BansilalRamnathAgarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to SavitribaiPhule Pune University)

Curriculum for
Final Year B. Tech.
(Computer Engineering)
2017 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 2017

Syllabus Structure

FINAL YEAR B. TECH (COMPUTER ENGINEERING), SEMESTER VII (PATTERN 2017)

MODULE-I

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
			L	T	P	ISE T1	ISE T2	CE	ESE	PR/OR		
CSUA40171	Design and Analysis of Algorithms	TH	3	-	2	20	10	20	50	50	150	4
CSUA40172	Cloud Computing	TH	3	-	2	20	10	20	50	50	150	4
CSUA40173	Compiler Construction	TH	3	-	2	20	10	20	50	-	100	4
CSUA40174/ ITUA40174	Elective-III	TH	3	-	2	20	10	20	50	-	100	4
CSUA40175	Intellectual Property Rights	CE	2	-	-	-	-	50	-	-	50	2
CSUA40176	Project Work	CE-PR/OR	-	-	10	-	-	100	-	50	150	5
A4	Audit Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	14	-	18	80	40	230	200	150	700	23

Elective – III:

1. CSUA40174A: Advanced Computer Networks-II
2. CSUA40174B: Advance Machine Learning
3. CSUA40174C: Information and Cyber Security
4. ITUA40174: Ubiquitous Computing

List of Audit Courses: Professional Ethics; Cyber Security; Value Engineering and Human Rights; Legislative Procedures; Technical Writing/Documentation; Sports/Yoga; Performing Art such as music, dance, and drama etc.; Languages; Online certification course (minimum two weeks); Participation in intercollegiate co-curricular and extra-curricular activities.

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

MODULE-II

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
			L	T	P	ISE		CE	ESE	PR/OR		
						T1	T2					
CSUA40177	Semester Internship	CE-PR/OR	-	-	24	-	-	100	-	50	150	12
A4	Audit Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	24	-	-	100	-	50	150	12

List of Audit Courses: Professional Ethics; Cyber Security; Value Engineering and Human Rights; Legislative Procedures; Technical Writing/Documentation; Sports/Yoga; Performing Art such as music, dance, and drama etc.; Languages; Online certification course (minimum two weeks); Participation in intercollegiate co-curricular and extra-curricular activities.

Semester Internship: For detail syllabus see the Annexure A

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FINAL YEAR B. TECH (COMPUTER ENGINEERING), SEMESTER VIII (PATTERN 2017)

MODULE-III

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
						ISE		CE	ESE	PR/OR		
			L	T	P	T1	T2					
CSUA42171/ ITUA42171	Elective-IV	TH	3	-	2	20	10	20	50	50	150	4
IOEUA42172	Open Elective-I	TH	2	-	2	20	10	20	50	-	100	3
IOEUA42173	Open Elective-II	TH	3	-	-	20	10	20	50	-	100	3
CSUA42174	Introduction to Research	CE-PR/OR	1	-	2	-	-	50	-	50	100	2
A4	Audit course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	9	-	6	60	30	110	150	100	450	12

Elective-IV		**Open Elective-I**		**Open Elective-II**	
CSUA42171A	Software Defined Network	IOEUA42172A	Introduction to Gaming	IOEUA42173A	Financial Technology
CSUA42171B	Robotic Process Automation	IOEUA42172B	Inferential Statistics for Data Science	IOEUA42173B	Agriculture Electronics
		IOEUA42172C	Solar and wind Energy	IOEUA42173C	Operation Research
CSUA42171C	Augmented/Virtual Reality	IOEUA42172D	Numerical Methods in Engineering	IOEUA42173D	Total Quality Management
ITUA42171	Business Intelligence	IOEUA42172E	Social Media Analytics	IOEUA42173E	Blockchain Technology

List of Audit Courses: Professional Ethics; Cyber Security; Value Engineering and Human Rights; Legislative Procedures; Technical Writing/Documentation; Sports/Yoga; Performing Art such as music, dance, and drama etc.; Languages; Online certification course (minimum two weeks); Participation in Intercollegiate co-curricular and extra-curricular activities.

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FINAL YEAR B. TECH (COMPUTER ENGINEERING), SEMESTER VIII (PATTERN 2017)

MODULE-IV

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
			L	T	P	ISE		CE	ESE	PR/OR		
						T1	T2					
CSUA40177	Semester Internship	CE-PR/OR	-	-	24	-	-	100	-	50	150	12
A4	Audit Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	24	-	-	100	-	50	150	12

List of Audit Courses: Professional Ethics; Cyber Security; Value Engineering and Human Rights; Legislative Procedures; Technical Writing/Documentation; Sports/Yoga; Performing Art such as music, dance, and drama etc.; Languages; Online certification course (minimum two weeks); Participation in intercollegiate co-curricular and extra-curricular activities.

Semester Internship: For detail syllabus see the Annexure A

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

FINAL YEAR B. TECH (COMPUTER ENGINEERING), SEMESTER VIII (PATTERN 2017)

MODULE-V

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
						ISE						
			L	T	P	T 1	T 2	CE	ESE	PR/OR		
CSUA40171	Design and Analysis of Algorithms	TH	3	-	2	20	10	20	50	50	150	4
CSUA40172	Cloud Computing	TH	3	-	2	20	10	20	50	50	150	4
CSUA40173	Compiler Construction	TH	3	-	2	20	10	20	50	-	100	4
CSUA40174/ ITUA40174	Elective-III	TH	3	-	2	20	10	20	50	-	100	4
CSUA40175	Intellectual Property Rights	CE	2	-	-	-	-	50	-	-	50	2
CSUA40176	Project Work	CE-PR/OR	-	-	10	-	-	100	-	50	150	5
A4	Audit Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	14	-	18	80	40	230	200	150	700	23

Elective – III:

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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.

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Final year B.Tech

Pattern 2017

Syllabus

Design and Analysis of Algorithms (CSUA40171)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3 Hrs/week** **Practical :2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment(ESE): 50 Marks** **Summative Assessment(PR/OR): 50 Marks**

Prerequisites: Discrete Mathematics, Data Structures and Theory Of Computation

Course Objectives

- Measure the performance of algorithms on the basis of time and space complexity.
- To explain different algorithmic strategies for solving given problems.
- To determine and solve the P and NP class of problem.
- To learn randomized and approximation algorithm.
- To understand the concepts of parallel programming paradigm.
- To understand the concepts of concurrent programming paradigm.

Course Outcomes

After completion of the course, student will be able to

1. Analyze algorithms for their time and space complexities in terms of asymptotic performance
2. Apply greedy method or dynamic programming algorithmic strategy for solving given problems.
3. Apply backtracking and branch and bound algorithmic strategy for solving given problems.
4. Apply principle of reducibility for solving intractable problems.
5. Understand randomized and approximation algorithm.
6. Apply concepts of parallel and concurrent programming to given problem.

Unit I: Introduction

Analysis of Algorithms, Best, Average and Worst case running times of algorithms, Mathematical notations for running times O, Ω, Θ. Master's Theorem
Problem solving principles: Classification of problem, problem solving strategies, classification of time complexities (linear, logarithmic etc.).
Divide and Conquer strategy: General strategy, Quick Sort and Merge Sort w.r.t. Complexity

Unit II: Greedy Method & Dynamic Programming

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

Unit III: Backtracking, Branch and Bound

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

Unit IV: Intractable Problems and NP-Completeness

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

Unit V: Approximation and Randomized Algorithms, Natural Algorithms

Approximation algorithms, Solving TSP by approximation algorithm, approximating Max Clique
Concept of randomized algorithms, randomized quick sort algorithms
Natural Algorithms–Evolutionary Algorithms and Evolutionary Computing, Introduction to Genetic Algorithm, Simulated Annealing.

Unit VI: Parallel and Concurrent Algorithms

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

Text Books

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

Reference Books

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, ―Introduction to Algorithms‖, MIT Press; ISBN 978-0-262-03384-8
2. Algorithms and Parallel Computing, Fayez Gebali, Willy, ISBN 978-0-470-90210-3 (Indian Paperback Edition)
3. Michael T. Goodrich, Roberto Tamassia , ―Algorithm Design: Foundations, Analysis and Internet Examples‖, Wiley, ISBN 978-81-265-0986-7
4. Rajeev Motwani and PrabhakarRaghavan, ―Randomized Algorithms‖, Cambridge University Press, ISBN: 978-0-521-61390-3
5.Dan Gusfield, ―Algorithms on Strings, Trees and Sequences‖, Cambridge University Press, ISBN:0-521-67035-7
6.AnanyLevitin, "Introduction to the Design and Analysis of Algorithms" Pearson Education

List of Assignments (in C++/Java/Python)
1. Implement Quick Sort using divide and conquer strategy.
2. Implement 0/1 knapsack using Dynamic Programming.
3. Implement Travelling Salesman problem using branch and bound technique.
4. Implement Concurrent Dining Philosopher Problem.

Cloud Computing (CSUA40172)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3 Hrs/week** **Practical : 2Hrs/Week**	**Formative Assessment: 50 Marks** **Summative Assessment(ESE): 50 Marks** **Summative Assessment(PR/OR): 50 Marks**

Prerequisites: **Computer Networks**

Course Objectives

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

Course Outcomes

After completion of the course, student will be able to

1.Summarize the basic concepts of cloud computing (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 in Cloud

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

Unit IV: Approximation and Randomized Algorithms, Natural Algorithms

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

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, TheDocker Workflow. Docker compose file, Docker volume, Docker storage.
Kubernetes : introduction to Kubernetes, Features of Kubernetes, Kubernetes API, Basic Architecture, Minikube.

Text Books

1. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 2010, The McGraw-Hill.
2. Dr. Kris Jamsa, “Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more” , Wiley Publications, ISBN: 978-0-470-97389-9.
3.Gautam 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

Compiler Construction (CSUA40173)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3 Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50Marks** **Summative Assessment: 50Marks**

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

Course Objectives

1. To study language processing fundamentals and assemblers.
2. To design macro processors.
3. To study and understand compiler design.
4. To understand working of syntax analyzer.
5. To understand importance of semantic analysis and storage allocation in compilation process.
6. To study different code optimization methods.

Course Outcomes

After completion of the course, student will be able to

1. Learn language processing fundamentals with detail designing of assembler.
2. Design and implement macro processors and understand working of linkers and loaders.
3. Understand various phases of compiler and use tool LEX for generation of Lexical Analyzer.
4. Understand working of parser and use YACC tool for generation of syntax analyzer..
5. Understand functions of Semantic Analysis.
6. Apply code optimization techniques in the compilation process.

Unit I: Introduction To Systems Programming And Assemblers

Introduction: Need of System Software, Components of System Software, Language Processing Activities, Fundamentals of Language Processing. Assemblers: Elements of Assembly Language Programming, A simple Assembly Scheme, Pass structure of Assemblers, Design of Two Pass Assembler.

Unit II: Macro processors, Loaders And Linkers

Unit III: Introduction To Compilers

Phase structure of Compiler and entire compilation process. Lexical Analyzer: The Role of the Lexical Analyzer, Input Buffering. Specification of Tokens, Recognition Tokens, Design of Lexical Analyzer using Uniform Symbol Table, Lexical Errors. LEX: LEX Specification, Generation of Lexical Analyzer by LEX.

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

Unit V: Semantic Analysis And Storage Allocation
Need, Syntax Directed Translation, Syntax Directed Definitions, Translation of assignment Statements, iterative statements, Boolean expressions, conditional statements, Type Checking and Type conversion. Intermediate Code Formats: Postfix notation, Parse and syntax tress, Three address code, quadruples and triples. Storage Allocation: Storage organization and allocation strategies.
Unit VI: Code Generation And Optimization
Code Generation: Code generation Issues. Basic blocks and flow graphs, A Simple Code Generator. Code Optimization: Machine Independent: Peephole optimizations: Common Sub-expression elimination, Removing of loop invariants, Induction variables and Reduction in strengths, use of machine idioms, Dynamic Programming Code Generation. Machine dependent Issues: Assignment and use of registers
Text Books
1.D. M. Dhamdhere, Systems Programming and Operating Systems, Tata McGraw-Hill, ISBN 13:978-0-07-463579-7, Second Revised Edition. 2.Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, Addison Wesley, ISBN:981–235–885 - 4, Low Price Edition. 3.John R. Levine, Tony Mason & Doug Brown, “Lex & Yacc”, O’Reilly
Reference Books
1. J. J. Donovan, Systems Programming, McGraw-Hill, ISBN 13:978-0-07-460482-3, Indian Edition.

List of Assignments
Note : Course Coordinator can ask students to implement some assignments from following suggested list of assignments. Students can implement following assignments using LEX/YACC, C/C++, JAVA, Python.
1.Generate Symbol table, Literal table, Pool table & Intermediate code of a two-pass Assembler for the given source code.
2. Implement pass-II of a two-pass Assembler and generate m/c language code for the given intermediate code.
3. Design suitable data structures & implement pass-I of a two-pass Macro processor
4. Design suitable data structures & implement pass-II of a two-pass Macro processor
5. Write a program to implement a lexical analyzer for parts of speech.
6.Write a program to evaluate arithmetic expression, built-in functions and variables using Yacc specification.
7.Write a program to generate three address code for simple expression.
8.Write a program to apply various code optimization techniques for given three address code.
9.Write a program to generate assembly language code for given three address code.

Elective-III (CSUA40174 / ITUA40174)

Advanced Computer Networks-II (CSUA40174A)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3 Hrs/week** **Pactical : 2Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisites: Fundamentals of Computer Networks, Computer Networks-I, Computer Networks-II

Course Objectives

- To understand the WAN concepts
- To identify the requirements for point to point and branch connections
- To illustrate the concept of security using access control lists
- To identify network security and monitoring requirements
- To understand QoS and parameters
- To perform network troubleshooting

Course Outcomes

After completion of the course, student will be able to

1. Explore the WAN concepts- REMEMBER.
2. Analyze the connection types- ANALYSE
3. Describe and Demonstrate the Access Control Lists– UNDERSTAND & APPLY
4. Analyzing the network security requirements ANALYSE
5. Analyze QoS parameters- ANALYSE
6. Planning and implementing network troubleshooting- CREATE

Unit I: WAN Concepts

Introduction to WAN, WAN Topologies and Types of Networks, WAN Operations: Circuit Switching and Packet Switching, Selecting A WAN, Public WAN Infrastructure, Selecting WAN Services

Unit II: Point to Point and Branch Connections

Serial Communication, HDLC Encapsulation, PPP, PPP implementation, PPP Troubleshooting, Remote Access Connection, PPPoE, PPPoE implementation, VPN. GRE, GRE implementation, eBGP.

Unit III: Access Control Lists

Introduction to ACL, ACL Operation, Types of IPv4 ACLs, Configuration and implementation of Standard and Extended IPv4 ACLs, IPv6 ACL Creation, Configuring IPv6 ACL, Troubleshooting ACLs.

Unit IV: Network Security and Monitoring

LAN Security: LAN Security Attacks, Best Practices, SNMP: Operation, Configuration, Cisco Switch Port Analyzer (SPAN): Overview, Configuration, SPAN as a troubleshooting tool

Unit V: Quality of Service

QoS overview, Traffic characteristics, Queuing algorithms QoS Models, QoS implementation techniques.

Unit VI: Network Evolution and Network Troubleshooting

Internet of Things: IoT Elements, IoT Pillars, Cloud and Virtualization: Cloud Computing, Virtualization, Virtual Network Infrastructure, Network Programming: Software Defined Networking, Controllers, Network Troubleshooting: Troubleshooting methodology, Troubleshooting process, isolating issues using layered models. Troubleshooting scenarios: Using IP SLA, Tools, Symptoms and causes of troubleshooting, Troubleshooting IP Connectivity.
Text Books
1.Fourauzan B., "Data Communications and Networking", 5th edition, McGraw-Hill Publications **2.**Stallings William., "Data and Computer Communications", Sixth Edition, Prentice Hall of India . **3.**Andrew S. Tanenbaum ,"Computer Networks", Pearson
Reference Books
1. CCNA Basics and Fundamentals-Cisco. 2.CCNA Routing and Switching 200-125 Official Cert. Guide Library. 3.Cisco CCNA Command Guide- An introductory Guide for complete beginners

List of Assignments
1. (Packet Tracer Index-2.1.2.5)Troubleshooting serial interfaces
2. (Packet Tracer Index-2.3.2.6)Configuring PAP and CHAP authentication
3. (Packet Tracer Index-2.4.1.4)Troubleshooting PPP with authentication
4. (Packet Tracer Index-3.4.2.4 and 3.4.2.5)Configuring and troubleshooting GRE
5. (Packet Tracer Index-3.5.3.4)Configuring and verify eBGP
6. (Packet Tracer Index-4.3.1.5 and 4.3.2.6)Configure standard IPv4 and IPv6 ACL
7. (Packet Tracer Index-)4.4.2.9 and 4.4.2.10Troubleshooting IPv4 and IPv6 ACLs
8. (Packet Tracer Index-8.2.4)Troubleshooting IP connectivity

Elective-III (CSUA40174 / ITUA40174)

Advanced Machine Learning (CSUA40174B)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3 Hrs/week** **Practical : 2Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisites: Knowledge of Programming, Engineering Mathematics III

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,
- To learn to improve understanding of the on-going research in computer vision and multimedia field.
- To know programming of algorithms

Course Outcomes

After completion of the course, student will be able to

1. Differentiate between supervised, unsupervised machine learning approaches.
2. Apply specific supervised or unsupervised machine learning algorithm for a particular problem.
3. Analyze and suggest the appropriate machine learning approach for the various types of problem.
4. Design and make modifications to existing machine learning algorithms to suit an individual application.
5. Use of CNN,RNN algorithms
6. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.

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, Sparse PCA, Kernel PCA

Unit II: Supervised Learning

Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Ridge, Lasso and ElasticNet, Polynomial regression, Isotonic regression,
Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations,
Bayes Theorom, Naïve Bayes Classifiers.
Support Vector Machine(SVM)- Linear Support Vector Machines, Kernel based classification, Non-linear Examples. Controlled Support Vector Machines, Support Vector Regression.

Unit III: Unsupervised Learning

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

Unit IV: 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 Feed forward Neural Networks.

Unit V: 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 VI: Convolutional Neural Networks and Recurrent Neural Networks

Convolutional Neural Networks- Convolutional Neural Networks , Architectures, convolution / pooling layers, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks.
Recurrent Neural Networks- Recurrent Neural Networks , Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs
Deep Learning research: Object recognition, Sparse coding, Computer Vision, Natural Language Processing

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 2nd Edition-2013, ISBN 978-0-262-01243-0
3. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

Reference Books

1. Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN : 0070428077 9780070428072
2. Nikhil Buduma, "Fundamentals of Deep Learning", O"REILLY publication, second edition 2017, ISBN: 1491925612
3. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioners Approach", O"REILLY, SPD, ISBN: 978-93-5213-604-9, 2017 Edition 1st.

List of Assignments:- 6-8 assignments will be based on above syllabus.

Elective-III (CSUA40174 / ITUA40174)

Information and Cyber Security (CSUA40174C)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3 Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**
Prerequisites: Fundamentals of Computer Networks	

Course Objectives

- To know the need and basic of security
- To learn various types of Cryptographic algorithm
- To learn various authentication techniques
- To acquire knowledge of protocols employed to provide Confidentiality and integrity
- To understand various methods for network security
- To acquaint with current security scenario

Course Outcomes

After completion of the course, student will be able to

1. Identify the need and basic of security (Knowledge)
2. Summarize various Cryptographic algorithm (Understand)
3. Infer various authentication techniques (Understand)
4. Summarize protocols for confidentiality and integrity (Understand)
5. Identify various techniques used securing a network (Knowledge)
6. Relate with current industry trends (Understand)

Unit I: Security Basics and Introduction to cryptography

Introduction, Elements of Information Security, Understanding concepts: threat, exploit, privacy, vulnerability and policy, Types of Attacks, Operational Model of Network Security, Cryptography, Substitution Ciphers, Transposition Ciphers, Stenography applications and limitations

Unit II: Symmetric Key Cryptography

Introduction, Encryption Methods: Symmetric, Asymmetric, Block Ciphers and methods of Operations, Data Encryption Standard (DES), Advance Encryption Standard (AES).

Unit III: Asymmetric Key Cryptography

Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Authentication methods, Message Digest, Kerberos, X.509 Authentication service, Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol.

Unit IV: Network Layer Security

IP Security: IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, Oakkey determination Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction(SET)

Unit V: Firewall And Intrusion

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS:Need, Methods, Types of IDS, Password Management, Limitations and Challenges.

Unit VI: Introduction to OWASP

Introduction, Top 10 Vulnerabilities, understanding Top 10 Vulnerabilities

Text Books

1. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4.
2. Dr. V.K.Pachgare, "Cryptography and Network Security", PHI, 2nd Edition, 2015.

Reference Books

1. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN : 978-93-325-1877-3.
2. Forouzan, "Cryptography and Network Security (SIE)", Mc Graw Hill, ISBN, 007070208X, 9780070702080 .

Web Resource:

1.www.owasp.org

List of Assignments
Student are free to choose any programming language from C++,Java and Python
1.Implement Symmetric key algorithm DES
2.Implement Symmetric key algorithm AES
3.Implement ASymmetric key algorithm RSA
4.Implement Asymmetric key algorithm Diffie-Helman Key exchange
5.Study and implement SSL
6.Study and implement IDS
7.Study and implement any 3 Vulnerabilities of OWASP

Elective-III

Ubiquitous Computing (ITUA41174)

Teaching Scheme	**Examination Scheme**
Credits: 2 **Lectures: 2Hrs/week** **Practicals: 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 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, Modeling 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.

Textbooks :

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.

Reference Book :

Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtor, Thomas Schaeck, "Pervasive Computing," Pearson, Eighteenth Impression, 2014.

Ubiquitous Computing Lab

Prerequisites: Human Computer Interaction, Computer Network Technology.

Course Objectives :

- To design and implement user interfaces for performing database operations.
- To design applications for accessing smart devices and data generated through sensors and services.
- To implement authentication protocols for providing security.

Course Outcomes :

After studying this course, students will be able to:

1. Set up the Android environment and explain the Evolution of cellular networks.
2. Develop the User Interfaces using pre-built Android UI components.
3. Create applications for performing CURD SQLite database operations using Android.
4. Create the smart android applications using the data captured through sensors.
5. Implement the authentication protocols between two mobile devices for providing. Security.
6. Analyze the data collected through android sensors using any machine learning algorithm.

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 another computer 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

Intellectual Property Rights (CSUA40175)

Teaching Scheme	**Examination Scheme**
Credits: 2 **Lectures: 2Hrs/week**	**Formative Assessment: 50 Marks**

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, Mc Graw 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

Project Work (CSUA40176**)**

Teaching Scheme: **Practical :10Hrs/week** **Credit 5**	**Examination Scheme:** **Formative Assessment: 100 Marks** **Summative Assessment:50 Marks**

Course Objectives:

- To apply SDLC and meet the objectives of proposed development or research work
- To test rigorously before deployment of work in obj 1
- To validate the work undertaken during obj 1 and 2
- To consolidate the development or research work as project report.

Course Outcomes:

On completion of the course, student will be able to–
1. Produce evidence of independent investigation
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. Link techniques and results from literature as well as actual research and future research lines with the research.
5. Appreciate 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-II

Elective-IV(CSUA42171/ ITUA42171)

Software Defined Network (CSUA42171A)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures**: 3 Hrs/week **Practical :** 2 Hrs/week	**Formative Assessment:** 50Marks **Summative Assessment(ESE): 50 Marks** **Summative Assessment(PR/OR): 50 Marks**

Prerequisites: Computer Networks

Course Objectives

- To understand the challenges of the traditional networks and evolution of next generation networ
- To gain conceptual understanding of Software Defined Networking (SDN) and its role in Data Ce
- To understand role of Open Flow protocol and SDN Controllers.
- To study industrial deployment use-cases of SDN
- To Understand the Network Functions Virtualization
- To understand SDN.

Course Outcomes

After completion of the course, student will be able to

1. Interpret the need of Software Defined Networking solutions.
2. Analyze different methodologies for sustainable Software Defined Networking solutions.
3. Select best practices for design, deploy and troubleshoot of next generation networks.
4. Develop programmability of network elements.
5. Demonstrate virtualization and SDN Controllers using OpenFlow protocol
6. Demonstrate SDN Controllers using OpenFlow protocol

Unit I: Introduction to Software Defined Networking (SDN)

Challenges of traditional networks, Traditional Switch Architecture - Control, Data and management Plan Introduction to SDN, Need of SDN, History of SDN, Fundamental characteristics of SDN (Plane Separati 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, SD Devices and SDN Applications.

Unit II: Open Flow

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

Unit III: SDN Controllers

SDN OpenFlow Controllers: Open Source Controllers - NOX, POX, Beacon, Maestro, Floodlight, Ryu a Open Daylight, Applicability of OpenFlow protocol in SDN Controllers, Mininet, and implementing softw defined network (SDN) based firewall.

Unit IV: SDN in Data Centre

Data Center Definition, Data Center Demands (Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering and Path Efficiency), Tunneling Technologies for the Data Center, SD Use Cases in the Data Center, Comparison of Open SDN, Overlays, and APIs, Real-World Data Center Implementations.

Unit V: Network Functions Virtualization (NFV)

Definition of NFV, SDN Vs NFV, In-line network functions, Benefits of Network Functions Virtualizatio Challenges for Network Functions Virtualization, Leading NFV Vendors, Comparison of NFV and NV.

Unit VI: 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. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach",
2. Morgan Kaufmann, 2014, ISBN: 9780124166752, 9780124166844.
   Siamak Azodolmolky, "Software Defined Networking with Open Flow, Packt Publishing, 2013, 9781849698726
3. 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

Reference Books

1. Vivek Tiwari, "SDN and OpenFlow for Beginners", Digital Services, 2013,
   ISBN: 10: 1-940686-00-8, 13: 978-1-940686-00-4
2. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", CRC Press, 2
   ISBN: 10: 1466572094
3. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015

Elective –IV (CSUA42171/ ITUA42171)

Remote Process Automation (CSUA42171B)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3 Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment(ESE): 50 Marks** **Summative Assessment(PR/OR): 50 Mark**

Prerequisites: Software Engineering, Software Testing, java programming concept

Course Objectives

- To learn concepts of Robotic Process Automation.
- 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 busin
- To learn ADDING METABOT and folders to METABOT
- To implement RPA in Enterprise
-

Course Outcomes

After completion of the course, student will be able to

1. Gain insights into Robotic Process Automation Technology
2. Learn basic concepts of UI Automation using UiPath
3. Learn to use several types of data inside a workflow
4. Learn to organize a real-world workflow automation project
5. Develop skills in debugging a workflow
6. Understand reusing of automation by implementing templates
7.

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

Unit III: Types of BOTS

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

Unit IV: Integrate PDF

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

Unit V: ADDING METABOT and folders to METABOT

Recording Record set ,Various configurations in MetaBot Screens ,Calibrations in MetaBotScreens, addi
folders to METABOT: How to record in MetaBot, Logic Editor,.Import and export MetaBot

Unit VI: Implementing RPA in Enterprise : Case study

Building a business case, Determining which process to automate, Case study of invoice automation

Text Books/ Web Links

https://www.cb-india.com/books/artificial-intelligence-en/robotics/robotic-process-automation-and-risk-mitigation-the-definitive-guide/?currency=INR
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=06VJFMFHZNR8MWA2QE
https://www.simplilearn.com/introduction-to-robotic-process-automation-course#course-description
https://www.tutorialspoint.com/blue_prism/blue_prism_introduction_to_rpa.htm
https://www.multisoftvirtualacademy.com/robotics/robotics-process-automation-online-training
https://www.edureka.co/lms_courses/download_curriculum?filename=robotic-process-automation-traini 3.pdf
https://www.yet5.com/institutes/courses/244/1263/1/875/rpa-robotic-process-automation-training-at-pondicherry-city.html

Reference Books

Elective –IV (CSUA42171/ ITUA42171)

Virtual and Augmented Reality (CSUA42171C)

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment(ESE): 50 Marks** **ummative Assessment(PR/OR): 50 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. ● To learn **VR Development Tools** ● To know vAugmented Reality System Structure	
Course Outcomes 1. After completion of the course, student will be able to 2. To understand the basic concept and framework of virtual reality 3. To understand the technology for multimodal user interaction and perception in VR Decide and apply algorithmic strategies to solve a given problem 4. To apply VR Tools in real time environment. 5. To understand Augmented reality 6. To understand Augmented Reality System Structure	
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, Virtools etc

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

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:- 6-8 assignments will be based on above syllabus.

Elective-IV

Business Intelligence (ITUA42171D)

Teaching Scheme	**Examination Scheme**
Credits: 4	Formative Assessment: 50
Lectures / Week: 3Hrs/week	**Summative Assessment(ESE): 50 Marks**
Practical's / Week: 2 Hrs/week	**Summative Assessment(PR/OR): 50 Marks**

Prerequisites : Database Management System

Course Objectives :

- This course focuses on how to design and build a Business Intelligence solution.
- Students will also learn how to design and build a data warehouse within the context of student BI projects.
- Students can develop their own projects within collaborative teams or be assigned an existing data source to develop a project.
- To ensure success during the implementation phase, students will plan for and gather business requirements, as well as design the data warehouse in order to develop an effective BI plan.

Course Outcomes :

After studying this course, students will be able to:

1. Design and implement OLTP, OLAP and Warehouse concepts.
2. Design and develop Data Warehouse using Various Schemas & Dimensional modelling.
3. Use the ETL concepts, tools and techniques to perform Extraction, Transformation, and Loading of data.
4. Report the usable data by using various reporting concepts, techniques/tools, and use charts, tables for reporting in BI.
5. Use Analytics concepts like data mining, Exploratory and statistical techniques for predictive analysis in Business Intelligence.
6. Demonstrate application of concepts in BI.

Unit I – Important Concepts

Introduction to Data, Information, and Knowledge, Design and implementation aspect of OLTP, Introduction to Business Intelligence and Business Models, Design and implementation aspect of OLAP/Data Warehouse, BI Definitions & Concepts, Business Applications of BI, Role of DW in BI, BI system components, Components of Data Warehouse Architectures. Data mode: Physical data model,logical data model,difference between data warehouse and a database.

Unit II - Extraction, Transformation, and Loading

Data Quality, Data profiling, Data enrichment, data duplication, ETL Architecture and what is ETL, Extraction concept and Change data capture, Transformation concept, lookups, time lag, formats, consistency, Loading concept, Initial and Incremental loading, late arriving facts, What is Staging, Data marts, Cubes, Scheduling and dependency matrix. Difference between ETL(Data warehouse),ELT approach(Data Lake),performance tuning during data load,reconciliation process after data load.Surrogate keys importancwe in datawarehouse.

Unit III – Reporting

Metadata Layer, Presentation Layer, Data Layer, Use of different layers and overall Reporting architecture, Various report elements such as Charts, Tables, prompts Data aggregation: Table based, Materialized views, Query rewrite, OLAP, MOLAP, Dashboards, Ad-hoc reports, interactivity in analysis (drill down, drill up),

Security: report level, data level (row, column), Scheduling. Dashboard design using reporting tool. Automated report from Dashboard.

Unit IV - Analytics

Analytics concepts and use in Business Intelligence, Exploratory and statistical techniques:- Cluster analysis, Data visualization, Predictive analysis :- Regression, Time series, Data Mining :- Hierarchical clustering, Decision tree Text analytics :- Text mining, In-Memory Analytics and In-DB Analytics, Case study: Google Analytics. Difference between descriptive, prescriptive and predictive analytics, supervised and unsupervised learning.

Unit V – Recent Trends in BI

Big data like HIVE, PIG and DW appliances like Netezza, Teradata, Smart Change data capture using log based techniques, Real time BI, Operational BI, Embedded BI, Agile BI, BI on cloud, BI applications (Case study on BI tools like: QlikView, Pentaho, Tableau, MyReport, Spotfire, OR any other BI tool).

Unit VI - BI Deployment, Administration and Security

Centralized versus Decentralized Architecture, Phased and Incremental BI road map, Setting early expectations and measuring the results, EPM (Enterprise performance Management), End-User Provisos, OLAP Implementation, Implementation, Data Warehouse Architecture, Predictive Analysis, Text Mining , Authentication, Authorization, Access Permissions, Group and Roles, Single Sign-on (SSO), Data Backup and Restoring.

Text books :	1. Reema Thareja, "Data Warehouse", Publisher: Oxford University Press. 2. Jiawei Han, Micheline Kamber,Jian Pei "Data Mining: concepts and techniques", 2nd Edition, Publisher: Elsevier/Morgan Kaufmann. 3. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit", 3rd edition, Publisher: Wiley 4. Descriptive analytics (IBM ICE Publication)
Reference Books :	1. Rajiv Sabherwal and Irma Becerra-Fernandez, Business Intelligence, Wiley Publications (2010). 2.Swain Scheps, Business Intelligence For Dummies, Wiley Publications (2011) 3. Arshad Khan, Business Intelligence & Data Warehousing Simplified, Mercury learning & information LLC (2012). 4. William Inmon, "Building the Data Warehouse", Wiley publication 4th edition. 5. Efrem G. Mallach, "Decision Support And Data Warehouse Systems", 1st Edition Publisher: Tata McGraw-Hill Education,. ISBN-10: 0072899816. 6. Efraim Turban, Ramesh Sharda, Dursun Delen, David King, "Business Intelligence", ISBN-10: 013610066X Publisher: Prentice Hall.ISBN-13: 9780136100669 7. Dorian Pyle, "Business Modeling and Data Mining", Elsevier Publication MK.

Business Intelligence Laboratory

Prerequisites: Basic knowledge of RDBMS (relational database management system) concepts with hands-on exposure (includes design & implementation of table structures).

Guidelines for Laboratory Conduction:

With intent to get some exposure in the Business Intelligence space:

A project that allows the students to apply Technical, Behavioral, Process concepts learnt in the elective course by:

- Executing near real-life project (with large data)

<table>
<tr><td colspan="2">
- Working in teams (project teams will ideally comprise of 4 members)
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.

Operating System recommended: - 64-bit Open source Linux or its derivative
Programming Languages: JAVA/PYTHON/R
Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net,
Backend: MongoDB/MYSQL/Oracle,
Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.
</td></tr>
<tr><td>Project I</td><td>Data in disparate data sources such as Excel, text file, databases etc. will be provided to the students. They will be expected to extract, cleanse, integrate and load it.</td></tr>
<tr><td>Project II</td><td>Design reports according to given business scenarios. The data for the reports is to be pulled from the data-warehouse built in the earlier project.</td></tr>
<tr><td>BI Tools</td><td>It is not enough to collect all of the information. You will need to analyze it — and that is where data science and business intelligence tools come in. Open-source software is overtaking proprietary platforms, so here’s the compiled and comprehensive list of free and open-source BI tools.
Explore at least 3 tools to analyze the selected dataset from above mentioned sample datasets.
- BIRT
- ClicData
- The ELK Stack
- Helical Insight
- Jedox
- KNIME
- JasperReport Servers
- Pentaho
- MS Power BI
- RapidMiner
- ReportServer
- Seal Report
- SpagoBI / Knowage
- SQL Power Wabit
- Tableau Public
- Zoho Reports
- Metabase
- A Reporting Tool (ART)</td></tr>
<tr><td>Sample Dataset</td><td>https://archive.ics.uci.edu/ml/datasets/Iris

https://www.capitalbikeshare.com/trip-history-data

https://datahack.analyticsvidhya.com/contest/practice-problem-big-mart-sales-iii/

https://datahack.analyticsvidhya.com/contest/practice-problemtwitter-sentiment-analysis/

https://datahack.analyticsvidhya.com/contest/practice-problemtime-series-2/

https://github.com/mghatee/Overall-Driving-Behavior-Recognition-By-Smartphone

https://github.com/Eromera/uah_driveset_reader

https://data.gov.in/</td></tr>
</table>

Open Elective –I

Introduction to Gaming (IOEUA42172A**)**

Teaching Scheme	**Examination Scheme**
Credits: 4 **Lectures: 3Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Course Objectives

- To learn about the video game art principles, Video Game production, Design Process and the Industry
- To understand and distinguish Video game elements, genres, types ad hardware
- To Study various video game production practices, terminology, Industry roles and responsibilities
- To know the application and use of a game engine across various verticals and develop and learn how to work with the game engine as a tool for production
- To examine and game engine interface, coding, game objects, asset Store, services, etc

Course Outcomes:

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

1. Use terminology related to Games and Interactive Media Industry
2. Relate to Industry demands and structure project as per required specifications
3. Define Specifications for the execution of the project
4. Demonstrate game engine tools usage across art, animation, asset management, Interface, Audio, Lighting, Materials, Physics and Programming systems.
5. List and select gaming services related to project structure
6. Develop basic interactive games

Topics to be covered :

Unit I : Introduction to Games Industry	

Video game production techniques, hardware, production roles and responsibilities, Video game design elements, game genres, game types, examples of gaming platforms, gaming services, video game controls, video game industry terms, model asset optimization, asset store, video game art principles, video game industry practices, video game industry terminology

Unit II : Game Engine Fundamentals	

Gaming engine user interface, hierarchy, editor, game Window, navigation, inspector, scene, project, game object, prefab, models, tags, sounds, assets, project management, materials, textures, effects, lights, modelling practices and optimization practices, Import system, managing materials, managing textures

Unit III: World Building and Animation	

Environment, Static Meshes, Rigid Body, Colliders, Preparing for lighting, Light tools, light types, User Interface, Art principles, Sprite editor, Lighting process, Baking process, Animated objects, Importing animation, Setting up animation states, Animation controllers, Transition, Animation refinement.

Unit IV: Scripting a Game Development

Script types, Variables, Methods, C# fundamentals, Game mechanics, Ray casting, Program Debugging, Various Error states, Navigation, Nav Mesh, Building NPC, Simple AI, Enemy System, Particle system, Adding Game audio, Audio types, Audio formats, Audio clips and properties, Camera System, Building camera system, Player Behaviors, User Interface system, User Interface Implementation, Properties of UI, Build tools, Cloud Services, Console, Build Settings, Platforms, Publishing tools, Mobile Publishing

Text books :

1. Tom Meigs, Ultimate Game Design: Building Game Worlds 1st Edition, McGraw-Hill Education, 2003
2. Sam R. Kennedy, How to Become a Video Game Artist: The Insider's Guide to Landing a Job in the Gaming World, Watson-Guptill, 2013

Reference Books :

1. Penny de Byl, Holistic Game Development with Unity: An All-in-One Guide to Implementing Game Mechanics, Art, Design and Programming, 2nd Edition, A K Peters/CRC Press, 2017
2. Mike Geig, Unity 2018 Game Development in 24 Hours, Sams Teach Yourself, 3rd Edition, Sams Publishing, 2018

List of Assignments

Develop a game "Roller Madness" in Unity environment as following assignments
1. Implement the Setting Up the Scene, Camera Setup
2. Implement the Physics system
3. Configure the Player Control and Appearance
4. Health and Damage, Pickups,
5. UI Basics and Game Manager,
6. Create the Enemies
7. Implement the Particle System
8. Implement Animations to the game avatar
9. Spawners to create multiple objects of same type

Note : Do any 6 assignments based on syllabus

Open Elective – I

Inferential Statistics for Data Science (IOEUA42172B)

Teaching Scheme	Examination Scheme
Credits: 3 **Lectures: 2Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisite: Readers/students are expected to know the following concepts:
Basics of Probability

Course Objectives

- To equip students with the basic understanding of the fundamental concept of data and the nature of data sets
- To understand the fundamentals of probability distributions and their application for data analysis
- To derive the conclusions from the data sets with Bayesian and Inferential statistics

Course Outcomes:

On completion of the course, students will be able to

1. Comprehend and correlate the nature and central tendency of given data sets using appropriate probability distribution for the given data set.
2. Implement the fundamentals of Bayesian statistics to find out probability of unknown parameters of statistical model
3. Analyze and conclude the hypothesis using inferential statistical tests
4. Evaluate the prominent characteristics of data sets with exploratory data analysis methods

Topics to be covered :

Unit- I : Understanding Data and probability distributions

Understanding Data, Frequency Tables, Distributional Shapes, Central Tendency
Describing Spread: Range, Interquartile Ranges and Standard Deviation , Measuring Data ,Measurements of Central Tendency, Measurements of Dispersion, Bi-variate Data and Covariance ,Pearson Correlation Coefficient, Uniform Distribution, Binomial Distribution, Poisson Distribution, Normal Distribution, Normal Distribution - Formulas and Z Scores

Unit-II : Bayesian Statistics

Likelihood function and maximum likelihood, The minimaxity, Computing the MLE, Computing the MLE: examples ,Continuous version of Bayes' theorem, Priors and prior predictive distributions
Prior predictive: binomial example, Posterior predictive distribution, Bernoulli/binomial likelihood with uniform prior, Conjugate priors

Unit III: Inferential analysis

Univar ate data: measures of center and spread, transformations, visualization. – Bivariate data: Simple regression, curve fitting, – Trivariate/Hypervariate data: Multiple regression, model selection, principal components. – Binary responses: Logistic regression, residuals. – Categorical data: Contingency tables, correspondence analysis. – Distance data: Multi-dimensional scaling, non-linear dimensionality reduction. – Graph data: Descriptive statistics, spectral methods, visualization.

Text books :

1. **Sahu,** Pradip Kumar, **Pal**, Santi Ranjan, **Das**, Ajit Kumar, "Estimation and Inferential Statistics", Springer
2. S.C. Gupta and V. K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, , New Delhi.
3. Manoj Kumar Srivastava, Abdul Hamid Khan, Namrata Srivastava, "Statistical Inference, Theory of estimation", PHI

Reference Books :

1. George Casella, Roger Berger," Statistical Inference ",CENGAGE Learning, Second Edition
2. Malcom O, Asadoorian, Demetri Kantarelis, "Essentials of Inferential Statistics", University Press of America

List of Assignments

Perform experiments using Python/R

1. Study of Hypothesis testing (One sample t test, z test)
2. Analysis of variance (ANOVA)
3. To study Linear regression to predict the outcome of a variable
4. Study of outlier in Predictive analysis
5. Finding the most important predictor variable in a dataset for feature Selection
6. Model selection and analysis for a real world dataset
7. Study of Logistic Regression
8. To build an application: Time series forecasting

Open Elective-I

Solar and Wind Energy (IOEUA42172C)

Teaching Scheme	Examination Scheme
Credits: 3 **Lectures: 2Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisite: Readers/students are expected to know the following concepts:
Basic Mechanical Engineering,
Basic Electrical and Electronics Engineering

Course Objectives

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

Course Outcomes:

On completion of the course, students will be able to

1. Understand solar radiation and geometry principles.
2. Apply aspects of solar thermal system and its practical applications.
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 existing system.

Topics to be covered :

Unit I: Solar Energy Principles

Present solar energy scenario, world energy futures, 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 Thermal Systems and Applications

Types of Solar thermal collector, flat plate collector analysis, Evacuated tube collectors (ETC) analysis, its design and application, solar air heaters and its types, solar distillation.
Solar Concentrating collectors: types- line and point concentrator, theory of Concentrating collectors, parabolic trough collector, parabolic dish collector, solar tower, concentrated Fresnel linear receiver (CFLR).

Unit III: Solar Photovoltaic and Applications

Forming the PN junction solar cells & its applications, Structure of a solar cell, types of modules, PV array, solar cell equation, Fill factor and maximum power, Grid aspects of solar power, equipment used in solar photovoltaic plants, Power Conditioning Equipment-inverters, Regulators, Other Devices; System Analysis-Design Procedure, Design Constraints, Other Considerations.

Unit IV: Wind Energy

Principle of wind energy conversion; Basic components of wind energy conversion systems; various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations, wind energy potential and installation in India.

Text books :

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

Reference Books :

1. Mukund R. Patel, 'Wind And Solar Power Systems: Design, Analysis and Operation, Second Edition', CRC Press
2. Kreith And Kreider, Solar Energy Handbook, McGraw Hill
3. Ray Hunter, 'Wind Energy Conversion: From Theory to Practice', John Wiley and Son Ltd
4. Gary L Johnson, 'Wind Energy Systems', Prentice-Hall Inc., New Jersey
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. Robert Gasch, 'Wind Power Plant Fundamentals, Design, Construction and Operations', Springer
8. C S Solanki, 'Solar Photovoltaic: Fundamentals, Technology and Applications', PHI Learning

List of Assignments :

1. Design of solar food drier for domestic purpose referring existing system.
2. Design of parabolic dish solar cooker for domestic purpose.
3. Design and analysis of liquid flat plate type heater used in domestic purpose
4. Design of solar photovoltaic system for domestic/ commercial building purpose.
5. Case study on designing miniature wind mill for domestic purpose referring existing system.
6. Visit to solar PV system used in commercial building.
7. Visit to wind power system used in commercial building.

Open Elective – I

Numerical Methods in Engineering (IOEUA42172D)

Teaching Scheme	Examination Scheme
Credits: 3 **Lectures: 2Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisite: Readers/students are expected to know the following concepts:
Engineering Mathematics

Course Objectives

- To prepare the students to apply numerical methods to solve differential equations, integrations and simultaneous equations and perform regression analysis.

Course Outcomes:

On completion of the course, students will be able to

1. Apply curve fitting techniques, carry out regression and interpolation analysis of any engineering problem.
2. Solve simultaneous equations using numerical technique.
3. Perform numerical integration for any engineering problem.
4. Solve differential equation of any engineering problem using numerical technique.

Topics to be covered :

Unit I: Curve Fitting, Regression and Interpolation

Curve fitting with Linear Equation, Criteria for a Best Fit, Linear Least Square Regression, Linear Regression Analysis, Coefficient of Determination, Polynomial Regression, Multiple Linear Regression, Lagrange's Interpolation, Newton's Forward Interpolation, Hermit Interpolation, Inverse Interpolation

Unit II: Simultaneous Equations

Gauss Elimination Method, Partial Pivoting, Gauss Seidel Method, Gauss Jordan Method and Thomas Algorithms for Tridiagonal Matrix.

Unit III: Numerical Integration

Trapezoidal rule, Simpson's Rule ($1/3^{rd}$ and $3/8^{th}$), Gauss Quadrature2 point and 3 point method, Double Integration- Trapezoidal Rule, Simpson's $1/3^{rd}$ Rule

Unit IV: Numerical Solution of Differential Equations

Euler Method, Modified Euler Method (Iterative), Runga-Kutta Fourth Order Method, Simultaneous Equations using Runga-Kutta Second Order Method, Introduction to Finite Difference Method.

Text books :

1. Numerical methods- Rao V. Dukkipati- New Age International Publishers
2. Introductory Methods of Numerical Analysis- S.S.Sastry-University Press

Reference Books :

1. Numerical Methods in Engineering with Python 3 – Jaan Kiusalaas-Cambridge University Press
2. Numerical Methods -S. Balachandra Rao and C.K.Shantha, University Press

List of Exercises

At least three assignments on each unit.

Open Elective – I
Social Media Analytics (IOEUA42172E)

Teaching Scheme	Examination Scheme
Credits: 3 **Lectures: 2Hrs/week** **Practical : 2 Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisite: Readers/students are expected to know the following concepts:
1.Basic knowledge of Graphs.
2. Data mining.
3. Data Analysis.

Course Objectives :

- To understand foundations of Social Media Analytics.
- To Visualize and understand the data mining aspects in social networks.
- To solve mining problems by different algorithms.
- To understand network measures for social data.
- To understand behavioral part of web applications for Analysis.
- To analyze the data available on any social media applications.

Course Outcomes:

On completion of the course, students will be able to

1. Understand the basics of Social Media Analytics.
2. Understand the visualization of social networks and the significance of Data mining in Social media.
3. Demonstrate the algorithms used for text mining.
4. Compare and Apply network measures for social media data.
5. Explain Behavior Analytics techniques used for social media data.
6. Apply social media analytics for Facebook, LinkedIn and Twitter kind of applications.

Topics to be covered :

Unit I: Introduction to Social Media Analytics (Sma) and Types of Analytics Tools

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas, The foundation for analytics, Social media data sources, Defining social media data, data sources in social media channels, Estimated Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics

Unit II: **The Social Networks Perspective and its Visualization**

The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. A Taxonomy of Visualization, The convergence of Visualization, Interaction and Analytics. Data mining in Social Media: Introduction, Motivations for Data mining in Social Media, Data mining methods for Social Media.

Unit III: Text Mining in Social Networks

Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining.

Unit IV: Network Measures

Centrality: Degree Centrality , Eigenvector Centrality, Katz Centrality , PageRank, Betweenness Centrality, Closeness Centrality ,Group Centrality ,Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence

Unit V: Behavior Analytics

Individual Behavior: Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior Prediction Collective Behavior: Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction

Unit VI: Case Study

Mining Twitter: Overview, Exploring Twitter's API, Analyzing 140 Characters
Mining Facebook: Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections.
Mining Linked In: Overview, Exploring Linked In API

Text books:

1. Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, ISBN: 10: 1107018854.
2. Charu C. Aggarwal, Social Network Data Analytics, Springer, ISBN: 978-1-4419-8461-6.
3. Matthew Ganis, Avinash Kohirkar Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media,Pearson publications,2016

Reference Books :

1. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, McGraw Hill Education, 978-0-07-176829-0. 2.
2. Matthew A. Russell, Mining the Social Web, O'Reilly, 2nd Edition, ISBN:10: 1449367615.Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2nd Edition, ISBN: 13: 978-1-55860-901-3 ISBN: 10: 1-55860-901-6.
3. Bing Liu, Web Data Mining : Exploring Hyperlinks, Contents and Usage Data, Springer, 2nd Edition, ISBN: 978-3-642-19459-7

Open Elective – II (IOEUA42173)

FinTech (Financial Technology) (IOEUA42173A)

Teaching Scheme	**Examination Scheme**
Credits: 3 **Lectures: 3Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisites: N/A

Course Objectives

- To Introduce FinTech and it's sub sectors
- To Explain the classification of various models of FinTech.
- To Describe the innovation in FinTech
- To Introduce an innovative Fin Tech strategy
- To Study the development of FinTech Application and about future trends in Fin Tech

Course Outcomes

After completion of the course, student will be able to

1. Understand what FinTech is and the sub sectors that comprise it.

2. Classify various models of the Fintech

3. Illustrate various innovations done using latest technology trends in FinTech

4. State the Critical Success Factors in Fin Tech

5. Be able to adopt an innovative Fin Tech strategy within their own organization to lead a digital transformation project.

6. Develop the application using the concepts of FinTech as a case study

Unit I: Introduction to Fintech

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

Unit II: Model and Classifications

Introduction, Classification, Five Ws and one H : 1. Why a fintech initiative was born? 2. For whom was it born? 3. Which are the services it aims to provide? 4. Where does it aim to perform its business? 5. When does it aim to operate, within the framework of the financial cycle? 6. How is fintech working? The organization and its elements, The V4 business model framework, A Business Model, A Business Model for Fintech, Revenue—Focus on Customer Lifetime Value, Components of an effective marketing plan.

Unit-III: Fintech Innovation Introduction,

Innovation and Fintech, Digital Transformation and Fintech, A model for an integrated innovation strategy, Types of Innovation : Product (or services), Process, Organization, Business models, Examples

of Innovation, Fintech business model canvas, Process Innovation : Big Data Analytics, Value Creation from Big Data Analytics, Kreditech's self-learning algorithm, Internet of Things, Blockchain Technology, Organizational Innovation: Social Networks, Business Model Innovation, Robots, The V4 business model framework for Kreditech, Virtual Currencies, Technology Acceptance Model

Unit-IV: Critical Success Factors

The Model, Low-Profit Margin, Agility, Scalability, Security Management, Innovation, Ease of Compliance, Metrics, Fintech and Financial Services, Structure of fintech initiatives, The Challenges, Aspects to Consider, A Cooperation Model, Open Innovation

Unit-V: Regulations

The Role of the Regulators, Equal Treatment and Competition, The Risks to Consider, Regtech, A Business Model for Insurtech Initiatives, Drivers of Disruption, The Impact of Technology, Insurance and Technology: Insurtech, Application of the Model to the Insurance Industry, The Empowerment of Customers, Mobility in Support of Insurance Companies, Digital Wholesale Insurance,

Unit VI: A Case Study

Introduction, Robotica, Business Model Canvas, The Value Proposition, Customer Experience, Channels, Processes and Activities, Resources and Systems, Partnership and Collaborations, Revenues, Costs and Investments, The Future: Financial Services as Platforms

Text Books :

1. B. Nicoletti, The Future of FinTech, 1st ed. Palgrave Macmillan, 2017
2. Kelvin Leong and Anna Sung "FinTech (Financial Technology): What is It and How to Use Technologies to Create Business Value in Fintech Way?" International Journal of Innovation, Management and Technology, Vol. 9, No.

Reference Books:

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

Open Elective – II
Agriculture Electronics (IOEUA42173B)

Teaching Scheme	**Examination Scheme**
Credits: 3 **Lectures: 2Hrs/week** **Practical: 2Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisite: Readers/students are expected to know the following concepts:
Basic Electronics devices and their operations
Basic understanding of sensors and transducers.
Basic Farming Activities.

Course Objectives:

- To empower the learner to recognize environmental problems and to provide solutions to agricultural sector.
- An over view of technology of advanced topics like DAS, SCADA and IOT .
  The ability to select the essential elements and practices needed to develop and implement the Engineering Automation for Agricultural sector.

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

1. Understand Role of Instrumentation & DAS.
2. Understand basics of Sensors and transducers.
3. Describe Instrument technology used in agriculture.
4. Apply knowledge of Electronics to achieve Precision Farming.
5. design select and justify system components for different control Farming applications
6. Understand Smart Agriculture Technology & Role of Electronics Governance

Unit I : Introduction of Instrumentation system and Data acquisitions systems (DAS)

Introduction of Instrumentation system, Block diagram,
Data loggers, Data acquisitions systems (DAS), Basics of PLC , Supervisory control and data acquisition (SCADA),

Unit II : Sensors and Transducers

Basic of sensors and transducers, Type of sensors, Performance terminology - Displacement, Velocity and Motion sensors - Proximity sensors, Force, Pressure.
Soil parameter measurement sensors - Flow, Level and Temperature sensors, Humidity, pH and Conductivity sensors, Specifications and selection criteria.

Unit III : Instrument technology for agriculture

Instruments for measurement of pH, Electrical conductivity, gas analysis, humidity, leaf area, chlorophyll content, and soil moisture & temperature.
Instrument for crop monitoring – moisture measurement – capacitive, infrared reflectance and resistance. Monitoring soil and weather – measurement of soil properties and meteorological parameters

Unit IV: Precision Farming

An introduction to precision farming. GIS/GPS positioning system for precision farming, Yield monitoring and mapping, soil sampling and analysis. Computers and Geographic information systems. Precision farming- Issues and conditions. Role of electronics in farm machinery for precision farming. Technology for precision farming.

Unit V: Control Applications in Farming :

Irrigation control systems. Instruments for crop establishment monitoring. Crop spraying – selective crop spraying – flow control. Yield monitoring.
Instruments for protected cultivation – Green house environment control – transducers and control system. Instruments and systems for crop handling processing and storage.

Unit VI: SMART agriculture :

Introduction to IOT, IOT in Agriculture, Wireless sensor networks, IOT network using LoRaWAN. Open Agriculture Initiative (OpenAg),
Agriculture & Electronics Governance: Technological Difficulties in Indian Context, Governance products & services in agriculture sector, Role of Electronics Governance in Agricultural sector.

Text Books :

1. K. Krishna Swamy**,** "Process Control"; New Age International Publishers.
2. C.S. Rangan, G.R. Sarma, V.S.V. Mani; "Instrumentation Devices and Systems "; Tata McGraw Hill; 2nd Edition
3. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education

Reference Books :

1. Shimon Y. Nof , "Springer Handbook of Automations", Springer.
2. Ernest O. Doebelin; " Measurement System Application and Design "; Mc-Graw Hill; 5th Edition
3. David G. Alciatore, Michael B Histand; "Introduction to Mechatronics and Measurement System"; Tata McGraw Hill

4. De Mess M. N. Fundamental of Geographic Information System. John Willy & sons, New York, Datta S.K.1987

Open Elective-II

Operations Research (IOEUA42173C)

Teaching Scheme	**Examination Scheme**
Credits: 3 **Lectures: 3Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisite: Readers/students are expected to know the following concepts:
Engineering Mathematics

Course objectives:
To familiarize the students with various tools of optimization, probability and statistics as applicable scenarios in industry for better management of various resources

Course Outcomes: On completion of the course, students will be able to
1. Solve linear programming problems using appropriate techniques
2. Propose the best strategy using decision making methods under uncertainty and game theory
3. Apply the concept of transportation/assignment models to optimize available resources
4. Develop mathematical skill to solve inventory and replacement problems
5. Perform minimization of process time

Use CPM and PERT techniques, to plan, schedule, and control project activities.

Unit I - Introduction to Operations Research

Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research.
Linear Programming Problem: Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, Two-phase method, Duality

Unit II – Decision Theory and Theory of Games

Decision Theory: Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, Decision under Risk, Decision under Uncertainty, Decision Trees
Theory of Games: Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, Solution by Graphical Method, m x n size Game Problem

Unit III – Transportation and Assignment Model

Transportation Model: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.
Assignment model: Formulation. Hungarian method for optimal solution. Solving unbalanced problem

Unit IV – Inventory Control and Replacement Analysis

Inventory Control: Basic Concepts, fixed order quantity inventory model, economic order quantity inventory models, probabilistic inventory model

Replacement Analysis: Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly: Individual replacement policy, Group replacement policy.

Unit V – Queuing Theory and Sequencing Model

Queuing Theory: Introduction, Basis Structure, Terminology (Kendal's Notations), Queuing Model M/M/1: /FIFO, M/M/c.
Sequencing models: Solution of sequencing Problem - Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing of n jobs through m Machines.

Unit VI – Project Management

Fundamentals of CPM and PERT networks, CPM: Construction of networks, Fulkerson's rule , Critical paths, Forward and backward pass, Activity Float analysis, Crashing Analysis, PERT: Time estimates, Construction of networks, Probability of completing projects by given date.

Text Books:

1. Sharma S.D., "Operations Research", Kedarnath Ramnath and company publications. ISBN-13:1234567142552
2. Gupta P.K., Hira D.S., "Operations Research", S Chand and Co. Ltd., New Delhi. ISBN 13:9788121902816
3. Taha H.A., "Operations Research - An introduction", Prentice Hall Pvt. Ltd. ISBN-13: 978-0132555937
4.

Reference Books:

1. Hillier F.S., Lieberman G.J., "Introduction to Operations Research", Tata McGraw-Hill. ISBN 978-0-07-337629-5
2. Wagner H.M., "Principles of Operations Research", Prentice-Hall India ISBN 978-0-9843378-2-8
3. Ravindran A., "Operations Research", Tata McGraw-Hill. New Delhi ISBN-13: 978-0471086086
4. Basu S.K., Pal D.K., and Bagchi H., "Operations Research for Engineers", Oxford and IBH Publishing ISBN 81-204-1251-6
   Panneerselvam R., "Operations Research", Prentice Hall of India Ltd., New Delhi ISBN 81-203-1923-0

Open Elective – II

Total Quality Management (IOEUA42173D)

Teaching Scheme	**Examination Scheme**
Credits: 3 **Lectures: 3Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Course Objectives:

To introduce the basic concepts of Quality management System and Management Information System

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

1. Comprehend the aspects of Quality in Construction activity
2. Explain the application of Six Sigma and Seven Quality tools in the Total Quality Management
3. Explain the role of Quality Manual to monitor Total Quality Management System
4. Comprehend the aspects of benchmarking and certifications
5. Explain the techniques of TQM implementation and awards
6. Comprehend the aspects of Management Information System

Unit I: Quality in Construction

Quality – Various definitions and interpretation. Importance of quality on a project in the context of global challenges, Factors affecting quality of construction, Reasons for poor quality and measures to overcome, Contribution of various Quality Gurus (Juran, Deming, Crossby, Ishikawa), Evolution of TQM- QC, TQC, QA, QMS, TQM.

Unit II: TQM & Six Sigma

TQM – Necessity, advantages, 7QC tools, Quality Function Deployment(QFD), Six sigma – Importance, levels, Defects & it's classification in construction. Measures to prevent and rectify defects.

Unit III: ISO & Quality Manual

Study of ISO 9001 principles. Quality manual – Importance, contents, documentation. Importance of check-lists in achieving quality. Typical checklist for concreting activity, formwork activity, steel reinforcement activity. Corrective and Preventive actions, Conformity and NC reports

Unit IV: Management Control & Certifications

Benchmarking in TQM, Kaizen in TQM. Quality Circle. Categories of cost of Quality. CONQAS, CIDC-CQRA certifications.

Unit V: Techniques in TQM Implementation and awards

5 ‗S' techniques. Kaizen. Failure Mode Effect Analysis (FMEA). Zero Defects. National & International quality awards- Rajeev Gandhi Award, Jamuna lal Bajaj Award, Golden Peacock Award, Deming Prize, Malcolm Baldrize award.

Unit VI: Management Information System

Introduction to Management Information systems (MIS) Overview, Definition.

MIS and decision support systems, Information resources, Management subsystems of MIS, MIS based on management activity whether for operational control, management control, strategic control. Study of an MIS for a construction organization associated with building works.

Text books:

1. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra.
2. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ. Company.
3. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar—Biztantra.
4. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Reference books:

1. Juran's Quality Handbook – Juran Publication. Importance of quality on a project in the context of global challenges. Importance of quality on a project in the context of global challenges.
2. Management –Principal, process and practices by Bhat – Oxford University Press.
3. Financial management by Shrivastava- Oxford University Press.
4. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co.
5. Total Project Management – The Indian Context - P.K.Joy Macmillan India Ltd.

E- Sources:

www.nptel.ac.in , www.mobile.enterpriseappstoday.com

Open Elective-II

Blockchain Technologies (IOEUA42173E)

Teaching Scheme	**Examination Scheme**
Credits: 3 **Lectures: 3Hrs/week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Prerequisite: Nil

Course objectives:

- To understand the basic fundamentals of Blockchain.
- To introduce Bitcoin Blockchain.
- To explain blockchain creation process
- To know the importance of Hyperledger
- To gain knowledge about the multichaining
  To discuss the emerging trends in Blockchain and Use cases

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

1. Get fundamental knowledge of Blockchain
2. Know about Bitcoin Blockchain
3. Understand blockchain creation process
4. Explore Hyperledger
5. Know Emerging Trends in Blockchain

Unit I - Overview of Blockchain

Basics of Blockchain, History of Blockchain, Network and protocols, Smart Contract and Consensus Algorithms, Blockchain users and adoption, Blockchain challenges

Unit II – Bitcoin Blockchain

Blockchain TOC Bitcoin/ Blockchain data structures, Keys as identity, Digital Signatures, Hashes, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain transactions, Blockchain block structure.

Unit III – Creating the Blockchain: Mining

Mining explained, The bitcoin network, The bitcoin Minning Process, Minning Developments

Unit IV – Hyperledger

Overview of Hyperledger, Hyperledger Projects, Hyperledger Architecture, Consensus model for permissioned Blockchains, Consensus and its interaction with architectural layers, Architecture of Enterprise level Blockchain applications.

Unit V – Blockchain on Multichain

Introduction to Multichain, Privacy and Permissions in Multichain, Features of Assets in Multichain, Multichain Streams, Mining in Multichain, Interactive mode commands, Round Robin Mining
Unit VI – Emerging Trends in Blockchain and Use cases
Transaction limitations, Additional blockchains, Hyperledger, Ethereum, Ripple, R3, Blockchain and cloud computing, Cloud -Based Blockchains, Blockchain Use cases, Blockchain and Artificial Intelligence
Text Books:
1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos 2. Blockchain by Melanie Swa, O'Reilly 3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
Reference Books: Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

CSUA42174 Introduction to Research

Teaching Scheme	Examination Scheme
Credits: 2 **Lectures: 1 Hr/Week** **Practical: 2 Hrs/Week**	**Formative Assessment: 50 Marks** **Summative Assessment: 50 Marks**

Course Objectives:

- To study fundamental concepts of Research
- To study Technical Writing

Course Outcomes :

After completion of the course, student will be able to

1. Explain the basics of research methodology
2. Write and publish research article

Unit I : Introduction to Research

Overview of Research, Meaning of Research, Objectives, Types, Research Approaches, Significance, Research Methods vs Methodology, Research and Scientific Methods, Research Process. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Techniques involved in defining a problem
Data Collection, Preparation and analysis

Unit II: Technical Writing and Research Ethics

Technical Presentation and Technical Writing, Why Technical Writing, Layout of Technical Report/Article, Abstract, Introduction, Literature Survey-Overview of Literature Survey-Searching literature, Sources of Literature, Literature Survey and Reviewing Literature, Organizing Literature, Some Terminology-ISBN, ISSN, DOI, Bib TeX, Strategies to Search-Keyword search, Backward and Forward Chronological Search, Adding References to document, New Findings, Experimental Details, Results and Discussion. Plagiarism tools, Publication process of Technical articles

Text Books :

1. S. Kothari C.R., Research Methodology (2nd Ed.), New Age International, (2004); ISBN(13): 978-81-224-1522-3 2.
2. https://drive.google.com/file/d/1DVenZVYnCjLx1p0T5ZF-XC8pY_8FRADL/view

Reference Books :

1. Berkman, Elliot T., A Conceptual Guide to Statistics Using SPSS, Sage Publications, 2011; ISBN: 978-1-4129-7406-6

2.	Kumar, Ranjit, Research Methodology (3rd Ed); Sage Publications, 2011; IBSN: 978-1- 8492-0301-2 3.

List of Assignments
1. Assignment based on Data Collection and Data Preparation Process
2. Assignment based on statistical tools
3. Adding References in research paper using BibTex Referencing in Latex or Using Bibliography citations in Microsoft word
4. Project: Write and Publish a Research Article

Annexure A

Process Manual for Internship Activity

Vishwakarma Institute of Information Technology, Pune (w. e. f 01 /06/2020)

Table of Content

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales.

1. Objectives

- To give the exposure to the industrial environment
- To Provide 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 relevant to the subject area of training
- 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 Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control
- 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

2. Types of Internship

- Industry internship (Semester long)
- Research Organisation (IIT/NIT/research labs)
- Public undertakings organisation
- Government Organisation
- Social Internships
- VIIT Research Internship

3. Process

This process is conducted by students in consultation with their Faculty Mentor, who serves as the instructor of record for internships. Students must complete the following steps to set up, conduct and receive a grade for an Industrial Internship:

- **Allocation of Faculty Mentor** to the students for internship mentoring and evaluation
- **Identify an employment opportunity** of sufficient duration and at an appropriate level according to the Internship Descriptions. Discuss the requirements with the company mentor and provide them with a copy of this document.
- **Determine the Nature of Work to be done**, i.e. understand the job description and find out what types of tasks will be assigned, and the job

Schedule. As much

information as possible should be obtained, although not all tasks will be known ahead of time. This information will be included in the Internship Proposal.

- **Convert the general job description** and specific tasks into a list of Learning Objectives to be included in the proposal.
- **Write the Internship Proposal** using the information above and submit to the Faculty Mentor for review, refer **Annexure I**. Proposals generally require editing by the student prior to approval.
- Once approved, the student provides two copies of the proposal to the Faculty Mentor, both signed by the student and the Company Mentor. Both copies will be signed by the Faculty Mentor; one will be returned to the student for inclusion in the Internship Report; the second will be retained by the respective department.
- Along with this proposal, students will submit application and consent form (refer **Annexure II**) to the company with signature of faculty mentor. If both, student and company mentor agrees on this, department will issue deputation letter (refer **Annexure III**) to the student. (This is applicable to those internships who referred by student itself)
- Students should submit training report after completion of internship.
- Internship completion certificate to be obtained from industry after successfully completion of the internship.
- Feedback from student & industry will be taken for process improvement
- List of students who have completed their internship successfully will be issued by Internship /T & P Coordinator.

4. Students Responsibilities

- To identify and arrange an internship with a suitable external organization/company. The college Industry Institute Interaction Cell & Training & Placement Cell will make every effort to assist the student, but makes no guarantee that such a position will be found.
- To develop an acceptable Internship Proposal in conjunction with the faculty mentor and the external mentor.
- To bear the expense of traveling, subsisting, commuting and obtaining suitable business attire for the internship.
- To work diligently, punctually and creatively to provide the external organization/company with valuable, professional work product.
- To behave in an appropriate and professional manner, and to observe the organization's/company's policies for employee behavior during activities undertaken on their behalf.
- To observe the organization's/company's lawful requirements with respect to the protection of intellectual and physical property.
- To diligently prepare an internship report that fully and accurately represents the internship experience, including the fulfillment of the

learning objectives stated in the proposal.

5. Mentor (Faculty) Responsibility

- To discuss the goals of the internship with the student and the mentors of organization/company.
- To assure that the Internship Proposal is correctly and completely prepared, signed by all parties and a copy filed with the respective department.
- To assess the student internships.
- To receive and review the Internship Report and the evaluation done by organization/company and to record a grade for the course.

6. Mentor (Industry) Responsibility

- To fully and fairly represent the organization's/company's goals and objectives for the work to be performed by the intern.
- To fully explain organization/company policies to the intern.
- To provide full details of the financial arrangement to the intern.
- To arrange for the intern to be assigned meaningful work, within their capabilities and to give the intern reasonable opportunities to observe and participate in activities as learning experience.
- To arrange for the student to be fully and fairly evaluated concerning his/her engineering knowledge, skill and application in doing engineering work and level of professionalism and diligence in carrying out assigned work.

7. Internship Coordinator Responsibility

- To circulate internship notices to students.
- To take registrations for internships from students.
- To take applications forms, undertakings from students and depute the students for the internships.
- To conduct selection process for internships as per industry criteria
- To assign faculty to students as mentor to monitor internships activity
- To prepare review plan for the monitoring of progress of the student
- To collect evaluation sheets of internship activity from faculties and send it to examination cell.
- To maintain necessary evidences and documents for audit purpose
- To authenticate internships referred by the students.

8. General Guidelines

- **Duration: A** semester long internship needs to have duration of minimum 4.5 month till 6 months. It is also possible that a company may offer summer internship (2 months) initially and it may get converted for semester long internship. (Starting from 1st June/1st January of every year)
- **Single offer per student as per CTOP Policy**

- **Internships converted to Placement offer as per CTOP Policy**
- **Placement for students undergoing internship as per CTOP Policy**
- **Internship for students already placed as per CTOP Policy**
- **Criteria for internship completely based on companies requirements**
- **Dress code during interviews:** All students should be present in Formals.
- **Disciplinary Actions as per CTOP Policy**

5 Evaluation Process

Evolution of internship process is very important in the view of identifying the skills of the students during internship. It mainly comprises of two components of evaluation, first evaluation by industry and second evaluation by faculty.

5.1 Guidelines for Evaluation

The distribution of marks for finalizing the grades for semester-long internship is based on following parameters and department has freedom for it.

S. N.	Subject	Remarks
1	By Faculty Mentor	Interaction/presentation of student during project semester **(As per Annexure – IV)**
2	By Industry Mentor	Performa to be filled jointly by Industry Mentor and faculty mentor **(As per Annexure – V)**
3	With Department 1. Report (**As per Annexure VIII)** 2. Presentation 3. Viva Voce	The final Presentations/ evaluations will be made before faculty panel. **(As per Annexure – VI)**
4	Final	The final grade list to be submitted to the Exam Cell. **(As per Annexure – VII)**

5.2 Evaluation Parameters

Following parameters may be kept in mind while evaluating the student:

- **Job Knowledge** (refers to knowledge clarity of fundamentals, and latest development
- **Adaptability To New Environment** (refers to ability to acclimatize himself/herself to new work environment/culture.
- **Creativity** (refers to the ability to generate new and practical ideas for improvement of systems and operations related to the job)
- **Problem Formulation** (refers to initiative shown in converging to project formulation)
- **Planning Skills** (refer to the ability to conceptualize all aspect of the project and to systematically plan the series of activities to achieve the goals)

- **Techniques/Tools** used at various stages

- **Organising Skills** (refers to the ability to mobilize coordinate, integrate various activities/resources to achieve fast completion)
- **Execution Of The Project** (refers to (a) Setting Time frames (b) Efforts put into complete the project. (c) Maintenance of work diary.
- **Application Skills** (refer to the ability to apply knowledge to real life situations)
- **Project Report & Defence**
- **Job Involvement** (refers to the concern and diligence shown in execution of the project)
- **Presentation** (Refers to style and effectiveness)
- **Interpersonal Relationship** (refers to ability to work harmoniously with superiors and subordinates)
- **Written Expression**
- **Regularity & Punctuality** (refers to (i) Sanctioned authorized leave, absence without permission (ii) late coming & leaving work place early)
- **Oral Expression**

5.3 Calendar for Internship activity is as given below

S.N.	Activity Name	Time Line
1	Start of the Internship	By the normal specified date of registration for the semester for students taking up course-work.
2	Joining report	Within 15 days of start of project semester
3	Consolidated Summary Sheet of Joining report	Within 21 days of start of project semester
4	First Monitoring	Within 1½ month of joining
5	Second Monitoring	within three months of Joining
6	Final monitoring	During last week of Training
7	Final Evaluation at Institute	During project evaluation week as per academic calendar.

6 Disciplinary actions against misconduct behaviour

- Absenteeism, premature abandonment, non-submission of reports, misconduct at the workplace is some examples of serious misconduct during the internship. In case the student intern is found to have indulged in such misconduct, then he/she is liable for disciplinary actions which may also include: Cancellation of internship, withdrawal of final placement assistance etc.
- If student found in any serious conduction before first internship monitoring activity, then his/her internship is cancelled and withdrawal from final placement assistance. He should register for academic module of B.Tech. academic structure.

- If student found in any serious conduction before second internship monitoring activity, then his/her internship is cancelled and withdrawal from final placement assistance. He should register for academic module of B.Tech. academic structure.

7 Escalation Process

In case students have any queries they should do the following: Read the mails and criteria carefully. 100% information is conveyed in the mail sent. In case of doubts meet the office staff of TPO/I2IC section at VIIT between 10 to 5 p.m. (Monday to Friday) In case someone is out of station (as an intern) student may call up 020-25960419 or mail deanindustry@viit.ac.inThe students may also meet / contact their respective TPC. In case none of the above methods solved your query you may meet the undersigned in office.

Dr A. P. Kulkarni

Dean Industry Relations VIIT

Annexure I: - Sample Internship Proposal

Date: MM/DD/YYYY
From: Mr./Ms.
Student Name
Address:
E-mail:
Phone:

To: Prof. Faculty Name , VIIT, Pune
Re: Internship Proposal for Industrial Internship A.Y. 2019-20 Semester I

<<< The following is for your information – it should not appear in the proposal >>>

The purpose of this proposal is to describe the student's obligation to the Faculty Mentor and the Company mentor. It is the student's obligation to prepare the proposal and secure the required signatures on two copies. One copy is retained by the department; the second copy goes in the internship report. The proposal should be submitted prior to the commencement of the internship, or as soon as possible thereafter. Once the proposal is approved, the student must register for the course by submitting application and consent form.
Proposals will not be approved after the internship has been completed.

<<< end info >>>

Nature of work to be done: <<< ***modify as necessary*** >>>

Mr./Ms. Student Name will work for Privateer Power Inc. in the Schuyler power generating station in Pune. The Schuyler facility generates electric power for pune and will assist Mr./Ms. Company Mentor Name during the summer internship. The work will involve monitoring the overall performance of the power plant (including sub-systems), calibration of sensors, field inspection and data collection, project progress documentation, and other tasks as required.

Schedule: <<< ***modify as necessary*** >>>

The internship will begin on June DD, 20YY and will last for no less than (40) business days of at least (8) hours duration. Work hours will be X:00 AM – Z:30 PM, Monday through Friday with 30 minutes for lunch. A final report will be completed by the student and delivered in accordance with Industrial Internship Standards.
The bound final report is to be delivered to the faculty mentor at the end of the third full week of August, on August. DD, 20YY.

Learning objectives: <<< ***modify as necessary*** >>>

1. To learn and understand power plant operation.
2. Test system performance and troubleshoot problems.
3. Properly size replacement equipment for old or damaged components.

4. Design or redesign systems to increase efficiency or to suit operational needs.
5. Perform sensor calibrations
6. Perform preventative maintenance checks and services

Deliverables:

The deliverable for this project will be a final report documenting the learning experience. The report should be arranged in such a way that the engineering content of the work done by the student is demonstrated. The report must include, at minimum, the following items:

1. Description of the company, its organization, function, spectrum of work, etc.
2. Description of the capacity in which the student operated during the internship.
3. Documentation and Description of the engineering work participated in by the student. Work samples may include drawings, calculations, field notes, photographs, condition assessments, engineering reports, engineering correspondence, etc. Creation of an appropriate organizational structure and logical sequence to the report is up to the student. E.g., content can be organized by date, by project, by work type, etc.
4. Any other documentation pertinent to the internship.
5. A daily work log, including hours worked and brief summary of activity.
6. An employee evaluation completed by the internship mentor or other supervisory personnel. The evaluator may assign a letter grade to the internship if desired.
7. A signed copy of the internship proposal.

<<< The following is for your information – it should not appear in the proposal >>>

The physical format of the report should include the following sections, at minimum:

- Title page including student name, course name and number, due date.
- Executive Summary
- Table of Contents
- Introduction (items 1 and 2 above)
- Discussion (item 3 and 4 above)
- Appendices (items 5-7 above and additional as necessary)

All figures (e.g. photos, diagrams, spreadsheets, etc.) in the report must have a figure number and a descriptive caption. Only those figures referenced explicitly should be included in the body of the report. Supporting figures should go in an appendix; these figures must also have numbers and caption.

<<< end info >>>

Reviewed by:

_____Date:_____ Student Name, Department name, VIIT, Pune

_____Date:_____ Mr./Ms. Company Mentor name, XYZ pvt ltd, Pune

_____Date:_____ Prof. Faculty Name, VIIT, Pune

Annexure II

BRACT's

Vishwakarma Institute of Information Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University) Accredited with 'A' Grade by NAAC, An ISO 9001:2008 Certified Institute

S. No. 3/4, Kondhwa Bk, Pune-411 048, Maharashtra, India

Department of _____

(NBA accredited)

Internship Application and Consent Form

To, **Date:**

The Head of the Department,
Department of_____, VIIT-Pune.

Respected Sir,
I am willing to work as a full-time intern in this_____ _____(summer / winter) vacation in whichever company I get selected in. I will work hard, be regular and sincere during this period of internship starting from_____till_____. I will follow all the timings, rules and regulations of the company and will not leave the internship program mid-way.
I will submit an individual report of the work done during this internship period. Name: _____
Class: _____ Roll No. : _____ GRNO: _____

Mobile No: _____
Institute e-mail-id: _____ Academic Year: 2019-20

Yours
faithfully,
(Signature
of
Student)

Note: Please submit the form to Internship Coordinator of Computer Department

Annexure III

BRACT's

Vishwakarma Institute of Information Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University) Accredited with 'A' Grade by NAAC, An ISO 9001:2008 Certified Institute

S. No. 3/4, Kondhwa Bk, Pune-411 048, Maharashtra, India

Department of _____

(NBA accredited)

Internship Deputation Letter

Date:-

To,

_____

_____

_____

Subject: Deputation to Summer/Winter Internship

Dear Sir/Madam,

We are glad to depute_____bonafied student of Department of Computer Engineering (Roll No._____of_____class) for the internship program at your esteemed organization for the period starting from _____to_____.

He/She will have to report at your organization on_____at . He/She is expected to carry out the task allocated to him/her with utmost sincerity and diligence. He/She will have to maintain a log of his /her daily activity and the end submits an internship report and attendance record signed by his/her mentor to the department.

I thank you for giving the student this opportunity.

Coordinator-Internships Head of the Department

Annexure IV

BRACT's

Vishwakarma Institute of Information Technology

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S. No. 3/4, Kondhwa Bk, Pune-411 048, Maharastra ,India

Department of _____

(NBA accredited)

EVALUATION PERFORMA FOR FACULTY MENTOR

(To be filled jointly by Faculty mentor during first/second monitoring stages) Review Number:- 1/2

Name of the Organization: _____

S.N.	Roll No.	GR.No.	Student Name	Project Name	Marks (Out of 25)

(Evaluation should be done on the basis of evaluation parameters mentioned in Section 5.3)

Comments:-_____

_____

Name & Designation Faculty Mentor

Annexure V

BRACT's

Vishwakarma Institute of Information Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University) Accredited with 'A' Grade by NAAC, An ISO 9001:2008 Certified Institute

S. No. 3/4, Kondhwa Bk, Pune-411 048, Maharashtra, India

Department of _____

(NBA accredited)

EVALUATION OF INTERNSHIP PERFORMANCE IN INDUSTRY

(To be filled jointly by Faculty and Industry mentor during Third Monitoring) Name of the Organization: _____

S.N.	Roll No.	GR.No.	Student Name	Project Name	Marks (Out of 50)

(Evaluation should be done on the basis of evaluation parameters mentioned in Section 5.3)

Comments:-_____

_____

Name & Designation

Faculty Mentor

Name & Designation

Industry Mentor

Annexure VI

BRACT's

Vishwakarma Institute of Information Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University) Accredited with 'A' Grade by NAAC,An ISO 9001:2008 Certified Institute

S. No. 3/4, Kondhwa Bk, Pune-411 048, Maharastra ,India

Department of _____

(NBA accredited)

DEPARTMENT EVALUATION PERFORMA

(To be filled jointly by Faculty Panel during FINAL monitoring)

Name of the Organization: _____

S. N.	Roll No.	GR.No.	Student Name	Project Name	Evaluation (OR)			Total Marks (Out of 50 Marks)
					Report (Out of 15 Marks)	Presentation (Out of 15 Marks)	Viva Voce (Out of 20 Marks)	

(Evaluation should be done on the basis of evaluation parameters mentioned in Section 5.3)

Name & Designation Panel Members

1.
2.
3.
4.
5.

Annexure VII

BRACT's

Vishwakarma Institute of Information Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University) Accredited with 'A' Grade by NAAC,An ISO 9001:2008 Certified Institute

S. No. 3/4, Kondhwa Bk, Pune-411 048, Maharastra ,India

Department of _____

(NBA accredited)

OVER-ALL EVALUATION PERFORMA

(To be filled by Internship Coordinator)

Name of the Organization: _____

S.N.	Roll No.	GR. No.	Student Name	First Review (Out of 25 Marks) (As per Annexure IV)	Second Review (Out of 25 Marks) (As per Annexure IV)	Third Review (Out of 50 Marks) (As per Annexure V)	CE Marks (Out of 100 Marks)	OR Marks (Out of 50 Marks) (As per Annexure VI)

Internship Coordinator **Head of Department**

Annexure VIII

Internship report

The report should cover the following aspects:

1. **Cover Page (Refer Annexure IX)**
2. **Declaration (Refer Annexure X)**
3. **Internship Completion Certificate**
4. **Introduction:** Clear understanding of the topic/subject; understanding of the organisation/unit/field.
5. **Literature Review:** Published studies, review of similar studies
6. **Details about the study:** Objectives, formulation of the problem, scope, and rationale of the study.
7. **Methods/methodology adopted for the study:** Analytical, Survey, Field Work or any other method with appropriate justification and reasoning.
8. **Analysis and conclusions:** The logic of analysis, source of data, whether the conclusions are in line with the objectives, etc.
9. **Contribution and learning from the project**: Details of the contribution of the study, the benefits to the organisation, the learning from the study for the student, etc.
10. **Acknowledgements:** References/Citations and Bibliography and help, if any, received from other individuals/organisations. viii) Presentation of the report, format of the report, flow of the report, style, language, etc.

Annexure IX

INTERNSHIP REPORT

_____to_____,_____ (Start Month) (End Month) (Year)

(TITLE OF THE PROJECT)

Submitted by

(Name of student)
Student GR NO…….
.

Under the Guidance of

(Name of faculty mentor) (Name of Industry mentor) (with designation)
(with designation)

Department of **Engineering**

Vishwakarma Institute of Information Technology,
Pune Academic Year 20..

Annexure X

DECLARATION

I hereby declare that the project work entitled ("Title of the project") is an authentic record of my own work carried out at (Place of work) as requirements of semester long internship for the award of degree of B.Tech. (Department of_____ _____Engineering), Vishwakarma Institute of Information Technology, Pune under the guidance of (Name of Industry mentor) and (Name of Faculty mentor), during_____to_____, 20).

(Signature of student)
Name of Student
Student GR No

Date: _____

Certified that the above statement made by the student is correct to the best of our knowledge and belief.

(Name & Designation) Faculty Mentor

(Name & Designation) Industry Mentor

Annexure XI

BRACT's

Vishwakarma Institute of Information Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University) Accredited with 'A' Grade by NAAC,An ISO 9001:2008 Certified Institute

S. No. 3/4, Kondhwa Bk, Pune-411 048, Maharastra ,India

Department of _____

(NBA accredited)

FEEDBACK FROM INDUSTRY ON STUDENT INTERNSHIP

1. Were the students serious about their work?

A. Excellent B. Very Good C. Satisfactory D. Marginal

2. Were they allotted specific projects?

Yes / No

3. Has the work done by the students been of value to the Company?

Yes / No

4. Did the students have adequate background knowledge?

A. Excellent B. Very Good C. Satisfactory D. Marginal

5. Did the students have adequate maturity and adjustability?

A. Excellent B. Very Good C. Satisfactory D. Marginal

6. Do you think that the Institute can interact with the industry / organization in some other way also? Please specify.

Yes / No

7. How do you rate the student overall?

A. Excellent B. Very Good C. Satisfactory D. Marginal

8. Will you consider the student to be absorbed in your organization (if chance given)?

Yes / No

9. Would you like to take VIIT students again in next year?

Yes / No

Signature_____ Faculty Name: _____

Annexure IX

BRACT's
Vishwakarma Institute of Information Technology
(An Autonomous Institute affiliated to Savitribai Phule Pune University) Accredited with 'A' Grade by NAAC,An ISO 9001:2008 Certified Institute
S. No. 3/4, Kondhwa Bk, Pune-411 048, Maharastra ,India
Department of _____
(NBA accredited)

STUDENTS FEED BACK FORM

1. Name and Place of the Industry: _____

2. Student Roll No.:_____

3. Student Name: _____

4. Problems faced in the Industry with regard to:
i) Project identification (YES /No)
ii) Problem analysis (YES /No)
iii) Implementation of the Project (YES /No)
iv) Acceptance in Industry (YES /No)
v) Recognition of the work done by you (YES /No)

5. Has the Project Semester proved to be an exercise that has enhanced your :

I) **Personal Attributed at work**:
i) Communications Skills (YES /No)
ii) Confidence level (YES /No)
iii) Creativity (YES /No)
iv) Planning skills (YES /No)
v) Adaptability (YES /No)
vi) Being methodical (YES /No)
vii) Organizational skills (YES /No)
II) **Technic**
al Aspects
Knowledge
(YES /No)
Skill at work

(YES /No)

6. Were you provided the following?

i) Stipend
ii) Accommodation
iii) Conveyance

7. How do you rate overall?

A. Excellent B. Very Good C. Satisfactory D. Marginal