Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Curriculum for

Final Year B. Tech.

(Computer Engineering)

2018 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.

Final Year B.Tech.

Pattern 2018

Syllabus Structure

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

FINAL YEAR B. TECH (COMPUTER ENGINEERING, SEMESTER VII/VIII (PATTERN 2018) MODULE I / MODULE V

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
CSUA40181	Professional Elective -IV*	TH	3	0	2	20	30	20	30	25	125	4
CSUA40182	Professional Elective -V*	TH	3	0	2	20	30	20	30	25	125	4
IOEUA40183	Open Elective – II*	TH	3	1	0	20	30	20	30	25	125	4
IOEUA40184	Open Elective - III	TH	3	0	2	20	30	20	30	25	125	4
CSUA40185	Intellectual Property Rights (IPR)	CE	2	-	-	-	-	50	-	-	50	2
CSUA40186	Project Work	CE-PR/OR	-	-	10	100	-	-	-	50	150	5
M4	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	14	1	16	180	120	130	120	150	700	23

Note: * above indicates that the course has PR/OR component

Professional Elective-IV		Professional Elective-V		Open Elective- II		Open Elective- III	
CSUA40181A	Computer Network-III	CSUA40182 A	Wireless Sensor Network	IOEUA40183A	Project Planning and Management	IOEUA40184 A	Robotics
CSUA40181B	Advanced Machine Learning	CSUA40182 B	Robotic Process Automation	IOEUA40183B	Software Testing	IOEUA40184 B	Quantum Computing
CSUA40181C	High Performance Computing	CSUA40182 C	Natural Language Processing	IOEUA40183C	5G Mobile Networks	IOEUA40184 C	Business Intelligence
CSUA40181D	Virtual and Augmented Reality	CSUA40182 D	Ubiquitous Computing	IOEUA40183D	Cloud Computing	IOEUA40184 F	Business Analytics
				IOEUA40183E	Solar and Wind Energy		

BOS Chairman

Dean Academics

V.I.I.T. PUNE 48.

Director

DIRECTOR
Vishwakarma Institute of Information Technology
Pune 411048.

FINAL YEAR B. TECH (COMMON TO ALL PROGRAMS), SEMESTER VII/VIII (PATTERN 2018) MODULE II / MODULE IV

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
CSUA40187	Semester Internship	CE-PR/OR	-	-	24	100	-	-	-	50	150	12
M4	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	24	100	-	-	-	50	150	12

Semester Internship: For detailed syllabus see the Annexure A

FINAL YEAR B. TECH (COMMON TO ALL PROGRAMS), SEMESTER VIII (PATTERN 2018) MODULE III

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
CSUA42181	Professional Elective VI	TH	3	1/0	0/2	20	30	20	30	25	125	4
IOEUA42182	Open Elective-IV	TH	2	1/0	0/2	20	30	20	30	25	125	3
IOEUA42183	Open Elective-V	TH	2	1/0	0/2	20	30	20	30	25	125	3
CSUA42184	Introduction to Research	CE-PR/OR	1		2					25	25	2
M4	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	8	3/0	2/8	60	90	60	90	100	400	12

BOS Chairman

Dean Academics

V.I.I.T. PUNE 48. Vishwakarma Institute of Information Technology

Director

DIRECTOR
Vishwakarma Institute of Information Technology
Pune 411048.

Professional Elective-VI		Open Elective- IV		Open Elective -V	
CSUA42181A	INTRODUCTION TO GAMING	IOEUA42182A	ENGINEERING ECONOMICS	IOEUA42183A	INFERENTIAL STATISTICS FOR DATA SCIENCE
CSUA42181B	MODELLING AND SIMULATION	IOEUA42182B	COMPUTATIONAL BIOLOGY	IOEUA42183B	E- COMMERCE
CSUA42181C	DIGITAL SIGNAL PROCESSING	IOEUA42182C	SOFTWARE QUALITY ASSURANCE SYSTEM	IOEUA42183C	RURAL TECHNOLOGY
		IOEUA42182D	TECHNOLOGY AND FINANCIAL MANAGEMENT	IOEUA42183D	PRODUCT DESIGN ENGINEERING
		IOEUA42182E	NON-DESTRUCTIVE TECHNIQUES AND ENGINEERING DIAGNOSIS	IOEUA42183E	NUMERICAL METHODS

NOTE: Students who will register for Module-I in Semester VII have to register either of Module-III or Module IV in Semester VIII. Students who will register for Module-II in Semester VII have to register for Module-V in Semester VIII.

BOS Chairman

Dean Academics

V.I.I.T. PUNE 48.

Director

DIRECTOR
Vishwakarma Institute of Information Technology
Pune 411048.

Final Year B.Tech.

Pattern 2018

Syllabus

SEMESTER- VI/VIII (Module I)

CSUA40181A : Professional Elective –IV [Computer Network-III]

Teaching Scheme	**Examination Scheme**
Credits : 4	**Continuous Internal Evaluation(CIE): 20 Marks**
Lectures : 3 Hrs/week	**In-Semester Examination(ISE): 30 Marks**
Practical : 2 Hrs/week	**Skills & Competency Exam(SCE): 20 Marks**
	End Semester Examination(ESE): 30 Marks
	PR/OR: 25 Marks

Prerequisites :

- Computer Network –II

Course Objectives :

- To study the fundamentals of client-server environment.
- To understand working of Domain Name System.
- To understand the functionalities of TELNET, Rlogin, FTP, SMTP and HTTP.
- To understand the challenges of the traditional networks and evolution of next generation networks.
- To gain conceptual understanding of Software Defined Networking (SDN) and its role in Data Center.
- To understand role of Open Flow protocol, SDN Controllers and industrial use cases.

Course Outcomes :

After completion of the course, student will be able to

1. After completion of the course, student will be able to
2. Explore client-server environment. (Remember).
3. Recognize the functions of Domain Name System. (Understand)
4. Describe and Demonstrate the functionality of TELNET, Rlogin, FTP, SMTP and HTTP. (Understand and Apply)
5. Interpret the need of Software Defined Networking solutions. (Remember).
6. Analyze different methodologies for sustainable Software Defined Networking solutions. (Understand)
   Select best practices for design, deploy and troubleshoot of next generation networks. (Understand)

Unit I: Introduction to Client-Server environment

Introduction to Client-Server environment, Introduction Client-Server model, complexity of servers, RARP servers, UNIX IO paradigm and Network IO, Sending and Receiving data through a Socket
BOOTP and DHCP- BOOTP Operations, BOOTP Message format, DHCP Operations, DHCP Message format.

Unit II : Domain Name System

Domain Name System - Hierarchical Name space, Domain Name Space: Label. Domain name, FQDN, Distribution of Name space: Hierarchy of Name space, Zone, Root servers, DNS in the Internet, Resolution: Mapping Names to Address, Mapping Address to Names, Recursive resolution, Iterative resolution, caching.

Unit III : TELNET, Rlogin, FTP, SMTP and HTTP

TELNET and Rlogin- Concept of Telnet, Telnet Protocol and options, Timesharing Environments, Network Virtual Terminals (NVT), Mode of operations, Rlogin.
File Transfer Protocol- FTP, FTP features, process model, TFTP, RPC/RMI.
Simple Mail Transfer Protocol- SMTP, User Agent, Addresses, Mail Transfer Agent, Mail transfer phases, MIME, Multi part messages, POP.
Hyper Test transfer Protocols- Architectural components, URL, HTTP transactions, Response Message, Header, WWW.

Unit IV : Introduction SDN

Challenges of traditional networks, Traditional Switch Architecture - Control, Data and management Planes, Introduction to SDN, Need of SDN, History of SDN, Fundamental characteristics of SDN (Plane Separation, Simplified Device and Centralized control, Network Automation and Virtualization, and Openness), SDN Operation/Architecture, SDN API's (Northbound API's, Southbound API's, East/West API's), ONF, SDN Devices and SDN Applications.

Unit V : Open Flow

OpenFlow Overview, The OpenFlow Switch, The OpenFlow Controller, OpenFlow Ports, Message Types, Pipeline Processing, Flow Tables, Matching, Instructions, Action Set and List, OpenFlow Protocol, Proactive and Reactive Flow, Timers, OpenFlow Limitations, OpenFlow Advantages and Disadvantages, Open v Switch Features.

Unit VI : SDN Controllers and SDN in Data center

SDN OpenFlow Controllers: Open Source Controllers - NOX, POX, Beacon, Maestro, Floodlight, Ryu and Open Daylight, Applicability of OpenFlow protocol in SDN Controllers.

Data Center Definition, Data Center Demands, Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering and Path Efficiency, Tunneling Technologies for the Data Center, SDN Use Cases in the Data Center, Comparison of Open SDN

SDN Use cases: Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, Optical Networks, SDN vs P2P/Overlay Networks.

Text Books :

1. Douglas Comer, Internetworking with TCP/IP, Principles, Protocols and Architecture, Volume 1, Pearson Education Asia.
2. BehrouzForouzan, TCP/IP Protocol suite, Tata McGraw-Hill Edition
3. Karnjit S. Siyan, Inside TCP/IP Techmedia.

Reference Books :

1. Pete Loshin, TCP/IP Clearly Explained, Morgan Kaufmann Publications.
2. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, 2014, ISBN: 9780124166752, 9780124166844.
3. SiamakAzodolmolky, "Software Defined Networking with Open Flow, Packt Publishing, 2013, ISBN: 9781849698726

4 Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", 2013, ISBN: 10:1-4493-4230-2, 978-1-4493-4230-2

5 VivekTiwari, "SDN and OpenFlow for Beginners", Digital Services, 2013, ISBN: 10: 1-940686-00-8, 13: 978-1-940686-00-4

LIST OF ASSIGNMENTS:

1. Implement a client-server communication model (chat application) using socket programming in Python.
2. DHCP and DNS server configuration in Cisco Packet Tracer
3. Telnet configuration on switch and router in Cisco Packet Tracer
4. FTP and E-mail server configuration in Cisco Packet Tracer
5. Web server configuration in Cisco Packet Tracer
6. Study the Openflow, identify challenges in SDN and recent development in SDN.
7. Discuss SDN controller and issues in controller like scalability and flexibility.

CSUA40181B : Professional Elective –IV [Advanced Machine Learning]

Teaching Scheme	**Examination Scheme**
Credits : 4	**Continuous Internal Evaluation(CIE): 20 Marks**
Lectures : 3 Hrs/week	**In-Semester Examination(ISE): 30 Marks**
Practical : 2 Hrs/week	**Skills & Competency Exam(SCE): 20 Marks**
	End Semester Examination(ESE): 30 Marks
	PR/OR: 25 Marks

Prerequisites :

- Knowledge of Programming, Engineering MathematicsIII

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.
- To learn-to implement train, and validate neural network, and improve understanding of the on-going research in computer vision and multimedia field.
- To gain conceptual understanding of Software Defined Networking (SDN) and its role in Data Center.
- To understand role of Open Flow protocol, SDN Controllers and industrial use cases.

Course Outcomes :

After completion of the course, student will be able to

1. Understand the basics of machine learning and concepts of good dataset.
2. Identify supervised, unsupervised machine learning approaches and estimate the different algorithms with examples.
3. Summarize the basic concepts of Deep Learning .
4. Understand data, training parameters, network structure, and other strategies to increase performance and capability
5. Describe and compare different architectures of Convolutional Neural Networks.
6. Describe and Analyze the working of Recurrent Neural Networks.

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)-non negative matrix factorization, SparsePCA, KernelPCA

Unit II : Supervised Learning and Unsupervised Learning

Linearregression-
Linearmodels,LinearRegressionandhigherdimensionality,Ridge,LassoandElasticNet,Polynomial regression

Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations, **Support Vector Machine(SVM)-**Linear Support Vector Machines, Kernel based classification, Non-linear Examples.

Clustering Fundamentals- Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted R and Index, Hierarchical Clustering, Expectation maximization clustering, Agglomerative Clustering-Dendrograms.

Unit III : Introduction to Deep Learning

History of Deep Learning, McCulloch-Pitts Neuron, Thresholding Logic,Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed forward Neural Networks, Representation Power of Feedforward Neural Networks.

Unit IV : 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 V : 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 VI : Recurrent Neural Networks

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

Case Study

Text Books :

1 Giuseppe Bonaccorso,"Machine Learning Algorithms", Packt Publishing Limited**,** ISBN-10:1785889621,ISBN-13:978-1785889622

2 Ethem Alpaydin, "Introduction to Machine Learning", PHI 2ndEdition-2013, ISBN978-0-262-01243-0

3 Goodfellow,I, Bengio,Y. and Courville, A., DeepLearning, MITPress, 2016.

Reference Books :

1 Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN: 007042807797800704280 72

2 NikhilBuduma,"FundamentalsofDeepLearning",O"REILLYpublication,secondedition2017,ISBN:1491925612

3 JoshPatterson,AdamGibson,"DeepLearning:APractitionersApproach",O"REILLY,SPD,ISBN:978-93-5213-604-9,2017Edition1st.

LIST OF ASSIGNMENTS:

1. 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]?

2. 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?

3. In the following diagram let blue circles indicate positive examples and orange squares indicate negative examples. We want to use k-NN algorithm for classifying the points. If k=3, find the class of the point (6,6).

4. Implement Convolutional Neural Network for Image Classification.

5. Implement Recurrent Neural Network for Sentiment Analysis.

CSUA40181C: Professional Elective –IV [High Performance Computing]

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

Examination Scheme
Continuous Internal 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 :

- Microprocessor, Computer Organization and Architecture, Principles of Programming Languages, Systems Programming and Operating System

Course Objectives :

- To study parallel computing hardware and programmingmodels. **[Understanding]**
- To be conversant with performance analysis and modeling of parallelprograms.
- To understand the options available to parallelize theprograms.
- To know the operating system requirements to qualify in handling theparallelization.

Course Outcomes :

After completion of the course, student will be able to

1. Describe different parallel architectures, inter-connect networks, programmingmodels.
2. Develop an efficient parallel algorithm to solve givenproblem.
3. Analyze and measure performance of modern parallel computingsystems.
4. Build the logic to parallelize the programmingtask.

Unit I : Introduction

Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines.

Unit II : Parallel Programming

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

Unit III : Basic Communication

Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and

Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

Unit IV : Analytical Models of Parallel Programs

Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time.

Unit V : Parallel Algorithms- Sorting and Graph

Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best-First Search.

Unit VI : CUDA Architecture [06 Hours]

CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Text Books :

1 AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN:0-201-64865-2

2 Jasonsanders,EdwardKandrot,"CUDAbyExample",Addison-Wesley,ISBN-13:978-0-13-138768-3

Reference Books :

1 Kai Hwang, "Scalable Parallel Computing", McGraw Hill 1998, ISBN:0070317984

2 Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884

3 David Culler Jaswinder Pal Singh, "Parallel Computer Architecture: A Hardware/Software Approach", Morgan Kaufmann,1999, ISBN 978-1-55860-343-1.

4 Rod Stephens, " Essential Algorithms", Wiley, ISBN: ISBN: 978-1-118-61210-1

List of Assignments:

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses.

Instructions to Students:

Compare performance of each parallel program with sequential algorithm. [also considering different types of array sizes].

1 Study assignment on "Parallel Computing Architectures", "Parallel Computer Memory Architecture" and "Parallel Programming Models".

2 Study assignment on "CUDA Architecture".

3
a) Write a CUDA program that copies the array from Host to device and vice versa and print the elements.
b) Write a CUDA program to change the sign of array elements if the value is

less than threshold value. (Threshold value should be taken from user).

4 Write a CUDA program for add two large vectors.

5
a. Implement Binary Search using OPenMp.
b. Implement Parallel Reduction using Sum operations using OpenMp.

6 Design and implement parallel odd even sort using OpenMp.

SCE Components:

1. Study and Demonstrate multithreaded/parallel programming languages/frameworks/ libraries used for High performance computing: For Example: Python, MPI, OpenCL, OpenACC, OpenAMP.

References:

1. https://hpc.llnl.gov/training/tutorials/introduction-parallel-computing-tutorial
2. https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html#introduction
3. **https://www.openmp.org/resources/tutorials-articles/**

CSUA40181D: Professional Elective-IV [Virtual and Augmented Reality]

Teaching Scheme
Credits : 4

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

Examination Scheme
Continuous Internal 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 :

- Discrete Mathematics, Data Structures and Theory of Computation

Course Objectives :

- To make students know the basic concept and framework of virtual reality.
- To introduce students the technology for multimodal user interaction and perception in VR, in particular the visual, audial and haptic interface and behavior.
- To aware students the technology for managing large scale VR environment in real time.
- To provide students with an introduction to the VR system framework and development tools.

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 technology for multimodal user interaction and perception in VR Decide and apply algorithmic strategies to solve a given problem
3. To apply VR Tools in real time environment.
4. To understand Augmented reality

Unit I: Introduction

Introduction to Virtual RealityFundamental 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 Modeling;Behavior 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; Modeling Tools for VR; X3D Standard; Vega, MultiGen, Virtoolsetc

Unit VI : Augmented Reality

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.

Reference Books :

1 Alan B Craig, William R Sherman and Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009.
2 Gerard Jounghyun Kim, Designing Virtual Systems: The Structured Approach, 2005.
3 Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, 3D User Interfaces, Theory and Practice, Addison Wesley, USA, 2005.
4 Oliver Bimber and Ramesh Raskar, Spatial Augmented Reality: Meging Real and Virtual Worlds, 2005.
5 Burdea, Grigore C and Philippe Coiffet, Virtual Reality Technology, Wiley Interscience, India, 2003.
6 John Vince, Virtual Reality Systems, Addison Wesley, 1995.
7 Howard Rheingold, Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society, Simon and Schuster, 1991.
8 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
9 Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013

List of Assignments:

Subject teacher will frame lab assignment based on theory syllabus.

CSUA40182A : Professional Elective –V [Wireless Sensor Network]

Teaching Scheme	**Examination Scheme**
Credits : 4	**Continuous Internal Evaluation(CIE): 20 Marks**
Lectures : 3 Hrs/week	**In-Semester Examination(ISE): 30 Marks**
Practical : 2 Hrs/week	**Skills & Competency Exam(SCE): 20 Marks**
	End Semester Examination(ESE): 30 Marks
	PR/OR: 25 Marks

Prerequisites :

Computer Network- II

Course Objectives :

- To understand the fundamentals of Wireless Network.
- To studythe setup, installation, configuration of WSN.
- To understand the different programming tools.
- To study various Routing Protocols for WSN.
- To understand theInfrastructure Establishment for WSN.
- To study the Operating Systems for WSN.

Course Outcomes :

After completion of the course, student will be able to

1. Explore the program using data communication methods and algorithm. (Remember).
2. Describe and Demonstrate the setup, configure and program WSN. (Understand and Apply).
3. Describe the use different programming application for WSN, BIGDATA. (Understand).
4. Enlist and Demonstrate the functionality of Routing Protocols for WSN (Understand and Apply)
5. Describe the functionality of Infrastructure Establishment for WSN. (Understand).
6. Explore the Operating Systems for WSN. (Remember).

Unit I: Overview of Wireless Networks

Wireless Transmission: Electromagnetic Spectrum, Radio, Micro Waves, Infrared, Lightwave, Spread Spectrum Systems, modem Switching Techniques: Circuit Switching, Packet Switching and Message Switching, Hardware Components: Transceivers, Access Points and wireless routers, Data link layer design issues: Services, Framing, Error and flow control, Stop-and-Wait protocol, Sliding Window protocol, Medium access control sub layer, Channel allocation: Static and Dynamic allocation, Multiple Access Protocols: ALOHA, CSMA, CSMA/CD , CSMA/CA

Unit II : Basic Concepts of WSN

Background of Sensor Network Technology, Applications: Building Automation, Sensors and Robots, Health Care and Military Applications. WSN Architecture: Sensor Type and Technology, Sensor Network Organization and Tracking. RFID based data communication, Architecture.

Unit III: Data link layer protocols

Link Layer: Error control, Framing, Link management.MAC Layer: Low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, Networking Sensors: ZigBee, Sensor MAC(S-MAC) protocol for WSN, Naming and Addressing: Fundamentals, Address and name management in wireless sensor networks.

Unit IV: Routing Protocols for WSN

Data Dissemination and Gathering, Routing Challenges and Design Issues in WSN, Routing Strategies (Proactive and Reactive) in WSN. Geographic and Energy aware routing, Attribute based routing, Routing Techniques: Flooding, SPIN, Infrastructure Establishment: Topology Control, Clustering, synchronization, localization and services, Low energy adaptive Clustering, Power efficient gathering in sensor information system, case study of DataCommunication from HDMI Camera in host and accessory modes, PICONET, Tunnelling Protocols.

Unit V: Infrastructure Establishment for WSN

Localization and Positioning, tracking: Properties of positioning, Possible approaches, Task driven Sensing, Rolls of Sensor nodes and utilities, Information based sensor tracking, joint routing and information aggregation, Sensor Network Databases-BIGDATA, Sensor network platforms and tools, Single-hop localization, Positioning in multi-hop environments,Impact of anchor placement.

Unit VI Operating Systems for WSN

OS Design Issues, Examples of OS(Architecture, Design Issues, Functions): Tiny OS, Mate, Magnet OS, MANTIS, Nano-RK OS Architecture Block Diagram, LiteOS Architectural Block Diagram,LiteFS Architectural Block Diagram, Content delivery networks.

Text Books :

1 Kurose, Ross "Computer Networking a Top Down Approach Featuring the Internet", Pearson; 6th edition (March 5, 2012), ISBN-10: 0132856204,ISBN-13: 978-0132856201 (pdf available)

2 Fang Zhaho, Leonidas Guibas, "Wireless Sensor Networks: An information Processing Approach", Elsevier ISBN: 978-81-8147-642-5

Reference Books :

1 DipankarRaychaudhari, Mario Cerla,"Emerging Wireless Technologies and the FutureMobile Internet", Cambridge University Press, ISBN-13: 978-1-107-67864-4(Paperback)

2 Lyla B. Das, "Embedded Systems: An Integrated Approach" Pearson, ISBN:978-81-317-8766-3

3 KazimSohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks: Technology, Protocols and Applications", Wiley ISBN: 978-81-265-2730-4 (Students Edition)

4 Robert Faludi, "Wireless Sensor Networks", O'REILLY, ISBN 13: 978-93-5023-289-7

LIST OF ASSIGNMENTS:

1. Create a simple wireless sensor networks in NS2

2. Configure a LEACH protocol in NS2
3. Configure a cluster based routing protocol in NS2
4. Simulate a coverage hole in WSN using NS2
5. Create a shortest path for mobile sink in NS2
6. Create a cluster based aggregation and routing protocol in NS2
7. Study of WSN operating systems

CSUA40182B : Professional Elective –V [Robotic Process Automation]

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

Examination Scheme
Continuous Internal 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 :

- Software Engineering, Software Testing, java programming concept ,

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 :

After completion of the course, student will be able to

1. Gain insights into Robotic Process Automation Technology
2. Relate fundamental concepts of UI Automation using UiPath
3. To 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. Implement RPA for business enterprise

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

Unit II : Dashboard in Automation Anywhere

Task Bots, Recording the task. , Create Task, .Task Editor and its usages .Features in Task Editor. Dashboard applications.

Unit III : Types of BOTS

Task Bots and its usages, Meta Bots and its usages, Learn IQ Bots, Implement web services: MetaBot and its Usages,. Overview, Creation of Metabot , Understand Designer in MetaBot

Unit IV : Integration of PDF files

Usage of If/else command ,Datanse and AA, Email Automation in AA, .Handling Exceptions , Commons in PGP

Unit V : 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.

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://www.cb-india.com/books/artificial-intelligence-en/robotics/robotic-process-automation-and-risk-mitigation-the-definitive-guide/?currency=INR
2. https://www.amazon.com/Robotic-Process-Automation-Repetitive-Consultant-ebook/dp/B07DFNGWCH/ref=pd_sbsd_14_1/147-4549802-0204421?_encoding=UTF8&pd_rd_i=B07DFNGWCH&pd_rd_r=d79d69ba-d6e6-4662-9927-54ebbfb5273a&pd_rd_w=srv7k&pd_rd_wg=PPSKp&pf_rd_p=2c2d0d3b-b3c5-4110-93fa-2c1270309ac1&pf_rd_r=06VJFMFHZNR8MWA2QEPF&psc=1&refRID=06VJFMFHZNR8MWA2QEPF
3. https://www.simplilearn.com/introduction-to-robotic-process-automation-course#course-description
4. https://www.tutorialspoint.com/blue_prism/blue_prism_introduction_to_rpa.htm https://www.multisoftvirtualacademy.com/robotics/robotics-process-automation-online-training
5. https://www.edureka.co/lms_courses/download_curriculum?filename=robotic-process-automation-training-3.pdf
6. https://www.yet5.com/institutes/courses/244/1263/1/875/rpa-robotic-process-automation-training-at-pondicherry-city.html

List of Assignments:

All the assignments arebased on Automation Anywhere/UIPATH tool

1. Build a process in UiPath using UI Automation Activities
2. Create an automation process using key System Activities
3. Automate login to your (web)Email account
4. Recording mouse and keyboard actions to perform an operation
5. Scraping data from website and writing to CSV
6. Create an automated Gmail Login Application
7. Build a business process based on REFramework and utilizing various components of this framework such as its workflows, states, variables and exceptions. Consider ERP Application.

CSUA40182C : Professional Elective –V [Natural Language Processing]

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

Examination Scheme
Continuous Internal 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 :

- Basic understanding of probability theory.
  Basic knowledge of finite automata.

Course Objectives :

- To understand the core concepts of Natural language processing and levels of language analysis.
- To understand the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- Make them understand the concepts of morphology, syntax, and semantics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic and semantic processing

Course Outcomes :

After completion of the course, student will be able to

1. Understand the core concepts of natural language processing and levels of language analysis.
2. Understand concept of morphology and sequential tagging
3. Understand language grammar and various parsing techniques for natural languages
4. Understand distributional semantics and word embeddings
5. Understand concept of topic models and information extraction
6. Understand various applications of natural language processing.

Unit I : Introduction To Natural Language Understanding & Language Modelling

The Study of Language, Applications of Natural Language Understanding, Evaluating Language Understanding Systems, The Different Levels of Language Analysis, Representations and Understanding, The Organization of Natural Language Understanding Systems, Challenges in NLP , Introduction to language modelling, N gram models, Evaluation of language models- basic and advanced smoothing ,

Unit II : Sequential Tagging

Morphology fundamentals, Finite State Machine Based Morphology, Introduction to POS Tagging, Hidden Markov Models for POS Tagging , Viterbi Decoding for Hidden Markov Models, Parameter Learning, Maximum Entropy models , Conditional Random Fields

Unit III : Grammars And Parsing

Grammars and Sentence Structure, What Makes a Good Grammar, Classical Parsing (Bottom up, top down, Dynamic Programming: CYK parser) , Parsing using Probabilistic Context Free Grammars, Dependency grammar and parsing – introduction

Unit IV : Distributional Semantics and Word Embeddings

Distributional Semantics - Introduction, Distributional Models of Semantics, Distributional Semantics: Applications, Structured Models, Word Embeddings, Lexical Semantics, Wordnet

Semantic web Ontologies, Word Sense disambiguation, Semantic roles

Unit V : Topic Models and Information Extraction

Topic Models - Introduction, Latent Dirichlet Allocation: Formulation, Gibbs Sampling for LDA, Applications, Information Extraction: Definition and Applications, Regex, Hand-built Patterns,Bootstrapping and Supervised Relation Extraction

Unit VI : Applications And Recent Trends In NLP

Information Extraction, Question answering, Machine Translation, Sentiment Analysis, MT evaluation tools such as Bleu, (word error rate) WER etc. Automatic text summarization, Sentiment Speech Recognition, Semantic web search, Automatic text Clustering,Cross Lingual Information Retrieval

Text Books :

1 James Allen, "Natural Language Understanding", Pearson Publication, ISBN: 978-81-317-0895-8 2nd Edition
2 D. Jurafsky, J. H. Martin, "Speech and Language Processing", Pearson Education

Reference Books :

1 Christopher D. Manning, HinrichSchutze, Foundations of Statistical Natural Language Processing, The MIT Press, Cambridge, Massachusetts, 1999
2 TanveerSiddiqui, US Tiwary, Natural Language Processing and Information Retrieval
3 Daniel M.Bikel, ImedZitouni, Multilingual Natural Language Processing Applications

List of Assignments:

1 To learn to calculate bigrams from a given corpus and calculate probability of a sentence.

2 Using programming language Python and suitable libraries perform fundamental language processing for three different languages

3 Survey various techniques for POS tagging and implement any one of them

4 Write a program that can give you the country by its capital. Write a function that takes in three words, and the embeddings dictionary. Your task is to find the capital cities. For example, given the following words input: 1: Athens 2: Greece 3: Baghdad, your task is to predict the country 4: Iraq. You can use the pre trained word embeddings and a similarity function.

5 Implement sentiment analysis over any suitable dataset by applying pre-processing, extracting necessary features and using machine learning algorithm

Mini Project

Study and implementation of research paper in Multidisciplinary NLP using open source tools and libraries

CSUA40182D : Professional Elective –V [Ubiquitous Computing]

Teaching Scheme	**Examination Scheme**
Credits : 4	**Continuous Internal Evaluation(CIE): 20 Marks**
Lectures : 3 Hrs/week	**In-Semester Examination(ISE): 30 Marks**
Practical : 2 Hrs/week	**Skills & Competency Exam(SCE): 20 Marks**
	End Semester Examination(ESE): 30 Marks
	PR/OR: 25 Marks

Prerequisites :

- Human Computer Interaction, Computer Network Technology

Course Objectives :

- To describe ubiquitous computing, its properties applications and architectural design.
- To explain various smart devices and services used in ubiquitous computing
- To teach the role of sensors and actuators in designing real time applications using Ubicomp.
- To explore the concept of human computer interaction in the context of Ubicomp
- To explain Ubicomp privacy and challenges to privacy.
- To describe Ubicomp network with design issues and Ubicomp management

Course Outcomes :

After studying this course, students will be able to:

1. Describe the characteristics of pervasive computing applications including the basic computing application problems, performance objectives and quality of services, major system components and architectures of the systems.
2. Analyze the strengths, problems and limitations of the current tools, devices and communications for pervasive computing systems.
3. Recognize the different ways that humans will interact with systems in a ubiquitous environment and account for these accordingly
4. List and exemplify the key technologies involved in the development Ubicomp systems
5. Develop an attitude to identify and propose solutions for security and privacy issues.
6. Explore the trends and problems of current pervasive computing systems using examples

Unit I: Introduction to Ubiquitous Computing

Concept of Distributed Computing, Mobile Computing, Pervasive Computing, Wearable Computing, Modelling the Key Ubiquitous/Pervasive Computing Properties, Mobile Adaptive Computing , Mobility Management and Caching.

Unit II : Pervasive Computing Devices

Smart Environment: CPI and CCI Smart Devices: Application and Requirements, Device Technology and Connectivity, Human Computer Interaction

Unit III : Human-Computer Interaction

Explicit HCI, Implicit HCI, User Interface and Interaction for four hand-held widely used devices, Hidden UI via basic smart devices, Hidden UI via wearable and Implanted devices, Human centered design, user models

Unit IV : Middleware for Pervasive Computing

Adaptive middleware, Context aware middleware, Mobile middleware, Service Discovery, Mobile Agents. User Models: Direct and indirect user input and modeling, modelling users' planned tasks and multiple tasks-based computing

Unit V : Security in Pervasive Computing

. Security and Privacy in Pervasive Networks, Experimental Comparison of Collaborative Defense Strategies for Network Security

Unit VI : Challenges and Outlook

Overview of challenges, smart devices, Smart Interaction, Smart physical environment device interaction, Smart human-device interaction, Human Intelligence versus machine intelligence, social issues.

Case Study- Wearable Computing/ Cyber Physical System

Reference Books :

1 Stefan Poslad, Ubiquitous Computing, Wiley, Student Edition, ISBN:9788126527335
John Krumm, Ubiquitous Computing Fundamentals.

2 Frank Adelstein, Sandeep Gupta, Golden Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing," Tata McGraw Hills.

3 JochenBurkhardt, Horst Henn, Stefan Hepper, Klaus Rindtor, Thomas Schaeck, "Pervasive Computing," Pearson, Eighteenth Impression, 2014

List of Assignments :

1 **Setting-up the environment:** Android development environment. Installing and setting up the environment. Hello world application. Running the emulator. Inserting debug messages.

2 **UI Design:** Design a User Interface using pre-built UI components such as structured layout objects, UI controls and special interfaces such as dialogs, notifications, and menus. Also make this UI attractive using Android graphics platform OpenGL.

3 **Database Connectivity:** Create a SQLite Database for an Android Application and perform CRUD (Create, Read, Update and Delete) database operations.

4 **Sensors for building Smart Applications:** Use any sensors on the device to add rich location and motion capabilities to your app, from GPS or network location to accelerometer, gyroscope, temperature, barometer, and more.

5 **Design and Development of Smart Application/System:** List of Project Areas: Context-aware computing, Proactive computing, Mobile and real-time data/media management, Multimedia data and sensing dissemination, Mobility management, Location-dependent query processing, and positioning and Healthcare application.

6 **Android API:** Implement an application that uses Android APIs like Google Map, recording and playing audio and video, using the built-in camera as an input device.

7 **Machine Learning :**Mobile multimodal sensing- Draw inferences over the data coming from phone's sensing hardware (e.g. accelerometer, GPS, microphone), and processing these samples with the help of machine learning. (Any Application: Healthcare, Smart City, Agriculture, etc).

8 **Wireless Network and Security :**The inputs are supplied by the mobile phone/ by anothercomputer connected through wireless networks and Authentication of two devices.

WebLink Links for Laboratory Assignments:

1. https://developer.android.com/
2. https://www.androidhive.info/2011/11/android-sqlite-database-tutorial/
3. https://developers.google.com/android/guides/api-client
4. https://developer.android.com/guide/topics/sensors/sensors_overview

IOEUA40183A : Open Elective –II [Project Planning and Management]

Teaching Scheme
Credits : 4
Lectures : 3 Hrs/week
Tutorial : 1 Hr/week

Examination Scheme
Continuous Internal 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 impart knowledge of project life cycle.
- To introduce students to Project Identification Process, Project Initiation, Pre-Feasibility Study and Project feasibility Studies,
- To construct CPM, PERT network for a project.
- To introduce students to Steps in Risk Management, Risk Identification, Risk Analysis and Reducing Risks
- To introduce students to process of project Performance Measurement, Evaluation and closeout

Course Outcomes :

Upon completion of the course, students will be able to

1. Understand what a Project is, Essential of Project Management.
2. Understand the Project Identification Process, Project Initiation, Pre-Feasibility Study and Project feasibility Studies,
3. Learn and Apply project planning and controlling techniques.
4. Identify risks in a project and strategies for managing the project risks
5. Understand project risk Management and Quality control in a project. Understand the process of project Performance

Unit I : Basics of Project Management

Introduction, Need, Project Management Knowledge Areas and Processes, Concept of Organizational Structure and types, The Project Life Cycle (preferably with case study), Essentials Project Management Principles.

Unit II : ProjectIdentification and Selection

Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. Case study is preferred

Unit III : Project Planning and controlling

Introduction, Need for Project Planning, Work Breakdown Structure (WBS), LOB, CPM and PERT, Resource Allocation,Monitoring and Control of project, Crashing, Resource Leveling, Updating

Unit IV : Project Risk Management

Identifying potential risks in a project, categorizing of project risks, and defining the strategies for managing the project risks

Unit V : Project Monitoring

Project monitoring Progress reporting, review meetings and report. Common causes of schedule delays, measuring productivity, methods of enhancing productivity, issue in project delays, Concept of quality, aspects of quality, quality control and assurance, inspection, preparation of manuals and checklists

Unit VI : Project Performance Measurement, Evaluation and closeout

Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Project Close-out, Steps for Closing the Project, Project Termination, and Project Follow-up.Case study is preferred

Text Books :

1 Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014)
2 Project Management – K Nagrajan – New age International Ltd.
3 Project Management – Ahuja H.N. – John Wiely, New York.
4 Project Management-Planning and Control---Rory Burkey 4th ed.— Wiley,India

Reference Books :

1 Project Risk Management - Bruce Barkley- McGraw-Hill, 2004

IOEUA40183B : Open Elective –II [Software Testing]

Teaching Scheme
Credits : 4
Lectures : 3 Hrs/week
Tutorial : 1 Hr/week

Examination Scheme
Continuous Internal 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 :

- Software Engineering, Java Programming

Course Objectives :

- To study and understand software testing terminologies and framework,
- To study and understand the basics of software testing life cycle.
- To study and understand test and defect management
- To study and understand an automation testing
- To study and understand an automation testing tools
- To study and understand automation testing for web application

Course Outcomes :

After completion of the course, student will be able to

1. Understand complete software testing life cycle and various terms and technologies used in testing domain
2. Demonstrate understanding of generating test plan and designing test cases
3. Demonstrate understanding of test and defect management process
4. Demonstrate understanding of automation testing
5. Create test script and execute automated tests using Selenium IDE
6. Create test script and execute automated tests using TestNG Framework

Unit I: Introduction to Testing

Why is testing necessary? What is testing? Role of Tester, Testing and Quality, Overview of Software Testing Life Cycle, V model, SDLC vs STLC, different stages in STLC, document templates generated in different phases of STLC, different levels of testing, different types of testing

Unit II: Basics of test design techniques

Static techniques, reviews, walkthroughs, Various test categories, test design techniques for different categories of tests. Designing test cases using MS-Excel.

Unit III: Test and Defect Management

Test Management: Documenting test plan and test case, effort estimation, configuration management, project progress management. Use of Testopia for test case documentation and test management. **Defect Management** Test Execution, logging defects, defect lifecycle, fixing / closing defects. Use of Bugzilla for logging and tracing defects.

Unit IV : Basics of Automation testing

Introduction to automation testing, why automation, what to automate, tools available for automation testing.

Unit V : Automation testing using Selenium

Understanding to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing.

Unit VI : Automation testing using TestNG Framework

Understanding TestNG framework, Automation testing using TestNG Framework.

Reference Books :

1. M G Limaye, "Software Testing Principles, Techniques and Tools", Tata Mcgraw Hill, ISBN: 9780070139909 0070139903
2. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson, ISBN-10: 817758121X
3. NareshChauhan, "Software Testing Principles and Practices ", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847
4. Dr.K.V.K. Prasad , "Software Testing Tools", Dreamtech Press ISBN: 10:81-7722-532-4

List of assignment:

With intent to get some exposure in the software testing domain, students apply Technical, Behavioural, Process concepts learnt in the course by executing near real-life project and working in teams (project teams will ideally comprise of 4 members)

There will be 3 projects:

Project 1: Use of Testopia for test case management. The project will consists of test plan, test design for a sample web application and maintaining Requirement Traceability Matrix using the tool

Project 2: Use of Bugzilla for defect management. The project will include execution of tests designed in previous project, identifying, logging and tracing the defect and maintaining the Requirement Traceability Matrix

Integrated Project: Use of Selenium for automation testing. The project will consists of identifying which tests from project 1 can be automated, then creating script for those tests using tool, executing the tests with the help of tool and generating report for the tests cases

IOEUA40183C : Open Elective –II [5G Mobile Networks]

Teaching Scheme
Credits : 4
Lectures : 3 Hrs/week
Tutorial : 1 Hr/week

Examination Scheme
Continuous Internal 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 :

- Basics of Analog and Digital Communication
- Basics of Mobile Communication
- Basics of Networking

Course Objectives :

- To understand evolution of 5G technologies with its challenges
- To describe 5G cellular structure and design to achieve appropriate gain
- To discuss fundamentals of 5G functional and physical architecture and its requirements
- To understand design principles for multi-user communications
- To design and interpret the 5g Use cases

Course Outcomes :

After completion of the course, student will be able to

1. Understand evolution of 5G technologies with its challenges
2. Interpret the 5G cellular structure and design to achieve appropriate gain
3. Illustrate and explain the 5G functional and physical architecture and its requirements
4. Comprehend the Radio access technology in 5G
5. Understand Cooperation in 5G systems and analysis in terms of QOS
6. Design and analysis of 5G Use Cases

Unit I : Drivers for 5G

Historical Trend for Wireless Communication - Mobile Communications Generations: 1G to 4G – Evolution of LTE Technology to Beyond 4G – Pillars of 5G – Standardization Activities -Use cases and Requirements – System Concept – Spectrum and Regulations: Spectrum for 4G – Spectrum Challenges in 5G – Spectrum Landscape and Requirements – Spectrum Access Modes and Sharing Scenarios(R1)

Unit II : Small Cells for 5G Mobile Network

Introduction to Small Cells, WiFi and Femtocells as Candidate Small-Cell Technologies, performance-Indoor and Outdoor, Capacity Limits and Achievable Gains with Densification, Gains with Multi-Antenna Techniques, Gains with Small Cells, Demand vs Capacity, Small Cell challenge(R1)

Unit III : 5G Architecture And Channel Models

5G Architecture: Software Defined Networking, Network Function Virtualization, Basics about RAN Architecture,High-Level Requirements for 5G Architecture ,Functional Architecture and 5G Flexibility ,Physical Architecture and 5G Deployment
5G wireless propagation channel models: Modelling requirements and scenarios, Channel model requirements, Propagation scenarios, The METIS channel models, Map-based model, Stochastic model(R2)

Unit IV : 5G Radio-Access Technologies and Millimeter wave communication

Access design principles for multi-user communications, Multi-carrier with filtering: a new waveform, Non-orthogonal schemes for efficient multiple access, Radio access for dense deployments, Radio access for V2X communication
Millimeter Wave Communication: Channel Propagation – Hardware Technologies for mmW Systems – Deployment Scenarios – Architecture and Mobility – Beamforming – Physical layer Techniques.

Unit V : Cooperation for Next Generation Wireless Networks

Introduction to Cooperative Diversity and Relaying Strategies ,Cooperation and Network Coding, Cooperative ARQ MAC Protocols, PHY Layer Impact on MAC Protocol Analysis ,Impact of Fast Fading and Shadowing on Packet, Reception for QoSGuarantee, Impact of Shadowing Spatial Correlation

Unit VI : 5G Use Cases and Deployment

NB-IoT Devices, Smart Parking, Smart City, Smart Home, Message Queue Telemetry Transport (MQTT), MQTT telemetry. NB-IoT Baseline Deployment, Deployment bands and modes

Text Books :

1 Jonathan Rodriguez "Fundamentals of 5G Mobile Networks",Wiley Publication

2 AfifOsseiran, Jose F . Monserrat, Patrick Marsch"5G Mobile and Wireless Communications Technology",Cambridge University Press.

3 Hossam Fattah "5G LTE NarrowbandInternet of Things(NB-IoT),CRC Press

Reference Books :

1 Fei Hu, "Opportunities in 5G Networks: A research& development perspective", CRC Press
2 Krzyszt of Wesolowski, "Mobile Communication Systems", Wiley Student Edition
3 Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press
4 Aditya Jagannatham, "Principles of Modern Wireless Communication Systems"

List of Assignments :

<Instructions to the students, if nay>

1 NS-3 simulation basics. Basic client server paradigm

2 Study of TCP internals and the difference between each of the variants. NS-3 tracing mechanism

3 Study of Queues, packet drops and their effect on congestion window size

4 Study of Optimised Link State Routing(MANETS)

5 Study of 802.11 working with and without RTS/CTS. An insight into why its hard to setup efficient wireless networks.

6 Study of effect of Radio channel models transmission. An insight into Identifying the channel model that is more appropriate for each case (indoor, outdoor, LoS, NLoS, etc.).

mmWave network simulator project implementation

Mini Project/Seminar (SCE)

IOEUA40183D : Open Elective –II [Cloud Computing]

Teaching Scheme
Credits : 4
Lectures : 3 Hrs/week
Tutorial : 1 Hr/week

Examination Scheme
Continuous Internal 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 :

- Computer Networks

Course Objectives :

- To understand cloud computingconcepts.
- To study supporting technologies ofcloud
- To study open research problems of cloudcomputing
- To study various platforms for cloudcomputing.
- To explore the applications based on cloudcomputing.
- To study and evaluate the contemporary technologies in cloudcomputing

Course Outcomes :

After completion of the course, student will be able to

1. Summarize the basic concepts of cloud computing(Remember)
2. Explore the supporting technologies of cloud computing(Understand)
3. Analyze the challenges and opportunities in the cloud computing(Analyze)
4. Use the cloud services for deployment of his own applications(Create)
5. How technologies are interrelated and use with each other(Apply)
6. To explore future trends of cloud computing(Evaluate)

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 inCloud

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 shooting 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 LoadBalancer.

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, TheMcGraw-Hill.
2. Dr.KrisJamsa,"CloudComputing:SaaS,PaaS,IaaS,Virtualizationandmore" Wiley Publications, ISBN: 978-0-470-97389-9
3. Gautam Shrof, "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: Subject teacher will frame the lab assignment based on theory syllabus.

IOEUA40183E : Open Elective –II [Solar and Wind Energy]

Teaching Scheme
Credits : 4

Lectures : 3 Hrs/week
Tutorial : 1 Hr/week

Examination Scheme
Continuous Internal 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 :

- Basic Mechanical Engineering, Basic Electrical and Electronics Engineeringand Heat Transfer

Course Objectives :

- To understand fundamentals of solar and windenergies.
- To understand constructions, working principle and design procedure of solarand wind power plants.
- To apply basic engineering principle to design a simple solar and wind powersystem

Course Outcomes :

After completion of the course, student will be able to

1. Understand solar radiation and geometryprinciples.
2. Apply aspects of solar thermal system and its practicalapplications
3. To aware design process of solar food drier/solar cooker/solar pv system for domestic purpose
4. Design miniature wind mill for domestic purpose referring existingsystem

Unit I : Solar Energy Basics

Present solar energy scenario in India, governing bodies (self-study), solar radiations and its measurements, solar constant, solar radiation geometry, solar radiation data, estimation of average solar radiation, solar radiation on tilted surface

Unit II : Solar Cell Operation

Solar Spectrum, Solar Radiation Spectrum, Worked Problem - Total Irradiance, Solar Cell Fundamentals, Worked Problem - The I-V Characteristic, Solar Cell Types and Technologies, Multi-junctions. Conversion Efficiency Limitations, Worked Problem - Solar Cell under Concentration, From Cell to Module, Energy Audit of Home/Residence

Unit III : Design of Solar PV Systems

PV Sizing and Output, Orientation and Tilt, Temperature Dependent Output, Temperature Dependent Output asaPercent, Module andarrayconditions,Shading calculations using PV Watts, PV Sizing and output under different conditions, Inverter Sizing and Selection, CaseStudies

Unit IV : Wind Energy and its assessment

Wind power scenario inIndia, Characteristics of Wind Energy: Wind movement, wind profile,roughness, effects of obstacles in wind path. wind data and site selection considerations, Comparison with Solar Energy, Types of Wind Turbine Blades, BladeProfile

Unit V : Wind Power Plants

Types of Wind Power Plants (WPPs): Small and large wind turbines; Horizontal and Vertical axis;Upwind and Downwind, One, Two and Three blades; constant and variable Speed; Geared, Direct- Drive and Semi-Geared (Hybrid) WPPs; WECS, WEGs, WTs, WPPs,

WPP Tower Types: Lattice; tubular: steel, concrete, hybrid, ladders, cables WPP substation: Switchgear, transformers, electronic components

Unit VI : Design and Control Aspects of Wind Mill/Plant

Design: horizontal and vertical axis wind turbines, blades, control mechanisms, drive train, tower, nacelle, foundation, choice of materials, manufacture, adaptation to different climates

Control: control targets, system modelling, control strategies (pitch and stall regulation), hardware Systems: wind power parks, transports, erection, grid connection, operation, maintenance

Text Books :

1 S. P. Sukhatme, 'Solar Energy: Principles of thermal collections and storage', McGrawHill
2 G. D. Rai, 'Non-Conventional Energy Sources', KhannaPublisher
3 Tiwari G N. 'Solar Energy: Fundamentals, design, modelling and Applications', Narosa,2002

Reference Books :

1 MukundR.Patel,'WindAndSolarPowerSystems:Design,AnalysisandOperation,Second Edition', CRCPress
2 Kreith And Kreider, Solar Energy Handbook, McGrawHill
3 Ray Hunter, 'Wind Energy Conversion: From Theory to Practice', John Wiley and SonLtd
4 Gary L Johnson, 'Wind Energy Systems', Prentice-Hall Inc., NewJersey
5 Martin O L Hansen, 'Aerodynamics of Wind Turbines', James &James/Earthscan
6 Goswami D Y, Kreith F, Kreider J F, 'Principles of Solar Engineering', Taylor &Francis
7 RobertGasch,'WindPowerPlantFundamentals,Design,Construction AndOperations', Springer
8 C S Solanki, 'Solar Photovoltaic: Fundamentals, Technology And Applications', PHILearning

IOEUA40184A: Open Elective –III [Robotics]

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

Examination Scheme
Continuous Internal 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 :

- Mathematic, SOME, KOM

Course Objectives :

- To acquire basic understanding of Industrial Robots and its technologicalapplications
- To understand peripherals of Robotic system and their use

Course Outcomes :

After completion of the course, student will be able to

1. Recognize and differentiate between different types of Robots, and their features.
2. Understand industrial applications of Robots
3. For the given industrial application students will be capable of selecting the apropriate Robot considering all the parametrs.
4. Recognize different concepts related to industrial Robotics like end effecros, sensors, actuators etc
5. Generate Robot Programming
6. Understand the social relevance of Robots

Unit I : Fundamental of Robotics

Evolution of Robots, Types of Robots, Reason behind use of Robot, Robot Uses cases, Advantages of Robot, Disadvantages of Robot, Defining Robot, Laws of Robotics, Future of Robot,

Unit II : Performance Specifications of Industrial Robots

DOF of Robot, Joints and Links in Robot,Singularity in Robots,Industrial Applications of Robot, Selection parametersand Robot Specification

Unit III : Insight Industrial Robotand System Peripherals

Actuators: Pneumatic, Hydraulic and Electric, Brakes, Transmission, Gears, Soft limits and Hard Limits. Controller, Teach Pendant, End Effectors, Fixtures, Pneumatic System, Communication between System Peripherals.

Unit IV : Automation and Control Systems

Introduction to Automation, Introduction to Artificial Intelligence, Industry 4.0, Fundamentals of PLC, Relay, Encoder, Field Sensors, Communication Protocols, HMI, SCADA, IIOT

Unit V : Robot Programming

Robot Programming Concepts, Programming Methods, Offline Programming, Programming Languages, Program Organization, Writing Robot Program of Instructions, Robot Simulation, Coordinate Systems.

Unit VI : Social Issues Related to Robotics

Reasons for installing Robots, Economic costs and benefits of installing industrial Robots, Acceptability of industrial Robots by the workforce, Employment and Other social issues of Robotics.

Text Books :

1 Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012
2 Craig. J. J. "Introduction to Robotics- mechanics and control", Addison-Wesley, 1999
3 Saeed B. Niku, "Introduction to Robotics – Analysis, Systems and Application" : PHI 2006

Reference Books :

1 D J Todd, "Fundamentals ofRobot Technology" Kogan Page, 1986

List of Assignments:

<Instructions to the students, if nay>

1 System Peripherals
2 Control system for robotics
3 Drives system used in robots
4 Forward Kinematics
5 Backward kinematics
6 Robot Programming
7 Robot proposal preparation with costing
8 Industrial visit

IOEUA40184B : Open Elective –III [Quantum Computing]

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

Examination Scheme
Continuous Internal 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 :

- Data Structures and Algorithms, Programming in Python / C#, Machine Learning and Data Science Basics, Neural Networks and Deep Learning Basics, Information Theory and Models of Computation, Classical Fourier Transform

Course Objectives :

- To provide introduction and necessary expertise to the learner in the upcoming discipline of Quantum Computing and Machine Learning.
- To enable the students to learn Quantum Computing and Quantum Machine Learning in practical-oriented learning sessions so that he/she can independently use existing open-source Quantum Computing Hardware and Software Frameworks.
- To teach the students to develop hybrid solutions by applying Quantum Machine Learning to potential business application areas.
- To study Quantum Information Theory and Quantum Computing Programming Model of Computation.
- To study Quantum Algorithms and apply these to develop hybrid solutions .
- To study Quantum Concepts necessary for understanding the Quantum Computing Paradigm and compare the available hardware and software infrastructure and frameworks made available open source by major players in the Industry and Academia.

Course Outcomes :

After completion of the course, student will be able to

1. Explain the working of a Quantum Computing program, its architecture and programming model.
2. Develop quantum logic gate circuits.
3. Develop quantum algorithm(s).
4. Program quantum algorithm on major toolkits.
5. Develop Hybrid Solutions in Quantum Machine Learning for potential

applications / use cases.

6. Compare existing features provided by potential hardware and software infrastructure and frameworks service providers.

Unit I: Introduction to Quantum Computing

Motivation for studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), Origin of Quantum Computing, Overview of major concepts in Quantum Computing, Qubits and multi-qubits states, Bra-ket notation, Bloch Sphere representation, Quantum Superposition, Quantum Entanglement

Unit II: Mathematical Foundation of Quantum Computing

Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigenvectors.

Unit III: Building Blocks for Quantum Program

Architecture of a Quantum Computing platform, Hybrid Approach for Application Development, Details of q-bit system of information representation: Block Sphere, Multi-qubits States, Quantum superposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perspective e.g. Bell State, Operation on qubits: Measuring and transforming using gates, Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc., Programming model for a Quantum Computing Program, Steps performed on classical computer, Steps performed on Quantum Computer, Moving data between bits and qubits, Models of Computation used by key players as OEMs in Quantum Computing

Unit IV : Quantum Algorithms

Basic techniques exploited by quantum algorithms, Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks, Major Algorithms, Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch -Jozsa Algorithm, OSS Toolkits for implementing Quantum program, IBM quantum experience, Microsoft Q#, RigettiPyQuil (QPU/QVM) OR Cambridge Quantum Computing, Google's Tensorflow Quantum, Amazon Bracket, D-Wave Frameworks

Unit V : Machine Learning and Deep Learning

Machine Learning, Deep Learning and Artificial Intelligence Basics, Machine Learning Algorithms, Deep Learning Algorithms, Evolutionary Learning Algorithms

Unit VI : Quantum Machine Learning

Quantum Machine Learning and Quantum AI, Quantum Neural Networks, Quantum Natural Language Understanding, Quantum Cryptography, Application Domains for Quantum Machine Learning: Chemistry/Material Science, Space Tech, Finance related Optimisation Problems, Swarm Robotics, Cybersecurity

Text Books :

1 Quantum Machine Learning (What Quantum Computing Means to Data Mining) by Peter Wittek, University of Boras, Sweden - Elsevier Publications

2 Principles of Quantum Artificial Intelligence by Andreas Winchert, Instituto Superior Técnico - Universidade de Lisboa, Portugal - World Scientific Publishing, British Library Cataloguing-in-Publication Data

Reference Books :

1 Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2 David McMahon, "Quantum Computing Explained", Wiley
3 IBM Quantum Experience:https://quantumexperience,ng,bluemix.nethttps://quantum-computing.ibm.com/docs/
4 Microsoft Quantum Development Kithttps://www.microsoft.com/en-us/quantum/development-kit
5 Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/
6 Amazon Bracket Documentation on AWS:https://aws.amazon.com/braket/
7 D-Wave Systems Documentation: https://docs.dwavesys.com/docs/latest/index.html

List of Assignments:

1 Building Quantum dice
2 Building Quantum Random Number Generator
3 Composing simple quantum circuits with q-gates and measuring the output into classical bits.
4 Implementation of Shor's Algorithms
5 Implementation of Grover's Algorithm
6 Implementation of Deutsch's Algorithm
7 Implementation of Deutsch-Jozsa's Algorithm
8 Mini Project such as implementing an API for efficient search using Grover's Algorithms or Integer factorization using Shor's Algorithm
9 Graph Partitioning using Quantum Machine Learning
10 Implementing Quantum Neural Network
11 Basics program implementing Quantum Natural Language Understanding Solution
12 Comparative study of Quantum Software Frameworks

IOEUA40184C : Open Elective –III [Business Intelligence]

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

Examination Scheme
Continuous Internal 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 :

- Database Management System

Course Objectives :

- To study and understand the importance of Business Intelligence and need of data Visualisation for Business Intelligence.
- To study and understand the different components of analytics landscape and project cycle aligned with these components.
- To study and understand different data transformations, data modelling steps and visualize the data on the data models.
- To study and understand the ways of adding custom calculations needed and understanding the applications of different statistical concepts.
- To study and understand the BI deployments, administration cycle of BI implementations using Power BI
- To study and understand various topics and concepts in the areas of analytics and their industrial applications through study of different use cases.

Course Outcomes :

After completion of the course, student will be able to

1. Describe the importance of Business Intelligence and need of data visualisation for Business Intelligence.
2. Identify, describe, relate to the concepts of different components of analytics landscape and project cycle aligned with these components.
3. Design and develop different data transformations, data models, analyse and visualize the data.
4. Design and develop custom calculations based on business and technical needs and demonstrate and implement different statistical concepts.
5. Author BI deployments, BI environments.
6. Describe and compare industrial BI implementations, use cases and current and

future trends.

Unit I: Introduction to Analytics and Data Preparation

Introduction to Analytics: What isAnalytics?Need of Analytics, Types of Analytics, Role of Analytics in Business

Data Sources: Data Collection, Transactions Entry, Organizational Systems, Data Sources and Data Source Categories, Issues in Data and Need of Data Preparation

Power BI Desktop: Need of visualisation, Different Visualisation tools, Why Microsoft Power BI?Installation and configuration of Power BI Desktop, Setup of required connector

Data Visualization: What are KPIs?Dashboards, Reports and Scorecards, Types of Dashboards, Slicers and Filters, Setting interactivity, Drilldowns and Drill-through, Formatting your visualizations, Best practices of visualizations

Unit II: Data& BI Landscape and Project Cycle

Understanding Data and Databases: What is a database? What is a DBMS? What is SQL?What are tables?Organization of tables in databases, Types of Data, Database Keys, Relationships between tables, Joins and Unions, Type of Data: Structured, Unstructured and Semi-structured

BI Architecture: BI Architecture, Data Security and Governance, Administration

BI Project Lifecycle: Requirements Understanding, Data Understanding, Data Integration and Data warehouse, Reporting and Analysis, Dashboard development, Deployment, Documenting, Project Team and Roles, Challenges in Projects

Unit III: Data Preparationand Data Modelling

Data Integration and Data Warehouses: What is Data Integration?Need of DataIntegration, ETL, what is Data Warehouse?Need of Data Warehouse, Facts and Dimensions

Star Schema and Snowflake Schema, Data Marts

Need of Data Preparations: What is Data Preparation?Joining data, Appending Data, New Calculations, Removing Inconsistencies, Transposing

Data Transformation [Basics]: Merging and Appending Data, Filtering, Cleaning Data, Fixing Errors, Transforming Data, Aggregating Data

Data Modelling: Setting Relationships, Creating Data Models

Unit IV : Custom Calculations And Analytics

Data Transformations [Advanced]: Pivot/Unpivot data, Split data, Handling inconsistent data, Conditional Column, Custom column

Calculations: Introduction to DAX, Calculated Column, Calculated Measures, M-Query calculations, YTD, QTD, MTD calculations, Moving Averages and Running Total

Statistical Analysis: Central Tendency: Mean, Mode, Median, Dispersion: Variance and Standard Deviation, Summarization data by using histogram

Unit V : Power BI Deployment, Administration And Mobility

Power BI Deployment: Overview of Power BI Service, publishing reports to Power BI Service, Understanding the Power BI Service User Interface, Creating Dashboards in Power BI Service, Subscriptions, Comments and Data Driven Alerts, authoring reports within Power

BI Service, sharing dashboards across your organization, Configuring Power BI Gateway, scheduling automated refresh of your reports using Data Gateway

Power BI Mobile: Creating Dashboards for Mobiles, using dashboards and reports using Mobile App

Power BI Advanced Features: Using NLP to creating dashboards, Influencers, Delivering Insights, Explain Analysis

Unit VI : Industry Analytics Landscape

Tableau Overview: Introduction to Tableau, Tableau Products, Tableau architecture, Installation and Setup of Tableau Desktop, Visualizing with Tableau, Tableau online and Tableau server, Publish and share reports on Tableau online

Applications of Business Intelligence: Manufacturing Use Cases, Retail Use Cases, Marketing use Cases, Banking use cases, Future Trends of Analytics

Text Books :

1 "Business Intelligence Guidebook: From Data Integration To Analytics" by Rick Sherman, Elsevier Inc.
2 "Successful Business Intelligence, Second Edition: Unlock The Value Of BI & Big Data" by Cindi Howson, McGraw Hill Edition
3 "Data Analytics For Beginners: Your Ultimate Guide To Learn And Master Data Analysis. Get Your Business Intelligence Right – Accelerate Growth And Close More Sales" by Victor Finch
4 Data Strategy: How To Profit From A World Of Big Data, Analytics And The Internet Of Things" by Bernard Marr, KoganpagePublicaitons, Auva Press

Reference Books :

1 "Performance Dashboards – Measuring, Monitoring, And Managing Your Business" by Wayne Eckerson, John Wiley & Sons, Inc
2 "Business Intelligence Roadmap: The Complete Project Lifecycle For Decision-Support Applications" by Larissa T. Moss &ShakuAtre, Addison-Wesley information Technology Series
3 "Artificial Intelligence: Building Intelligent Systems" by Dr.ParagKulkarni, Dr.Prachi Joshi, PHI publication (for understanding of concepts)

List of Assignments:

1 Creating multiple sample tables and joining them in Power BI
2 Connecting to data source and transforming data in Power BI
3 Connecting to data source and creating data models by establishing relationships
4 Connecting to data source and visualizing and analysing data
5 Connecting to data source and creating custom calculations
6 Deploying the dashboards and reports to Power BI Service
7 Administering and using advanced features of Power BI Service
8 Creating Mobile layouts in Power BI Desktop

IOEUA40184F: Open Elective –III [Business Analytics]

Teaching Scheme	**Examination Scheme**
Credits : 4	**Continuous Internal Evaluation(CIE): 20 Marks**
Lectures : 3 Hrs/week	**In-Semester Examination(ISE): 30 Marks**
Practical : 2 Hrs/week	**Skills & Competency Exam(SCE): 20 Marks**
	End Semester Examination(ESE): 30 Marks
	PR/OR: 25 Marks

Prerequisites :

- Database Management System, MS-Excel

Course Objectives :

- To study and understand the importance of Business Intelligence and need of data Visualisation for Business Intelligence
- To study and understand the different components of analytics landscape and project cycle aligned with these components
- To study and understand different data transformations, data modelling steps and visualize the data on the data models
- To study and understand implementation and evaluation ways of adding custom calculations needed and BI deployments
- To study and understand the descriptive statistics, inferential statistics, normal distribution and prediction analysis by performing regression.
- To study and understand Tableau background and concepts in the areas of analytics and their industrial applications through study of different use cases.

Course Outcomes :

After completion of the course, student will be able to

1. Describe the importance of Business Intelligence and need of data visualisation for Business Intelligence.
2. Identify, describe, relate to the concepts of different components of analytics landscape and project cycle aligned with these components
3. Design and develop different data transformations, data models, analyse and visualize the data
4. Design and develop custom calculations based on business requirements and Author BI deployments, BI environments.
5. Perform descriptive and inferential statistics and prediction analysis by performing regression
6. Describe and compare industrial BI implementations, use cases and current and future trends.

Unit I : Introduction to Analytics and Data Preparation

Introduction to Analytics: What is Analytics? Need of Analytics, Types of Analytics, Role of Analytics in Business

Data Sources: Data Collection, Transactions Entry, Organizational Systems, Data Sources and Data Source Categories, Issues in Data and Need of Data Preparation

Power BI Desktop: Need of visualisation, Different Visualisation tools, Why Microsoft Power BI? Installation and configuration of Power BI Desktop, Setup of required connector

Data Visualization: What are KPIs? Dashboards, Reports and Scorecards, Types of Dashboards, Slicers and Filters, Setting interactivity, Drilldowns and Drill-through, Formatting your visualizations, Best practices of visualizations

Unit II : Data & Analytics Landscape and Project Cycle

Understanding Data and Databases: What is a database? What is a DBMS? What is SQL? What are tables? Organization of tables in databases, Types of Data, Database Keys, Relationships between tables, Joins and Unions, Type of Data: Structured, Unstructured and Semi-structured

BI Architecture: BI Architecture, Data Security and Governance, Administration

BI Project Lifecycle: Requirements Understanding, Data Understanding, Data Integration and Data warehouse, Reporting and Analysis, Dashboard development, Deployment, Documenting, Project Team and Roles, Challenges in Projects

Unit III : Data Preparation and Data Modelling

Data Integration and Data Warehouses: What is Data Integration? Need of Data Integration, ETL, what is Data Warehouse? Need of Data Warehouse, Facts and Dimensions

Star Schema and Snowflake Schema, Data Marts

Need of Data Preparations: What is Data Preparation? Joining data, Appending Data, New Calculations, Removing Inconsistencies, Transposing

Data Transformation [Basics]: Merging and Appending Data, Filtering, Cleaning Data, Fixing Errors, Transforming Data, Aggregating Data

Data Modelling: Setting Relationships, Creating Data Models

Unit IV : Calculations And Power BI Deployment

Data Transformations [Advanced]: Split data, Handling inconsistent data, Conditional Column, Custom column

Calculations: Introduction to DAX, Calculated Column, Calculated Measures, M-Query calculations, YTD, QTD, MTD calculations

Power BI Deployment: Overview of Power BI Service, Publishing reports to Power BI Service, Understanding the Power BI Service User Interface, Creating Dashboards in Power BI Service, Subscriptions, Comments and Data Driven Alerts, authoring reports within Power BI Service, sharing dashboards across your organization,

Power BI Mobile: Creating Dashboards for Mobiles, using dashboards and reports using

Mobile App

Unit V : Business Analytics using Excel

Statistical Analysis: Central Tendency: Mean, Mode, Median, Central Tendency exercise in Excel. Dispersion: Variance and Standard Deviation, Dispersion exercise in Excel. Coefficient of variation, rule of thumb for Standard deviation. Outliers.
Summarization data by using histogram, Descriptive Statistics. Interpretation of excel result of descriptive statistics. Inferential statistics,Sample and population, Point estimate, true value, sampling error, Normal Distribution,

Regression and forecasting: Simple Regression Model and Type, Regression line, Relationship between two variables, Forecasting using Excels, Interpreting Regression Result, Example of single regression in Excel and forecasting.

Unit VI : Industry Analytics Landscape

Tableau Overview: Introduction to Tableau, Tableau Products, Tableau architecture, Installation and Setup of Tableau Desktop, Visualizing with Tableau, Tableau online and Tableau server, Publish and share reports on Tableau online

Applications of Business Analytics: Manufacturing Use Cases, Retail Use Cases, Marketing use Cases, Banking use cases, Future Trends of Analytics

Text Books :

1. "Business Intelligence Guidebook: From Data Integration To Analytics" by Rick Sherman, Elsevier Inc
2. "Successful Business Intelligence, Second Edition: Unlock The Value Of BI & Big Data" by Cindi Howson, McGraw Hill Edition
3. "Data Analytics For Beginners: Your Ultimate Guide To Learn And Master Data Analysis. Get Your Business Intelligence Right – Accelerate Growth And Close More Sales" by Victor Finch
4. Data Strategy: How To Profit From A World Of Big Data, Analytics And The Internet Of Things" by Bernard Marr, KoganpagePublicaitons, Auva Press

Reference Books :

1. "Performance Dashboards – Measuring, Monitoring, And Managing Your Business" by Wayne Eckerson, John Wiley & Sons, Inc
2. "Business Intelligence Roadmap: The Complete Project Lifecycle For Decision-Support Applications" by Larissa T. Moss &ShakuAtre, Addison-Wesley information Technology Series
3. "Artificial Intelligence: Building Intelligent Systems" by Dr. Parag Kulkarni, Dr. Prachi Joshi, PHI publication (for understanding of concepts)

List of Assignments (Any 6):

<Instructions to the students, if nay>

1	Creating multiple sample tables and joining them in Power BI
2	Connecting to data source and transforming data in Power BI
3	Connecting to data source and creating data models by establishing relationships
4	Connecting to data source and visualizing and analysing data
5	Performing Descriptive statistics in Excel
6	Numerical based on normally distributed data.
7	Performing regression in Excel and forecast by interpreting results.
8	Deploying the dashboards and reports to Power BI Service
9	Administering and using advanced features of Power BI Service
10	Creating Mobile layouts in Power BI Desktop.

CSUA40185: Intellectual Property Rights

Teaching Scheme
Credits : 2
Lectures : 2Hrs/week
Tutorial : NA

Examination Scheme
Continuous Internal Evaluation(CIE): NA
In-Semester Examination(ISE): NA
Skills & Competency Exam(SCE): 50 Marks
End Semester Examination(ESE): NA

Prerequisites :

- NA

Course Objectives :

- Explain the importance of ideas, concept and creativity
- Transfer the knowledge about the IPR required for Engineer's
- Describe the how IPR creates National wealth
- Teach National and International IP System

Course Outcomes :

After completion of the course, student will be able to

1. Infer that tomorrow's world will be ruled by ideas, concept, and creativity
2. Gather knowledge about Intellectual Property Rights which is important for students of engineering as they are tomorrow's technocrats and creator of new technology
3. Discover how IPR are regarded as a source of national wealth and mark of an economic leadership in context of global market scenario.
4. Study the national & International IP system.

Unit I: Introduction

Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives of understanding Intellectual Property Rights , IPR and IITs

Unit II: Types of IPRs

Understanding the types of Intellectual Property Rights: - Patents, Designs, Trademarks (Registered and unregistered trademarks), Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting, (Case Studies)

Unit III: IPR Development Cycle

New Developments in IPR , Process of Patenting and Development: technological research, innovation, patenting, development, International Scenario: WIPO, TRIPs, Indian Patent Office and its Administration .

Unit IV : Patent System

Administration of Patent System – Patenting under Indian Patent Act , Patenting under PCT , Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non Provisional Patent Application and Specification

Text Books :

1 Resisting Intellectual Property by Halbert, Taylor & Francis Ltd ,2007 .
2 Industrial Design by Mayall, McGraw Hill.

3 Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley

Reference Books :

1 Intellectual Property Rights under WTO by T. Ramappa, S. Chand.
2 Introduction to Design by Asimov, Prentice Hall

CSUA40186: Project Work

Teaching Scheme
Credits : 5
Lectures : NA
Practical : 10

Examination Scheme
Continuous Internal Evaluation(CIE): 100
In-Semester Examination(ISE): NA
Skills & Competency Exam(SCE): 50 Marks
End Semester Examination(ESE): NA
PR/OR: 150 Marks

Course Objectives :

- To apply SDLC and meet the objectives of proposed development or research work
- To test rigorously before deployment of work in previous objective
- To validate the work undertaken during previous two objectives
- To consolidate the development or research work as project report.

Course Outcomes :

After completion of the course, student will be able to

1. Produce evidence of independent investigation and imbibe inquisitiveness
2. Analyze the results and their interpretation intensively and critically.
3. Report and present the original results in an orderly way and placing the open questions in the right perspective.
4. Participate as a team with appropriate engineering and research practices to provide sustainable solution.
5. Exhibit practical implications and constraints of the specialist subject

Guidelines

The student shall complete the work of the Project which will consist of problem statement, literature review, SRS, Model and Design, Selection of Technology and Tools, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems and comparative analysis and validation of results and conclusions. The candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic. The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report. The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide and head of the Department/Institute.

Semester-VII/VIII

(Module-II)

Semester Internship (CSUA40187)

Teaching Scheme:	**Examination Scheme:**
Practical: 24 Hrs/week **Credits: 12**	**Continuous Internal Evaluation (CIE): 100 Marks** **PR/OR:50 Marks**

Course Objectives:

- To provide exposure to the industrial environment, with possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job
- To give exposure of the current technological developments, processes, and products of IT industry
- To learn to apply the Technical knowledge in real industrial situations
- To gain experience in writing Technical reports/projects
- To expose students to the engineer's responsibilities and ethics
- To promote academic, professional and/or personal development.
- To expose the students to future employers
- To understand the social, economic and administrative considerations that influence the working environment of industrial organizations
- To understand the psychology of the workers and their habits, attitudes and approach to problem solving

Course Outcomes:

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

1. Understand the industrial requirement in terms of ethics, skill sets for future employees/entrepreneurs
2. Apply knowledge gained in academics to the industrial applications
3. Function effectively as an individual and as a member of the multidisciplinary team
4. Provide students an opportunity to be industry ready.

Guidelines:

The student shall complete the work of the Semester Internship, in consultation with the Faculty Mentor, who serves as the instructor of record for internships. The student needs to complete the following steps to set up, conduct and receive a grade for an Industrial Internship. Initially, write and submit Internship Proposal to faculty mentor, for approval. Next, submit application and consent form to company. As there will be regular reviews and assessment of activities being performed at the company, by the Faculty Mentor and the Industry Mentor, the student shall be ready to deliver presentations on tasks performed. Towards the end of the internship the student should submit the training report to the faculty mentor, and prepare for a final assessment by a panel of examiners, including Faculty Mentor and Industry Mentors. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and training report. After completion of internship, the student shall submit to the Faculty Mentor, the internship completion letter provided by the company.