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools and other forensics acquisitions tools

Unit III: File System Analysis

Windows System Forensics, Linux System Forensics

Unit IV : Network Forensics Investigation

Email analysis, Network analysis

Unit V : Digital Evidence On Internet

Digital Evidence on Physical and Data-Link Layers, Digital Evidence on Network and Transport Layers

Unit VI : Case Study And Forensic Tools

Study of Forensic Tools (Wireshark, nmap, etc.)
Case study on Cyber Forensics

Text Books :

1. Eoghan Casey, "Digital Evidence and Computer Crime", Third Edition Elsevier Academic publication

Reference Books :

1. Nina Godbole, Sunit Belapur, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Publications, April, 2011.

List of Assignments:

1. Understanding Hard Disks and File Systems
2. Analysis of Windows / Linux log files.
3. Network Forensics
4. Evidence on Physical layer
5. Investigating Web Attacks
6. Email Analysis
7. Case study on any digital crime investigation

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Department of Computer Engineering

CSUA32202D: Professional Elective-II
Agile Methodology and DevOps

Teaching Scheme

Credits: 4

Lectures: 3 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks

In-Semester Examination(ISE): 30 Marks

Skills & Competency Exam(SCE): 20 Marks

End Semester Examination(ESE): 30 Marks

PR/OR: 25 Marks

Prerequisites :

- Software Engineering, Software Design and Architecture

Course Objectives :

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To understand the benefits and pitfalls of working in an Agile team.
- To gain in-depth knowledge on Continuous Development, Continuous Integration, and Continuous Testing by performing hands-on on GIT, Jenkins
- To get comprehensive knowledge on Configuration Management, and Continuous Deployment using Puppet
- To able automate all aspects of a modern code delivery and deployment pipeline using: Source code management tools

Course Outcomes:

1. To realize the importance of interacting with business stakeholders in determining the requirements for a software system
2. To perform iterative software development processes: how to plan them, how to execute them.
3. To show how agile approaches can be scaled up to the enterprise level.
4. To understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options to meet your business requirements
5. To have a detailed overview of continuous integration and container ecosystem by learning tools such as Jenkins and Docker
6. To be able to deliver change requests from customers rapidly and effectively by adding new (and updating existing) features

Unit I: Agile Methodology

Theories for Agile Management – Agile Software Development – Traditional Model vs.

Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

Unit II: Agile Processes

Lean Production – SCRUM, Crystal, Feature Driven Development- Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

Unit III: Agility And Requirements Engineering

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

Unit IV : DevOps Essentials

Why DevOps? What is DevOps? DevOps Market Trends, DevOps Engineer Skills, DevOps Delivery Pipeline, DevOps Ecosystem

Unit V : Build Tools – GIT and Jenkins

Introduction to VCS and GIT, GIT File workflow, Important GIT Commands, Plugin Management in Jenkins, Introduction to Continuous Integration and Jenkins, Various scenarios of Building Delivery Pipeline, Build Setup in Jenkins, Test Automation, Security in Jenkins, Notification System

Unit VI : Puppet

Puppet Introduction, Puppet Architecture, Basic Puppet Terminologies, Puppet Language Constructs, Puppet Modules, Puppet Environment, Node Classification, Puppet Classes, Puppet Template

Text Books :

1. David J. Anderson and Eli Schragenheim, ―Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results‖, Prentice Hall, 2003.
2. Hazza and Dubinsky, ―Agile Software Engineering, Series: Undergraduate Topics in Computer Science‖, Springer, 2009.
3. Gene Kim, Patrick Debois, John Willis, Jez Humble, John Allspaw, "The DevOps Handbook: How to CreateWorld-Class Agility, Reliability, and Security in Technology Organizations", October 6, 2016

Reference Books :

1. Craig Larman, ―Agile and Iterative Development: A Manager_s Guide‖, Addison-Wesley, 2004.
2. Kevin C. Desouza, ―Agile Information Systems: Conceptualization, Construction, and Management‖, Butterworth-Heinemann, 2007.
3. Jennifer Davis, Ryn Daniels, "Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale", 1st Edition.

List of Assignments:

1. Students should form and operate as Scrum teams to build a real open-source software product together. The project starts at the start of semester and continues through the end of the semester.
In this project, students will:
Form a Scrum team: Form a team, name your team, volunteer for Scrum roles, create a Slack channel, create a public git repository.
Create a product vision: Articulate your far vision and your near vision, identify your stakeholders.
Create your initial product backlog: Create initial product backlog items as user stories, order your product backlog.
Get your product backlog ready: Estimate the size of your backlog items and do everything you think you need to do to be ready for sprint planning.
Read the rubric carefully for a description of what to do.
Submit your team's GitHub repo URL as the solution to the assignment.
Be prepared to share your team roster, product vision, and initial product backlog in class.

2. Installing Git, First-Time Git Setup, Getting a Git Repository, Working Cth various git commands, Working Cth Local repository vs remote repository, Managing remote repository, Stashing operations and various local repository operations, Branching and merging operations, Resolving conflicts during merges, Managing access on repository managements

3. Installing Jenkins, Post-installation setup wizard, Unlocking Jenkins, Customizing Jenkins with plugins, User management — Authentication and Authorization, Deploying an application to a container using Jenkins

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Department of Computer Engineering

CSUA32203: Cloud Computing

Teaching Scheme

Credits : 4

Lectures : 3 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks

In-Semester Examination(ISE): 30 Marks

Skills & Competency Exam(SCE): 20 Marks

End Semester Examination(ESE): 30 Marks

TW: 25 Marks

Prerequisites :

- Computer Networks, Database Management Systems

Course Objectives :

- To understand cloud computing concepts
- To study supporting technologies of cloud
- To study open research problems of cloud computing
- To study various platforms for cloud computing
- To explore the applications based on cloud computing
- To study and evaluate the contemporary technologies in cloud computing

Course Outcomes :

After completion of the course, student will be able to

1. Summarize the basic concepts of cloud computing.
2. Make use of supporting technologies for cloud computing.
3. Analyze the challenges and opportunities in the cloud computing.
4. Use the cloud services for deployment of his own applications.
5. Correlate the IoT and Ubiquitous technologies with cloud .
6. Explore current trends of cloud computing

Unit I : Basics of Cloud Computing

Overview, Applications, Intranets and the Cloud. Your Organization and Cloud Computing- Benefits, Limitations, Security Concerns. Software as a Service (SaaS)-Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Benefits of Paas Solutions, Disadvantages of PaaS Solutions. Infrastructure as a Service (IaaS)-Understanding IaaS, Improving Performance through Load Balancing, System and Storage Redundancy

Case Study: Google Cloud Platform

Unit II : Virtualization

Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

Common Standards: The Open Cloud Consortium, Open Virtualization Format. Standards for Security. Case study :VirtualBox, vmware.

Unit III : Data Storage and Security in Cloud

Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo Cloud data stores: Datastore and Simple DB Cloud Storage-Overview, Cloud Storage Providers. Case study: Firebase**. Securing the Cloud**- General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats. Case study: Discuss research problems of cloud security

Unit IV : Amazon Web Services

Services offered by Amazon Hands-on Amazon, EC2 - Configuring a server, Virtual Amazon Cloud, AWS Storage and Content Delivery Identify key AWS storage options Describe Amazon EBS Creating an Elastic Block Store Volume Adding an EBS Volume to an Instance Snap shotting an EBS Volume and Increasing Performance Create an Amazon S3 bucket and manage associated objects. AWS Load Balancing Service Introduction Elastic Load Balancer Creating and Verifying Elastic Load Balancer.

Unit V : Ubiquitous Clouds and the Internet of Things

Introduction to Ubiquitous computing, Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management)

Unit VI : Future of Cloud Computing

Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, The Docker Workflow. Docker compose file, Docker volume, Docker storage.

Kubernetes : introduction to Kubernetes, Features of Kubernetes, Kubernetes API, Basic Architecture, Minikube.

Text Books :

1. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more" , Wiley Publications, ISBN: 978-0-470-97389-9
3. Gautam Shroff, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, *ISBN*: 9780511778476
4. Docker Documentation (https://docs.docker.com/get-started/)
5. Kubernetes Documentation (https://kubernetes.io/docs/home/)

Reference Books :

1. Dr. Kumar Saurabh, "Cloud Computing", Wiley Publication, ISBN10: 8126536039
2. Buyya, "Mastering Cloud Computing", Tata McGraw Hill, ISBN-13: 978-1-25-902995-0
3. Barrie Sosinsky, "Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8
4. Kailash Jayaswal, "Cloud computing", Black Book, Dreamtech Press
5. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, "Cloud Computing: Concepts, Technology and Architecture", Pearson, 1st Edition, ISBN :978

9332535923, 9332535922

6. Tim Mather, Subra K, Shahid L., Cloud Security and Privacy, Oreilly, ISBN-13 978-81-8404-815-5

List of Assignments :

1. Case study on Case Study: Google Cloud Platform
2. Write a web based application and use Firebase.
3. Create a sample web based application using PhP/Pyhton and deploy it on AWS.
4. Assignment to install and use Docker. Create Docker file.
5. Assignment to install and use kubernetes.

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Department of Computer Engineering

CSUA32204A: Professional Elective -III
Blockchain Technology

Teaching Scheme

Credits : 4
Lectures : 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
PR/OR: 25 Marks

Prerequisites :

- NA

Course Objectives :

- To introduce fundamentals of Blockchain
- To explain Bitcoin Blockchain
- To explain Ethereum Architecture & Components
- To explain Hyperledger Frameworks and Fabric Concepts
- To explain Web 3 technology
- To discuss Emerging Trends in Blockchain and Use cases

Course Outcomes:

After completion of the course, student will be able to

1. Explain fundamental knowledge of Blockchain (Understand)
2. Illustrate Bitcoin Blockchain (Understand)
3. Summarise Ethereum Architecture & Components (Understand)
4. Introduce Hyperledger Frameworks and Fabric Concepts (Understand)
5. Introduce Web 3 Technology (Understand)
6. Explore emerging trends in Blockchain and Use cases (Understand)

Unit I : Overview of Blockchain

What is Blockchain?, History of Blockchain, Network and protocols, Smart Contract and Consensus Algorithms, Blockchain users and adoption, Blockchain challenges

Unit II : Bitcoin Blockchain

Cryptocurrency, Bitcoin Blockchain fundamentals, Keys as Identity, Digital Signatures, Hashes, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain transactions, Blockchain block structure, Bitcoin Mining, Proof-of-Work

Unit III : Ethereum Architecture & Components

Evolution of Ethereum, Ethereum Components, Ethereum Virtual Machine, Types of Transactions, Solidity language, Ethereum Smart Contracts, Tokenization, Ethereum Clients, The Ethereum network, The Ethereum Mining Process, Ethereum Genesis Block Creation, Dapps.

Unit IV : Hyperledger Frameworks & Fabric Concepts

Overview of Hyperledger, Hyperledger Projects, Hyperledger Architecture, Consensus model

for permissioned Blockchains, Fabric Elements, Transaction Execution in Fabric, Fabric Network Setup, Fabric Chaincode Development & Deployment

Unit V : Web3

Web3 applications, cryptocurrency, Token creation, Web infrastructure protocols, web3 spaces, Payment process

Unit VI : Emerging Trends in Blockchain and Use cases

Introduction to Corda, Ripple, Multichain, etc.

Blockchain and cloud computing, Blockchain and Artificial Intelligence, Blockchain and IOT, Blockchain and Machine Learning.

Blockchain use cases in Health Care, Banking, Government Sector, Supply Chain Management, Identity Management, etc.

Text Books :

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Mastering Ethereum Building Smart Contracts and DApps, Andreas M. Antonopoulos, Gavin Wood, O'Reilly
4. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric

Reference Books :

1. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits
2. Etherium Yellow Paper : "Ethereum: A Secure Decentralised Generalised Transaction Ledger Petersburg", Dr. Gavin Wood

Suggested list of Assignments :

1. Study of various websites related Blockchain like
2. Case Study on various use cases of Blockchain.
3. Study of SOLIDITY programming.
4. Write Smart Contract for various use cases of Blockchain.
5. Implementations in Public Blockchain network such as – Bitcoin, Ethereum
6. Research & writing on topics such as Forking, Wallets, Consensus Mechanisms, Performance enhancement.
7. Comparative study of various Blockchain Platforms (Bitcoin, Ethereum, Hyperledger, Ripple, Corda, R3…).

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CSUA32204B: Professional Elective -III
Robotic Process Automation

Teaching Scheme

Credits: 4
Lectures: 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
PR/OR: 25 Marks

Prerequisites :

- Software Engineering, Software Testing

Course Objectives :

- To learn concepts of Robotic Process Automation techniques in businesses
- To learn Robotic Process Automation for performing repetitive, less complex tasks.
- Automate manually performed workflow tasks that are rule-based, repeatable, time-consuming
- Elaborates on the features and benefits of using Robotic Process Automation techniques in businesses

Course Outcomes:

1. Gain insights into Robotic Process Automation Technology
2. Relate fundamental concepts of UI Automation using various tools
3. Use several types of data inside a workflow
4. Demonstrate a real-world workflow automation project
5. Build templates using reusing of automation by implementing templates
6. Build templates for reusability of automation

Unit I : Basics of RPA

Basics of RPA, RPA VS Test automation, RPA history and drivers. Difference in RPA and automation, Architecture, Introduction to Product Architecture , Benefits and challenges of RPA, Business use case in RPA using process flow diagram

Unit II : Configuration and Management in RPA

Architecture: Blue prism Technology overview, installing blue prism, Automation Anywhere architecture, installing Automation Anywhere , Configuring control room in Blur prism/Automation Anywhere Configuring Automation Anywhere and Blue prism tool .Overview of Task Bots and its usages, Meta Bots and its usages. IQ Bots and its usage. Dashboard in Automation Anywhere and Blue prism.

Unit III : Basic data massing commands and Actions

Basic Input output commands/Action. Data types, Files and folder actions. the task of copying the files from a source folder to the destination folder with various options. Use of FTP/SFTP in

automation FTP /SFTP working. Commands use in FTP servers. Uploading and downloading files using SFTP Transferring audio and video files from local machine to FTP server. Usage of If/else/loop command, Database and RPA tool. Handling Exceptions.

Unit IV : Integration of PDF files

Converts a PDF document into a specified file type. , Extracts all form field data and selected text, and stores the data in variables. Merges selected PDF documents into a single PDF file.

Unit V : Credentials and Lockers

Why credentials and Lockers are needed How to create credential and Lockers Edit ,View and delete lockers, Related use cases, E mail automation using Lockers and credentials

Unit VI : Implementing RPA in Enterprise

Case study Building a business case, Determining which process to automate, Case study of invoice automation, Email automation, ERP automation of an institute for various students processing data .

Web links

1. https://docs.automationanywhere.com
2. https://community.blueprism.com

List of Assignments (Sample) :

1. Using variables and data types perform Window Action
   Sample P.S. : To automate the action of getting the title of an active window.
2. To perform various String operations such as comparing two strings, replacing a string, finding a length of the string, reversing a string, splitting a string , and so on.
   Sample P. S: Extract Domain name from an email id , extract country code from the list of mobile numbers
3. To automate the task of copying the files from a source folder to the destination folder.
   Sample P.S. : Transfer Student Attendance generated files from Google drive folder/ Mobile App to specific folder .(Process may automate after end of the month)
4. To automate the task of extracting a table from a webpage.
   Sample P. S. : Extract student information from a web page
5. To automate the task of Extracting, writing and displaying text from a CSV/Excel file and store it into a notepad file.
6. To automate the task of extracting the data from multiple PDF documents and storing the data into a CSV file.
   Sample use case: Generate an invoice
7. Create a cognitive Bot for any specific application.

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CSUA32204C: Professional Elective-III
Edge Artificial Intelligence

Teaching Scheme

Credits: 4

Lectures: 3 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks

In-Semester Examination(ISE): 30 Marks

Skills & Competency Exam(SCE): 20 Marks

End Semester Examination(ESE): 30 Marks

PR/OR: 25 Marks

Prerequisites :

- Artificial Intelligence, Machine Learning, Internet of Things

Course Objectives :

- To learn the existing techniques and component areas of Artificial Intelligence
- To apply AI knowledge to develop Edge Artificial Intelligent Systems
- To find optimized solution for given problem.

Course Outcomes:

1. Understand relation of Embedded Systems, AI and Edge Computing.
2. Understand the technologies of Edge AI
3. Apply segmentation techniques to improve efficiency of AI models.
4. Develop secured distributed Edge applications using federated learning approach.
5. Apply knowledge of AI for optimizing Edge application
6. Design and Develop edge application.

Unit I:	**Introduction to Edge AI**
Embedded systems , edge devices , edge computing, Artificial intelligence, Machine learning Machine learning**,** Cloud computing, fog computingEmbedded ML and tiny machine learning, need of edge AI**,** benefits of edge AI, Trends in Edge Computing, differences between edge AI and regular AI.	
Unit II:	**The Technology of Edge AI**
Sensors, signals, and sources of data: Types of sensors and signals: Acoustic and vibration Visual and scene, Motion and position, Force and tactile, Optical, electromagnetic, and radiation, Environmental, biological, and chemical Processors for edge AI: Microcontrollers and digital signal processors, System on Chip, Deep learning accelerators, FPGAs and ASICs, Edge servers, Multi-device architectures, Algorithms for edge AI, Edge Computing Frameworks	
Unit III:	**Artificial Intelligence Inference in Edge**
AI Models in Edge, Segmentation of AI Model, Early Exit of Inference, Sharing of AI Computation.	

Unit IV :	**Artificial Intelligence Training at Edge**
Distributed Training at Edge, Federated Learning (FL) at Edge, Communication-Efficient FL, Resource-Optimized FL, Security-Enhanced FL, A Case Study for Training Deep Reinforcement Learning at Edge	
Unit V :	**Artificial Intelligence for Optimizing Edge**
AI for Adaptive Edge Caching, Optimizing Edge Task Offloading, Edge Management and Maintenance, Use Case for Adaptive Edge Caching.	
Unit VI :	**Edge AI Applications**
Types of applications: Keeping track of objects, Understanding and controlling systems, Understanding people and living things, Generating and transforming signals. Case study 1: AI solution for people counting sensor	
Text Books :	
1.	Daniel Situnayake, Jenny Plunkett, "AI at the Edge", December 2022, Publisher(s): O'Reilly Media, Inc. ISBN: 9781098120146
2.	Wang, X., Han, Y., Leung, V. C., Niyato, D., Yan, X., & Chen, X. ,"Edge AI: Convergence of edge computing and artificial intelligence", Singapore: Springer, 2020, ISBN 978-981-15-6185-6

List of Assignments: Suitable assignments to be framed based on the six units

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CSUA32204D: Professional Elective -III
Software Design and Architecture

Teaching Scheme

Credits : 4
Lectures : 3 Hrs/week
Practical : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks
PR/OR: 25 Marks

Prerequisites :

- Software Engineering

Course Objectives :

- To understand software design methods and UML notations.
- To learn architectural design for real time software architecture.
- To select and use appropriate design pattern applicable to software system.
- To use the Siemens four-views approach for developing.
- To use the documentation and Architecture Analysis & Design Language.
- To select and use appropriate software architecture evaluation method.

Course Outcomes:

After completion of the course, student will be able to

1. Remember various software design methods and UML notations.
2. Understand importance of different views in architectural views.
3. Apply appropriate design pattern in software design.
4. Analyze need of Siemens four-views approach for developing.
5. Understand importance of the documentation and Architecture Analysis & Design Language.
6. Develop and use appropriate software architecture evaluation method.

Unit I : Introduction to Software Design

Design Methods: Procedural and Structural Design methods, Object Oriented design method, Unified modelling Language overview, Static and Dynamic Modelling Advance Use case, Class, State, Sequence Diagrams

Unit II : Architectural Design

Need of Architectural Design, importance and architecture views, client-server, service oriented, component based concurrent and real time software architecture with case studies.

Unit III : Design Pattern

Introduction, creational, Structural and behavioural patterns, singleton, proxy, adapter, factory, abstract factory, iterator, observer pattern with application. Case study of any one pattern

Unit IV : Aspect-Oriented Architecture

Introduction to Aspect-Oriented Programming (basic concepts), Aspect oriented architecture,

Aspect oriented Modelling using UML, Aspect Oriented Modelling tools, Model-Driven Architecture (MDA), Why MDA? State of the Art Practices and Tools.

Unit V : Documenting Architecture

Documenting Interfaces, documenting Behaviour, documenting architectural through views, reviewing architecture documents. Introduction to Architecture Analysis Languages (ADLs).

Unit VI : Evaluation of Software Architecture

What is architecture evaluation, Evaluation approaches, Benefits and limits of architecture evaluation, ATAM as evaluation method, Architecture Tradeoff Analysis Method, Example Evaluation; Tactics, Reverse Engineering of software architecture & Software Visualization

Text Books :

1. "Software Design", 2nd edition, Pearson Education, David Budgen.
2. Software Architecture in Practice, 3rd Edition by Len Bass, Paul Clements, Rick Kazman, Addison-Wesley Professional

Reference Books :

1. The UML Users Guide, Pearson Publication, Grady Booch, James Rumbaugh, Ivar Jacobson
2. Software Design: From Programming to Architecture, Eric J.
3. Applied Software Architecture, Christine Hofmeister, Robert Nord, Deli Soni, Addison-Wesley Professional
4. Enterprise Patterns and MDA: Building Better Software with Archetype Patterns and UML Addison-Wesley Professional, Jim Arlow, IlaNeustadt
5. Documenting Software Architectures: Views and Beyond, 2nd Edition, Addison-Wesley, Clements, P., et al.
6. The Architecture Analysis & Design Language (AADL): An Introduction, CMU/SEI-2006-TN-011, Carnegie Mellon University, Gluch, D., Feiler. P., and Hudak. J.

List of Assignments:

1. Design and draw diagram in UML for software system of Realtime use using any free UML tool. Environment/Tool/Language: Linux/Unix base free tool. (StartUML).
2. Perform architectural design and implement singleton pattern for software system using java/c++/python/any advanced programming language. Environment/Tool/Language: Linux/Unix base java/c++/python/any advanced programming language.
3. Perform architectural design and implement observer pattern for software system using java/c++/python/any advanced programming language. Environment/Tool/Language: Linux/Unix base java/c++/python/any advanced programming language.
4. Design and draw UML diagram using any one aspect-oriented approach for any software system with the help of JBoss AOP.Environment/Tool/Language: Linux/Unix base JBoss AOP
5. Perform detailed documentation of assignment no 4 using Doxygen/Swagger/any web-based tool etc. Environment/Tool/Language: Doxygen/Swagger/web based tool etc
6. Assignment based on unit 6

Bansilal Ramnath Agarwal Charitable Trust's
Vishwakarma Institute of Information Technology, Pune-48
(An Autonomous Institute affiliated to Savitribai Phule Pune University)
Department of Computer Engineering

IOEUA32205A: Open Elective-I
Engineering Economics and FinTech

Teaching Scheme

Credits : 3
Lectures : 3 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks
In-Semester Examination(ISE): 30 Marks
Skills & Competency Exam(SCE): 20 Marks
End Semester Examination(ESE): 30 Marks

Prerequisites :

- NA

Course Objectives :

- To learn about the economic development and related issues
- To explain the Indian banking structure and terms like GDP, inflation
- To introduce Cash Flow analysis and Taxes
- To introduce FinTech and it's sub sectors
- To explain the classification of various models of FinTech.
- To describe the innovation in FinTech

Course Outcomes :

After completion of the course, student will be able to

1. Understand the fundamental concepts in engineering economics
2. Illustrate the terms like GDP, inflation, and Indian banking structure
3. Analyze and Calculate cash flow analysis and taxes
4. Understand what FinTech is and the sub sectors that comprise it
5. Classify various models of the Fintech
6. Illustrate various innovations done using latest technology trends in FinTech

Unit I : Introduction to Economics

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost.

Unit II : Banking and Trades

Indian Economics – basic features, natural resources, population size and composition, national income concepts, microeconomics of India, Indian Banking, Role of Reserve bank of India, International Economy, inflation, GDP,Financial Analysis, Ratios, Cost Analysis, financial Institutions, Finance Commissions.

Unit III : Understanding Cash Flow analysis and Taxes

Budget Analysis, Break-even analysis – V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning, Accounting for Depreciation and Income Taxes, Project Cash-Flow Analysis, Understanding Financial Statements.

Unit IV: Introduction to FinTech

Introduction, Financial Services and Fintech: Introduction, Changing Environment, Customer Centricity, Digital Transformation, Definition of Fintech, History of Fintech, Fintech stages, An Overview of Fintech Initiatives Around the World, Ecosystems, Ranking National Ecosystems, Downsides of Disruptive Fintech Initiatives.

Unit V: Model and Classifications

Introduction, Classification, Five Ws and one H : 1. Why a fintech initiative was born? 2. For whom was it born? 3. Which are the services it aims to provide? 4. Where does it aim to perform its business? 5. When does it aim to operate, within the framework of the financial cycle? 6. How is fintech working? The organization and its elements, The V4 business model framework, A Business Model, A Business Model for Fintech. Business Model Canvas (BMC) for FinTech.

Unit VI : FinTech Innovation

Introduction**,** Innovation and Fintech, Digital Transformation and Fintech, A model for an integrated innovation strategy, Types of Innovation: Product (or services), Process, Organization, Business models, Examples of Innovation, Fintech business model canvas, Process Innovation : Big Data Analytics, Value Creation from Big Data Analytics, Kreditech's self-learning algorithm, Internet of Things, Blockchain Technology, Organizational Innovation: Social Networks.

Text Books :

1. B. Nicoletti, The Future of FinTech, 1st ed. Palgrave Macmillan, 2017
2. Krugman, International Economics, Pearson Education.
3. Thursen Gerald, Engineering Economics, Prentice Hall.

Reference Books

1. Accenture. (2015). The future of FinTech and banking: Digitally disrupted or reimagined? Accenture Research, 1–12
2. Dietz M., Khanna S., Olanrewaju T., and Rajgopal K. (2015). Cutting through the fintech noise: Markers of success, imperatives for banks. Practice, G. B. (Ed.), 1–18. McKinsey and Company. Retrieved from http://www.mckinsey.com/ industries/financial-services/our-insights/cutting-through-the-noise round financial - technology.
3. "What is FinTech and why does it matter to all entrepreneurs?". *Hot Topics. July 2014*.retrieved December 9, 2014.

CSUA32206: Project - II

Teaching Scheme

Credits : 2

Lectures : 1 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Summative Assessment (TW) : 25 Marks

Prerequisites :

- Programming knowledge, Software Engineering

Course Objectives :

- To adapt the usage of modern tools and recent software.
- To evaluate problems and analyze data using current technologies
- To learn how to employ Integrated Development Environment(IDE) for implementing and testing of software solution
- To acquire contemporary skills to make the students employable in computer engineering domain

Course Outcomes:

After completion of the course, student will be able to

1. Utilize current technologies in a wide variety of business and organizational contexts using modern tools
2. Identify Integrated Development Environment (IDE) for implementing and testing of software solution.
3. Apply best practices for building applications.
4. Make use of contemporary skills to make them employable.

MODULE-I (Node.Js, MongoDB)

Unit I : Node.Js

- Introduction and Foundation
- Node Projects
- Working with shrink-wrap to lock the node modules versions
- Working with asynchronous programming
- Building a HTTP Server with Node.JS using HTTP APIs
- File System
- Buffers, Streams, and Events
- Multi-Processing in NodeJS
- ExpressJS
- Express JS with MongoDB and Sqlite
- io, The Front-end, and A Chat App
- Introduction to Task Managers with unit testing

Unit II : MongoDB

- Introduction to NoSQL databases
- MongoDB A Database for the Modern Web
- CRUD Operations in MongoDB

- Indexing and Aggregation
- Replication and Sharding
- Developing Java and Node JS Application with MongoDB
- Administration of MongoDB Cluster Operations

Module – II: iOS Programming

Unit 1 : Fundamentals

Overview of iOS and X-CODE: Installation, Create and manage project using XCode, Introduction to iPhone Architecture, Introduction to SWIFT, Developer Technology Overview: The Apple Developer Tool, Swift, Cocoa Touch, Model-View-Controller, Interface Builder, Overview of latest iOS features.

Unit 2 : Swift Basics

Object oriented programming with swift, File structure in Swift, Swift Programming Basics: Data types, Constants, Variables, Operators, Decision making and Branching, Arrays, Functions, Enumerations. Introduction to iOS Playground

Unit 3 : iPhone Application Development

Exploring the iOS Framework with XCode, Cocoa Fundamentals, Tracking the iOS Application Life cycle, Understanding Interface Builder, Creating User Interface, Customizing the Interface Appearance using Layout, Views, Outlets and Actions, View Controllers and UI Controllers like Labels, Buttons, Sliders, Different Views, Gestures, etc. Connecting the code with Accelerometer, Location service, 3D touch, Push notifications Understand the MVC Design pattern, MVC in XCode, Using Application Templates, User Input and Output: Handling Keyboard Input, Implementing Alert, Sounds and Vibrations, Using XCode debugger

Unit 4 : Database Management and Web Services

Parsing JSON data, Parsing XML data, SqLite databases, Web Service APIs calls

Unit 5 : Submit App to Apple Store

Create Apple developer account, Submit App to Apple Store.

Textbooks:

1. Krasimir Tsonev, "Node.js by Example Paperback", May 2015
2. Matt Neuberg, " iOS 15 Programming Fundamentals with Swift: Swift, Xcode, and Cocoa Basics", October 2021

Reference Books:

1. Web link for Node.js : https://nodejs.org/en/
2. iOS 13 Programming for Beginners: Get started with building iOS apps with Swift 5 and Xcode 11, 4th Edition

List of assignments:

With intent to get some project development exposure, students must apply Technical, Behavioural, Process concepts learnt in the course by executing real-life project and working in teams.
(Project team will ideally comprise of 3 to 4 members)