Autonomous Programme Structure (Modified) of
Third Year B.Tech. Computer Engineering
AY: 2019-20

T. Y. B. Tech. Computer Engineering Semester – I										
Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
CE 3101	Computer Networks	3	1	0	50	50	0	0	100	4
CE 3102	Database Management Systems	3	1	0	50	50	0	0	100	4
CE 3103	Design and Analysis of Algorithms	3	0	0	50	50	0	0	100	3
OEHS 3101	Elective-I	3	0	0	50	50	0	0	100	3
PECE 3101	Programme Elective-I	3	0	0	50	50	0	0	100	3
CE 3104	Database Management Systems Laboratory	0	0	2	0	0	0	25	25	1
CE 3105	Computer Networks Laboratory	0	0	2	0	0	0	25	25	1
CE 3106	Programming Skills Development Laboratory-I	0	0	4	0	0	50	0	50	2
PECE 3102	Programme Elective-I Laboratory	0	0	2	25	0	0	0	25	1
AC 3101	Audit Course	0	0	2	0	0	0	0	0	0
	Total	**15**	**2**	**12**	**275**	**250**	**50**	**50**	**625**	**22**
	Grand Total	**29**			**625**				**625**	**22**

OEHS 3101: Elective-I

1. Entrepreneurship Development
2. Introduction to Digital Marketing
3. Intellectual Property Rights
4. Project Management

PECE 3101: Programme Elective-I

1. Cloud Computing
2. Digital Signal Processing and Applications
3. Statistics for Computer Science
4. Operations Research

PECE 3102: Programme Elective-I Laboratory

AC 3101 -- Audit Course: Employability Skills Development

MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

DEAN ACADEMICS
MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

Principal
MKSSS's Cummins College of Engg. For Women, Karvenagar, Pune-52.

APPROVED BY
Governing Body Members
MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

CE 3101 COMPUTER NETWORKS

Teaching Scheme
Lecture: 3 Hrs./week
Tutorial: 1 Hrs / week

Examination Scheme
In Semester Exam : 50 Marks
End semester: 50 Marks
Credits: 4

Prerequisite: Fundamental of Computer Networks (CE 2202)

Forward Linkage:

- Wireless and Mobile Communication (PECE 3201 Elective III)

Course Objectives:

Facilitate the learners to:-

1. Apply and distinguish the fundamental concepts of networking standards, protocols and technologies.
2. Identify role of protocols at various layers in the protocol stack.
3. Select and Compare the appropriate network by understanding the given requirerments for a given system.
4. Identify fundamental concepts of wireless network, mobile network and network security.

Course Outcome:

By taking this course, the learner will be able to–

1. Analyze data flow between two communicating hosts using various protocols at Application, Transport and Network Layer.
2. Identify appropriate computer networking protocol for a given application.
3. Analyze the requirements for a given system to select an appropriate network.
4. Identify technologies and characteristics in mobile network , wireless network and network security.

Unit-1: Network Layer **(07)**

Design Issues, Routing Algorithms: Dijkstra's, Distance vector Routing, Link State Routing, Network Layer Protocols: Address Resolution Protocol, Reverse Address Resolution Protocol, Internet Control Messaging Protocol, Routing Protocols: Routing Information Protocol, Open Shortest Path First , Boarder Gateway Protocol, Unicast Routing Protocols, Multicast Routing Protocols.

Unit-2: The Network Layer in the Internet **(07)**

IP Protocol addressing: IPV4 address classes, Public and private IP addresses. IP sub-netting, IP super-netting, classless inter domain routing (CIDR), Overview of IPv6, IPV4 Vs IPV6.

Unit-3: Transport Layer **(08)**

Transport layer design issues, Protocol Overview, Header Structure, Transmission Control Protocol (TCP) functions such as Connection Management, Error control, Flow control, Congestion control, User Datagram Protocol (UDP) overview, typical applications support, TCP Vs UDP, introduction to Socket Programming, TCP and UDP Socket Primitives. Quality of Service (Quality of Service): Differentiated Service

Unit-4: Application Layer **(07)**

Hyper Text Transport Protocol (HTTP): Overview, header structure, connections, request and response messages, persistence and non-persistence HTTP. Cookies, Simple Mail Transport Protocol (SMTP): Overview and Working of MIME, POP3, File Transfer Protocol (FTP): Overview and Working, identifying protocols for given application with example.

Unit-5: Network Servers **(06)**

Client-Server Architecture, Peer -to- Peer Architecture, Introduction to various Types of Servers, Dynamic Host Configuration Protocol (DHCP): Header, Working, DHCP Server Configuration, Domain Name Server(DNS) : Working, Proxy Server : Need and Significance, working, configuration, Introduction to virtualization: Server Visualization, creating network and providing internet connectivity.

Unit-6: Wireless and Mobile Networks **(07)**

Introduction to wireless LAN, Introduction to mobile communication: 1G,2G,3G,4G,features, limitations of mobile computing, Introduction to Network Security: Security mechanism and Services, Introduction of cryptography, Network Perimeter Security concept: Firewall.

Text Books:

1. Andrew S Tanenbaum, David J Wetherall,**'Computer Networks'**, *Pearson,* (5th Edition), (2014).

2. Forouzan B **'Data Communication and Networking'**, *Tata McGraw Hill,* (5th Edition), (2013).

Reference Books:

1. Kurose, Ross **'Computer Networking a Top Down Approach Featuring the Internet'** *Pearson,* (6th Edition) , (2014).

2. Stallings W **'Data and Computer Communications'** *Prentice Hall Pvt.Ltd.* (8th Edition), (2009).

3. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff **'Unix Network Programming Volume 1'**, *Addison-Wesley Publication,* (3rd Edition), (2003).

4. Geoffrey C. Fox, Jack Dongarra, and Kai Hwang,**'Distributed and Cloud Computing'** Morgan Kaufmann, (1st Edition),(2011).

5. Stallings W,**'Cryptography and Network Security: Principles and Practice'**, *Pearson,* (6th Edition), (2014).

CE 3105 Computer Networks Laboratory

Teaching Scheme:
Practical: 2 Hrs/week

Examination Scheme:
Practical : 25 Marks
Credits: 1

Course Objectives:

1. Configure the computing nodes with understanding of protocols and technologies.
2. To learn network programming.
3. Use modern tools for network traffic analysis and various networking configurations.
4. Learn Fundamental concepts of Virtualization.

Course Outcomes:

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

1. Configure switches and routers.
2. Demonstrate LAN and WAN protocol behavior using Modern Tools.
3. Analyze data flow between two communicating hosts using various protocols at Application, Transport and Network Layer.
4. Develop Client-Server Application.

Example List of Assignments:

Group A: (Mandatory)

1. Design an IP scheme for a WAN network (minimum 3 networks) using Cisco Packet Tracer tool.
2. Simulation of routing in the above network using Routing Information Protocol (RIP), by using CISCO packet tracer tool.
3. Write a program to analyze following packet formats captured through Wireshark for wired network. 1. Ethernet 2. IP 3.TCP 4.UDP (using Python).

Group B: (Any Four)

1. Installing and configuring DHCP server (windows server).
2. Write a program using TCP socket for wired network for following (using JAVA/ C)
   a. Say Hello to Each other b. File transfer
3. Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines. (using JAVA / C).
4. Configuring Ftp server for file upload /download using Cisco Packet Tracer.
5. Write a program to demonstrate subnetting and find the subnet masks.(JAVA /Python).
6. Write a program for DNS lookup. Given an IP address input, it should return URL and vice-versa. (JAVA / Python).
7. Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol (JAVA).

Group C:

1. Creation and configuration of Virtual Machines- Create 2 local virtual machines on host and ping the Virtual Machine.

CE 3102 DATABASE MANAGEMENT SYSTEMS

Teaching Scheme
Lecture : 3 Hrs/week
Tutorials: 1 Hr/week

Examination Scheme
In semester : 50 marks
End semester : 50 marks
Credits : 4

Prerequisite: Data Structures and Algorithms II(CE 2201)

Forward Course Linkages:
- Data Mining Data Warehousing (PECE 3202)
- Big Data Analytics (PECE 4101)
- Business Intelligence(OE 4201)
- E-Business (OE 4202)

Course Objectives:
To facilitate the learners to-
1. Design database schema using an entity relationship diagram (ERD) and normalization.
2. Design queries using Structured Query Language (SQL) to retrieve the required data from the database.
3. Understand Transaction management in a Database management System.
4. Understand NoSQL Databases to handle unstructured data.
5. To introduce advanced database topics such as Special purpose databases, Distributed database systems, Big data, Data mining and Data Warehousing etc.

Course Outcomes
With successful completion of the course, the students will be able to–
1. Design the Entity Relationship diagram for the system / application considering its constraints and design issues.
2. Apply the knowledge of SQL to retrieve the required data from the database.
3. Make use of various Transaction management algorithms for scheduling concurrent transactions.
4. Apply the knowledge of NoSQL databases to handle unstructured data.
5. Survey advanced database topics such as Special purpose databases, Distributed databases, Big data, Data mining and Data Warehousing.

Unit 1 : Introduction to Database Management Systems **(06)**
Introduction to database management systems, Advantages of a Database Management Systems over file-processing systems, Data abstraction, Data Independence, Relational Model, Architecture
Introduction to NoSQL databases. Special purpose databases- e.g. Temporal, Spatial, In-memory, Multimedia databases etc.

Unit 2 : Database design and Structured Query Language **(08)**
Data Modeling: Entity Relationship Diagram (ERD), Components and conventions (entity, attributes, relationships) Primary key, Converting Entity Relationship Diagram into tables, Foreign key and other Integrity constraints. Extended Entity Relationship Diagram features.
Structured Query Language:
SQL - Data Definition Language (DDL) : SQL Data Types, Null values and Literals, Creating, Modifying and Deleting tables. Views and Indexes.
SQL - Data Manipulation Language (DML) : Insert, Update, Delete, Select (all clauses), Set Operations, Joins, Tuple Variables, Nested sub-queries, Query Processing.

SQL - Transaction Control Language (TCL) : Commit, Savepoint, Rollback
SQL - Data Control Language (DCL) : Grant, Revoke
PL/SQL (Programming Language SQL) : Stored Procedures and Functions, Cursors, Triggers.

Unit 3 : Normalization **(06)**

Converting ERD to tables (Weak entity set, multivalued attributes,EER features).
Normalization, Purpose of Normalization, Data Redundancy and Anomalies (Insert / Delete / Update), Normal Forms: 1NF, Functional dependency, decomposition of tables using Functional Dependency :Second Normal Form (2NF), Third Normal Form (3NF), Boyce Codd Normal Form (BCNF)

Unit 4 : Transaction management **(08)**

Transactions, ACID Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability : Conflict serializability, View serializability, Cascaded Aborts, Recoverable and Non-recoverable Schedules. Concurrency Control: Need, Locking Methods, Deadlocks,Timestamping methods. Recovery methods : Shadow-Paging and Log-Based Recovery, Checkpoints

Unit 5 : NoSQL Databases **(08)**

Structured and unstructured data, NoSQL- Comparative study of SQL and NoSQL databases, Big data. BASE Properties, Types of NoSQL databases- Key-value store – JSON, Document Store - MongoDB, Column store - HBase and Graph based, MongoDB- MongoDB shell, Create, Retrieve, Update and Delete (CRUD) Operations, Indexing, Aggregation and MapReduce in MongoDB

Unit 6 : Advances in Databases **(06)**

Data warehousing: Data warehouse Architecture, schemas, data marts, Extract, Transform and Load (ETL) process
Data mining – Descriptive and predictive Data mining techniques
Introduction Business intelligence

Text Books:

1. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, **'Database System Concepts'**, *McGraw Hill*, (6^{th} edition), (2013)
2. Jiawei Han, Micheline Kamber and Jian Pei, **'Data Mining – Concepts and Techniques'**, *Morgan Kaufmann Publishers*,(3^{rd} Edition), (2012)
3. Kristina Chodorow, Michael Dirolf, **'MongoDB: The Definitive Guide'** , *O'Reilly*, (2^{nd} Edition), (2013)
4. Ramez Elmasri and Shamkant B. Navathe, **'Database Systems'**,*Pearson*, (6^{th} Edition), (2013)

References:

1. Raghu Ramakrishnan and Johannes Gehrke, **'Database Management Systems'**, *McGraw Hill*, (3^{rd} Edition), (2003)
2. C. J. Date, **'An Introduction to Database Systems'**, *Pearson*, (8^{th} Edition), (2006)
3. Thomas Connally, Carolyn Begg, **'Database Systems'**, *Pearson*, (4^{th} Edition), (2012)

Tutorials

The tutorials aim to strengthen the database designing and query writing skills of the learners.

Example Assignments for Tutorials:

1. Design an Entity Relationship diagram (ERD) for a given system.
2. Convert the ERD to tables and Normalize the tables up to Third Normal Form (3NF).
3. Write Structured Query Language Data Definition Language (SQL DDL) commands for Creating the tables with appropriate integrity constraints, Altering the tables and Deleting/ Dropping the tables.
4. Write SQL queries for retrieving the required data from the tables using SELECT, GROUP BY and ORDER BY clauses.
5. Write SQL queries using different JOINs.
6. Write SQL queries using UNION, INTERSECTION, EXCEPT and SUBQUERIES.
7. Write SQL commands to create Database VIEWS and INDEX.
8. Write a Stored Procedure (using explicit cursor) for the given requirements.
9. Write MongoDB Queries using different variations of the FIND() function.
10. Write Queries using the aggregation framework of MongoDB.
11. Define the dimensions and measures for the given database to build the star schema for the given database.
12. Define data mining query for the given database.

CE 3103 Design and Analysis of Algorithms

Teaching Scheme:
Teaching: 3 Hrs/Week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks
Credits: 3

Prerequisite:

1. Data Structures and Algorithms II (CE 2201)

Course Objectives:
To facilitate the learners :-

1. Understand and apply methods of analysis of algorithms.
2. Learn and apply strategies for designing the algorithms.
3. Learn and apply the concept of computational complexity classes for the given problem.
4. Get acquainted to the concept of abstract algorithms design.

Course Outcomes:
By taking this course, the learner will be able to :–

1. Apply the knowledge of analyzing the algorithm.
2. Evaluate algorithm design techniques for solution of a problem.
3. Perceive the given problem solution from computational complexity classes point of view.
4. Build knowledge to understand the design requirements of abstract algorithms.

UNIT I: **Introduction** [7]
Basic steps to solve the problems, Performance analysis of recursive and non-recursive algorithms, Recurrences: substitution method, recursion-tree method, master method.

UNIT II: **Divide and Conquer & Greedy Strategy** [7]
Divide and Conquer: General Strategy, Control Abstraction, min/max problem, Binary Search, Quick Sort and Merge Sort.
Greedy Method: General strategy, control abstraction, Knapsack problem, Job sequencing with Deadlines, Minimal Spanning Tree algorithms.

UNIT III: **Dynamic Programming** [7]
Dynamic programming: General Strategy, Multi stage graphs, Optimal Binary Search Tree problem(OBST), Knapsack problem, Travelling Salesperson Problem.

UNIT IV: **Backtracking and Branch and Bound** [7]

Backtracking: General Strategy, Implicit and Explicit constraints, DFS State space tree formulation, Sum of subsets, 8 Queens problem, Hamiltonian Cycle problem, Maze problem.

Branch and Bound: General Strategy, BFS state space tree formulation, Traveling Salesperson Problem.

UNIT V: **Computational Complexity Classes** [7]

Basic Concepts of complexity classes, Non deterministic algorithms, The classes P and NP, NP Complete and NP Hard.

Decision problems: Clique Decision problem, Node cover Decision problem,Directed Hamiltonian Cycle Problem, Satisfiability problem, Travelling salesman problem, NP Hard problems

UNIT VI: **Abstract Algorithms** [7]

Introduction to Parallel Algorithms, Evolutionary algorithm: Genetic Algorithms and Tabu search

Text Books:

1. Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2nd edition. Galgotia publication,, 2008, ISBN: 978 81 7371 6126

2. Gilles Brassard and Paul Bartley, "Fundamental of Algorithm.", PHI, 2010, ISBN-9788120311312 New Delhi

3. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithm", 3rd edition, 2009,PHI

Reference Books:

1.Fayez Gebali, "Algorithms and Parallel Computing", Willy, 2015, ISBN 9788126553891

2.Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 2014, Pearson Education

3.A. V. Aho and J.D. Ullman, "Design and Analysis of Algorithms", Pearson Education, 2006, ISBN: 978 81 317 0205 5

4.Parag Himanshu Dave, Himanshu Bhalchandra Dave, " Design And Analysis of Algorithms", PEARSON Education, ISBN 81-7758-595-9

CE 3104 DATABASE MANAGEMENT SYSTEMS LABORATORY

Teaching Scheme
Practical : 02 Hours/Week

Examination Scheme
Practical: 25 Marks
Credits : 1

Course Objectives:
To facilitate learners to-

1. Implement/Execute Structured Query Language (SQL) queries.
2. Implement/Execute PL/SQL stored procedures and functions.
3. Implement/Execute MongoDB queries.
4. Develop 2tier database applications.

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

1. Apply the knowledge of Structured Query Language (SQL) clauses to query the relational database.
2. Apply the knowledge of PL/SQL to solve the given business problem.
3. Apply the knowledge of NoSQL databases to query semi structured documents.
4. Solve the given database problem using database programming skills.

Example Assignments for Laboratory

Assignments Group A (Mandatory)

1. Design and Execute SQL Data Definition Language (DDL) statements to create tables and insert data into the tables. Make use of the Sequence feature.
2. Design and Execute at least 15 SQL queries for suitable database application using SQL Data Manipulation Language (DML) statements: Insert, Select, Update and Delete.
3. Design and execute at least 10 SQL queries for suitable database application using SQL DML statements: all types of Join, Sub-Query and View.
4. Create a 2 tier application using Java Database Connectivity (JDBC).
5. Create a MongoDB collection and Execute the MongoDB Queries using the find() function, SAVE method, logical operators.

Assignments Group B (Any 4)

1. Design and execute a Programming Language/ Structured Query Language (PL/SQL) stored procedure for returning a book in a library system. The procedure should calculate a fine as follows: Check the number of days (from date of issue), - If days are between 15 to 30 then fine amount will be Rs 5 per day. - If no. of days>30, per day fine will be Rs 50 per day & for days > 30, Rs. 5 per day. After submitting the book, status will change from I to R.
2. Write a PL/SQL stored procedure for calculating the income tax of employees of the company.
3. Write a PL/SQL stored procedure for populating the class secured by every student in the class.
4. Write a PL/SQL block of code that will merge the data from the old_Books table to the new Books table. If the data in the first table already exist in the second table then that data should be skipped.

5. Write a database trigger which will ensure that when data is inserted in the EMPLOYEE table, the department name is always in Upper case.
6. Write a database trigger which will ensure that when data in the Accounts table is updated, the old copy is preserved in the Transaction_Log table along with the date and userID.
7. Write a database trigger which will ensure that when data in the EMPLOYEE table is deleted, it is first copied in the Ex-employees table along with the date of deletion.
8. Write a PL/SQL function to calculate the number of distinction holders, first class holders, second class holders in the class.
9. Create a 2tier application using MongoDB as back end and Java as front end.
10. Implement aggregation and indexing with suitable example using MongoDB.
11. Implement Map reduce operation with suitable example using MongoDB.

Books/ Web references:

1. https://downloads.mysql.com/docs
2. Kristina Chodorow, Michael Dirolf, **'MongoDB: The Definitive Guide'** , *O'Reilly,* (2nd Edition)
3. http://docs.mongodb.org/manual/

CE 3106 PROGRAMMING SKILL DEVELOPMENT LABORATORY-I

Teaching Scheme
Practical : 4 Hrs/week

Examination Scheme
Oral : 50 Marks
Credits: 2

Prerequisites:

- Principles of Programming Languages Laboratory (CE2105)
- Data Structures and Algorithms-II (CE2202)

Course Objectives:
To facilitate the learners to

1. Explore Android tools.
2. Learn to develop mobile applications.
3. Create data-driven applications.
4. Design small system using Python or Android

Course Outcomes:
By taking this course, the learner will be able to

1. Analyze problems and select suitable Android development tools
2. Create mobile applications using basic components from Android Studio
3. Create data-driven mobile applications
4. Design and implement python Application to handle the Data

Example list of Assignments

Group A (Mandatory)

1. Download, install and configure android development tools, plugins and SDK / Studio.
2. Design simple calculator using UI Widgets – button, textview, editview etc.
3. Develop an application that uses Layout Managers and event listeners.
4. Develop an application that change text formatting.
5. Design an application in Python using classes and objects.
6. Write python code that loads any dataset and perform basic operations, and plot the graph.

Group B (Any Three)

1. Write a mobile application that draws basic graphical primitives on the screen.
2. Develop a mobile application that makes use of database.
3. Develop a native mobile application that uses GPS location information.
4. Implement a mobile application that creates an alert upon receiving a message.
5. Write a mobile application that creates alarm clock.
6. Write a mobile application for multimedia Application.
7. Write a mobile application for Image transformation.
8. Implement MySQL/Oracle database connectivity using python and implement Database navigation operations (add, delete, edit,) using ODBC/JDBC.
9. Write a program for Socket programming using python .

Group C

1. Micro Project.

PECE 3101 Cloud Computing

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

Prerequisites: Operating Systems (CE 2203)

Course Objectives:
To facilitate the learner to-

1. Understand the basic concepts related to cloud computing.
2. Analyze the underlying principles of different cloud service models.
3. Understand and apply the security techniques in cloud computing.
4. Get exposure to emerging trends in cloud computing.

Course Outcomes:
By taking this course, the learner will be able to-

1. Apply cloud computing concepts and the emerging trends to cloud based systems.
2. Analyze the cloud services and models.
3. Apply and analyze various cloud platforms and tools for realization of different services.
4. Apply security concepts to the cloud environment.

Unit 1: Introduction **(06)**

Introduction to Cloud Computing, Cloud Economics, National Institute of Standards and Technology (NIST) Definition of Cloud Computing, Cloud Characteristics, Cloud Service Models, Cloud Deployment Models, Benefits, Challenges and Risks.

Unit 2: Infrastructure-as-a-Service (IaaS) **(08)**

Introduction to Infrastructure-as-a-Service (IaaS), NIST Cloud Computing Reference Architecture, Virtualization – Introduction, Taxonomy, Characteristics, Pros and Cons, Types of Service Level Agreement (SLA), Hypervisors - Xen, Kernel Virtual Machine (KVM), VMware, Containers, Case Study- Amazon Web Services (AWS).

Unit 3: Platform-as-a-Service (PaaS) **(07)**

Introduction to Platform-as-a-Service (PaaS), Data in Cloud: Relational Databases, NoSQL Databases, Big Data, Cloud File System: Hadoop Distributed File System (HDFS), HBase, Map-Reduce Model, Case Study- Google App Engine (GAE).

Unit 4: Recent Trends **(06)**

Inter-cloud / Federated Cloud, Internet of Things (IoT) and Cloud Computing, Mobile and Cloud Computing, Data Centers- Introduction, Cloud Applications.

Unit 5: Software-as-a-Service (SaaS) **(08)**

Introduction to Software-as-a-Service (SaaS), Multi-tenancy, Mashups, Service Oriented Architecture (SOA), Web Services based on Simple Object Access Protocol (SOAP) and REpresentational State Transfer (REST), SaaS Applications, Case Study- Salesforce.com.

Unit 6: Cloud Security **(07)**

Cloud Security Fundamentals, Cloud Security Challenges and Risks, Virtualization Security, Identity Management and Access Control, Secure Execution Environment and Communication.

Text books:

1. Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, '**Mastering Cloud computing**', *McGraw Hill Education*, (2013), ISBN 978-1-25-902995-0.
2. Gautam Shroff, '**Enterprise Cloud Computing**', *Cambridge University Press*, (2010), ISBN 978-0-521-13735-5.
3. Ronald Krutz and Russell Dean Vines, '**Cloud Security**', *Wiley India Pvt. Ltd.*, (2010), ISBN 978-81-265-2809-7.
4. Kailash Jayaswal, Jagannath Kallakurchi, Donald Houde, Dr. Deven Shah, '**Cloud Computing Black Book**', *DreamTech Press*, (2015), ISBN 978-93-5119-418-7.

Reference books:

1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, '**Cloud Computing Concepts, Technology and Architecture**', *Prentice Hall*, (2013), ISBN 978-01-333-8751-3.
2. Barrie Sosinsky, '**Cloud Computing Bible**', *Wiley India Pvt. Ltd.*, (2015), ISBN 978-81-265-2980-3.
3. Rajkumar Buyya, James Broberg, Andrzej Goscinski, '**Cloud Computing Principles and Paradigms**', *Wiley India Pvt. Ltd.*, (2015), ISBN 978-81-265-4125-6.
4. Dr. Kumar Saurabh, '**Cloud Computing**', *Wiley India Pvt. Ltd.*, (2011), ISBN 978-81-265-2883-7.
5. Tim Mather, Subra Kumaraswamy, Shahed Latif, '**Cloud Security and Privacy**', *O'Reilly*, (2011), ISBN 13:978-81-8404-815-5.
6. A. Srinivasan, J. Suresh, '**Cloud Computing: A Practical Approach for Learning and Implementation**', *Pearson*, (2014), ISBN 978-81-317-7651-3.

Web References:

1. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf
2. https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf
3. http://searchdatacenter.techtarget.com/definition/data-center
4. http://www.sapdatacenter.com/article/data_center_functionality/
5. https://www.salesforce.com

Elective II- PECE 3101
Statistics for Computer Science

Teaching Scheme
Lectures: 3 Hr/Week

Examination Scheme
In Semester : 50 Marks
End Semester : 50 Marks
Credits : 3

Course Objectives
To facilitate the learners :-

1. To utilize fundamentals of statistics and descriptive statistics concepts.
2. To analyse multivariate data using multivariate, correlation and regression analysis.
3. To select and apply statistical quality control techniques using different statistical quality control charts.
4. To apply statistical inference techniques for dealing with uncertainty in decision making.

Course Outcomes
By taking this course, the learner will be able to –

1. Apply the methods of statistics on data and types of data.
2. Experiment with statistical multivariate analysis using variance, correlation and regression.
3. Apply statistical quality control techniques for given data.
4. Select and use sample statistics to draw inference.

Unit 1: Basic statistics **(6 hrs)**

Definition,collection and type of data, processing of data, classification,tabulation and graphical representation of data, limitation of statistics.
Types of averages: arithmetic mean, median, mode, geometric mean, harmonic mean, relationship among averages, variation, merits and limitations of variation, standard deviation

Unit 2 : Correlation and Regression **(8 hrs)**

Introduction, types of correlation, methods of studying correlation : scatter diagram, graphic method, Karl Pearson's coefficient of correlation, Rank correlation coefficient
Regression analysis : Introduction, uses of regression analysis, difference between correlation and regression analysis. Regression lines, regression equations, regression coefficient and it's properties.

Unit 3: Multivariate Analysis **(8 hrs)**

Partial regression, partial correlation, multiple correlation, multivariate regression, principal component analysis (PCA), introduction to cluster analysis.

Unit 4: Statistical Inference -Test of Hypothesis **(8 hrs)**
Introduction, procedure of testing hypothesis, types of hypothesis, two types of error in testing of hypothesis, two-nailed and one-nailed test

t-test, chi-square test, F-test, degrees of freedom, relation between t-test,chi-square and F-test.

Unit 5: Analysis of Variance **(6 hrs)**

Introduction, assumptions and techniques of analysis of variance, One-Factor analysis of variance, Two factor analysis of variance:Parameter estimation and testing hypotheses

Unit 6 : Statistical Quality Control **(6 hrs)**

Introduction, control charts : X chart, σ chart, R chart, role of acceptance sampling, OC curve
Case study : Educational and Psychological statistics.

Text Books:

1) "Statistical Methods", S.P. Gupta, 41st Edition, 2011, ISBN :978-81-8054-862-8, Sultan Chand and Sons publication.
2) "Basic statistics", B.L. Agarwal, 9th Edition, 2011, ISBN:978-81-224-2472-0, New Age publication.
3) "Statistics in Nutshell", Sarah Boslaugh and Paul Andrew Watters, 2008, ISBN : 978-81-8404-568-0, SPD O'Reilly publication.

Reference Books:

1) "Statistical Data analytic" by Piegorsch W.W., Wiley publication, 2017
2) "Introduction to Statistical Quality Control" by D.C Montgomery, 4th ed.,Publication John Wiley & Sons, 2007.
3) "Introductory statistics", Sheldon M. Ross, 2nd Edition, 2006, ISBN : 81312-00485, Elsevier publication.
4) "Applied multivariate statistical analysis", Richard A. Johnson, Dean W. Wichern, 6th edition, 2012, ISBN-978-81-203-4587-4, PHI Learning

PECE 3102 Cloud Computing Laboratory

Teaching Scheme
Practical: 2 Hrs/week

Evaluation Scheme
In Semester: 25 Marks
Credits: 1

Course Objectives:
To facilitate the learners to-

1. Explore the underlying principles of Infrastructure-as-a-Service (IaaS), virtualization and containers.
2. Understand the use of Map-Reduce programming model of the Hadoop ecosystem.
3. Get exposure to the use of cloud Application Programming Interfaces (APIs) for developing sample application(s).
4. Study different cloud platforms and tools for various cloud service models.

Course Outcomes:
By taking this course, the learner will be able to-

1. Apply the hypervisor and container-based virtualization.
2. Experiment with Map-Reduce programming model by implementing sample programs.
3. Make use of CloudSim framework for understanding cloud computing infrastructure and services.
4. Choose relevant social networking and cloud Application Programming Interfaces (APIs), services.
5. Analyze the use of different cloud platforms and tools for various cloud service models.

Example list of assignments:

Teachers will appropriately adopt assignments on similar lines as the examples shown here.

Assignments Group A (Mandatory)

1. Explore the CloudSim platform for Cloud Modelling. For example: Create a data centre with one host and run one cloudlet on it using CloudSim.
2. Demonstrate the use of Docker container by exploring its related commands. Also, show the use of Fedora/Ubuntu images over the docker engine.
3. Using Hadoop ecosystem, implement Map-Reduce word count program for the given sample data.
4. Create a virtual machine using Kernel Virtual Machine (KVM) and explore commands for virtualization.

Assignments Group B (Any 4)

1. Explore the CloudSim platform for Cloud Modelling. For example: Create and configure the data centre and user base to show response time, request servicing time and data centre loading.
2. Demonstrate the use of MySQL image over the Docker engine.
3. Frame Python scripts to perform operations (for e.g. start/pause/stop) on the Virtual Machine using Libvirt and Operating System (OS) calls for virtualization.
4. Using Hadoop ecosystem, implement Map-Reduce program for the given log file data.
5. Demonstrate the use of Hive query language (HQL) for Map-Reduce to process the data using Hadoop ecosystem.
6. Explore and configure the Xen hypervisor or equivalent open source hypervisor.

7. Explore the use of API for cloud storage application (for e.g. DropBox API) with the Linux command line interface and Python script.
8. Create an application using Force.com API.
9. For a sample application, implement and consume web service using social networking APIs with Simple Object Access Protocol (SOAP).
10. For a sample application, implement and consume web service using cloud APIs with REpresentational State Transfer (REST).

Assignments Group C (Any 1)

1. Installation and configuration of an open source cloud platform.
2. Study of different cloud platforms such as GoogleApp Engine (GAE), Amazon Platform Services, Microsoft Azure services, Openstack and Rackspace.

PECE 3102 Statistics for Computer Science Laboratory

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
In Semester: 25 Marks
Credits: 1

Course Objectives:

To facilitate the learners to -

1. Implement and analyze the basic and descriptive statistical operations for given problem.
2. Apply data representation knowledge for given data points.
3. Apply correlation, regression model, principal component analysis(PCA) model.
4. Design the solution for real life problems using the techniques of statistics.

Course Outcome:

By taking this course, the learner will be able to -

1. Perform and implement basic and descriptive statistical operations on given data..
2. Apply different data representation methods for interpretation of given data..
3. Analyze and apply various models of regression, correlation, PCA on given data.
4. Develop small statistical application using different techniques.

Example list of Assignments:

Assignments can be done using open source tool and technology like R , Python or using Matlab

Group A: (Mandatory)

1.Getting started with software, installation, its objects and data types

2..Graphical presentation of data in different plot forms/diagrams.

3.Apply basic statistical operations, measure of location (Arithmetic mean, harmonic mean,geometric mean, median, mode).

4.Perform measure of dispersion , standard deviation, quartile deviation etc

Group B: (Any four)

1.Plot the diagram for the given data, develop the regression model that best describes the data, also predict output for the given value.

2.Perform correlation analysis (positive negative, zero) that describes the degree to which variables are linearly related to each other.

3.Perform test of hypothesis, one sample t-test, paired t-test, chi-squared goodness of fit test, on given data and see how to use them for statistical inference.

4.Perform data dimensionality reduction using principal component analysis.

5. Perform Cluster analysis on given data.

6. Perform analysis of variance (ANOVA) on data for evaluating hypothesis.

Group C: (Any one)

1.Study software tool to understand how to construct charts related to quality control.

2.Data analysis case study for readily available data set using the statistical techniques studied.

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Autonomous Programme Structure (Modified) of Third Year B.Tech. Computer Engineering AY: 2019-20

T. Y. B. Tech. Computer Engineering Semester – II										
Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
CE 3201	Theory of Computation	3	1	0	50	50	0	0	100	4
CE 3202	Artificial Intelligence and Machine Learning	3	0	0	50	50	0	0	100	3
CE 3203	Software Design and Architecture	3	1	0	50	50	0	0	100	4
PECE 3201	Programme Elective-II	3	0	0	50	50	0	0	100	3
PECE 3202	Programme Elective-III	3	0	0	50	50	0	0	100	3
CE 3204	Seminar	0	0	4	25	0	25	0	50	2
CE 3205	Artificial Intelligence and Machine Learning Laboratory	0	0	4	0	0	0	50	50	2
PECE 3203	Programme Elective-III Laboratory	0	0	2	0	0	25	0	25	1
AC 3201	Audit Course	0	0	2	0	0	0	0	0	0
	Total	**15**	**2**	**12**	**275**	**250**	**50**	**50**	**625**	**22**
	Grand Total	**29**			**625**				**625**	**22**

PECE 3201: Programme Elective-II

1. Wireless and Mobile Communication
2. Software Testing and Quality Assurance
3. Human Computer Interaction
4. Multimedia Systems
5. Swayam Online Course

PECE 3202: Programme Elective-III

PECE 3203: Programme Elective-III Laboratory

1. Data Mining and Data Warehousing
2. Embedded and Real-Time Systems
3. Linux Internals
4. Image Processing

AC 3201 -- Audit Course: Employability Skills Development

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CE 3201 THEORY OF COMPUTATION

Teaching Scheme
Lectures: 03 Hrs/Week
Tutorial : 01 Hrs/Week

Examination Scheme
In Semester: 50 marks
End Semester: 50 Marks
Credits: 4

Prerequisites:
1. Data Structures and Algorithms II (CE 2201)
2. Discrete Mathematics (CE 2103)

Course Objectives:
To facilitate the learners -
1. Recall and understand the basics of mathematical concepts, formal languages and machines.
2. Understand and design different computational models like finite automata, regular expression, push down automata, context free grammar, turing machine for a given language.
3. Apply inter conversion between equivalent representations of a language.
4. Learn classification of a given problem into appropriate complexity class.

Course Outcomes:
By taking this course, the learner will be able to -
1. Make use of fundamentals of mathematical concepts, formal languages and automata theory.
2. Construct different computation models like finite automata, regular expression, push down automata, context free grammar, turing machine for a given language.
3. Evaluate capabilities of Computational model by inter-conversion.
4. Classify a problem into appropriate complexity class.

Unit 1: Introduction (06)
Finite and infinite set. Basic concepts of symbol, alphabet, string. Formal Language Definition, Problems. Finite representation of languages. Concept of Basic Machine and Finite State Machine introduction.
Regular Expression (RE): definition and operators, Regular Set, Algebraic Laws of Regular Expressions, Closure Properties of Regular Languages, Regular expression examples.

Unit 2: Finite Automata (08)
Finite Automata (FA) - (Deterministic FA, Non-deterministic FA, ϵ-NFA): Definition , Transition Function and language acceptance, Transition graph, Construction of FA.
Conversion of NFA with ϵ moves to NFA without ϵ moves, Conversion of NFA without ϵ moves to DFA, Direct Conversion of NFA with ϵ to DFA, Inter-conversion of RE and FA, Construction of RE equivalent to FA using Arden's Theorem. Construction of FA equivalent to RE (RE to ϵ-NFA, ϵ-NFA to DFA). Pumping Lemma for Regular languages, Limitations of FA.

Unit 3: Context Free Grammar (07)
Grammar- Definition, representation of grammar. Context Free Grammar (CFG) - Definition, Derivation – Leftmost, Rightmost, sentential form, parse tree, ambiguous grammar and removing

ambiguity from grammar, Simplification of CFG, Normal Forms - Chomsky normal form, Greibach normal form, Closure properties of Context Free Languages (CFL), Decision properties of CFL, Chomsky hierarchy. Regular grammar- Definition, left linear, right linear grammar, Applications of grammar.

Unit 4: Push Down Automata (07)

Definition, Notations – Transition Table form, Types of PDA (Deterministic PDA and Non Deterministic PDA), acceptance by final state, acceptance by empty stack, Construction of PDA (DPDA, NPDA), Instantaneous Description of PDA. Equivalence of PDA and CFG - Grammar to PDA conversion, Applications of PDA.

Unit 5: Turing Machine (07)

Turing machines (TMs) - Formal Definition, TM Instantaneous Description, Transition Function, Languages of TM, Turing Machine and halting, Deterministic Turing Machines (DTM) , Construction of DTM. Universal Turing Machine (UTM), Church -Turing hypothesis, Comparison between FA, PDA and TM. Turing Machine Halting Problem.

Unit 6: Introduction to Undecidability (07)

A Language that is not recursively enumerable, Enumerating the binary strings, diagonalization Language, An undecidable problem that is RE, Recursive language, Complements of Recursive and RE languages, universal language, Undecidability of the universal language, classes P, NP and NP-Complete Problem

Text Books:

1. Hopcroft J., Motwani R., Ullman J., "Introduction to Automata Theory, Languages and Computations", Third edition, 2008, Pearson Education Asia. ISBN: 9788131720479
2. John C Martin. "Introduction to Language and Theory of Computation", Third edition, 2012, Tata McGraw- Hill, ISBN: 978007660489

Reference Books:

1. Daniel Cohen., "Introduction to Computer Theory", Second edition, 2011, Wiley Publications (India) ISBN: 9788126513345
2. H.R. Lewis, C. H. Papadimitrou, "Elements of the Theory of Computation", Second edition, 2006, Prentice Hall Inc. ISBN: 8131703878
3. Michael Sipser, "Introduction to The Theory of Computation", Third edition, 2017 Thomson Course Technology, ISBN: 9781131525296
4. Vivek Kulkarni, "Theory of Computation", Oxford university edition, 2013, ISBN 13:9780198084587

Web References:

1. NPTEL :: Computer Science and Engineering – Theory of Computation http://nptel.ac.in/courses/106101061

Example List of Tutorials:

1. Identify Complexity (n2, log n etc.)for a given code
2. Design of Regular Expression from Language
3. Design Deterministic Finite Automata
4. NFA design and NFA to DFA conversion
5. RE to NFA with null moves and NFA with null moves to NFA without null moves
6. Formal language to CFG and CFG to language conversion
7. Simplification of CFG and Chomsky Normal Form
8. Design of Push down Automata
9. Design of Turing Machine
10. Classification of a problem into appropriate complexity classes by reduction

CE 3202 Artificial Intelligence and Machine Learning

Teaching Scheme
Lectures: 3 Hr/Week

Examination Scheme
In Semester : 50 Marks
End Semester : 50 Marks
Credits : 3

Course Objectives:
To facilitate the learners to-
1. Learn overview of classic Artificial Intelligence and basics of machine learning.
2. Understand various intelligent searches and knowledge representation.
3. Understand types of learning as well as machine learning.
4. Study applications in Artificial Intelligence and Machine Learning.

Course Outcomes:
By taking this course, the learner will be able to –
1. Build fundamental knowledge of AI, its applications and solve classical AI problems using different AI Techniques
2. Apply intelligent search algorithms on AI problems.
3. Make use of Knowledge Management techniques of AI for reasoning.
4. Apply the appropriate supervised / unsupervised Machine Learning (ML) method to solve the given problem.
5. Apply and examine different topics with various methods of expert system, pattern recognition, natural language processing, nature inspired computing.

Unit 1: Introduction to AI **(07)**
Definitions of Artificial Intelligence, Artificial Intelligence Problems, Topics of Artificial Intelligence: Learning Systems, Knowledge Representation and Reasoning, Planning, Knowledge Acquisition, Intelligent Search, Logic Programming, Soft Computing, Management of Imprecision and Uncertainty, Production Systems: Traveling Salesman Problem, Water-Jug Problem, State Space Representation, State Space Search, Tic-Tac-Toe as a State Space, Branches of Artificial Intelligence.

Unit 2: Heuristic Search Techniques **(07)**
Generate-and-Test, Search Techniques: Depth First Search, Breadth First Search, Best First Search Algorithm, Hill Climbing, Simulated Annealing, A* Algorithm, Problem Reduction, AND–OR Graphs, The AO* Algorithm, Towers of Hanoi Problem, Constraints Satisfaction: crypt-arithmetic problem, mini-max algorithm.

Unit 3: Knowledge Management **(07)**
Knowledge Management, Types of Knowledge: Declarative Knowledge, Procedural Knowledge, Knowledge Representation, Approaches to Knowledge Representation, Issues in Knowledge Representation, First-order Logic: Basic Predicate Representations, Conversion of WFF to Clause Form, Resolution, Unification, Resolution Examples, Reasoning, monotonic and non-monotonic reasoning, Truth Maintenance Systems.

Unit 4: Learning **(07)**

Types of Learning: Rote Learning, Learning by General Problem Solving, Concept Learning, Learning by Analogy, Learning problems and designing the learning systems, Machine Learning: Types of Problems in Machine Learning, Aspects of Inputs to Training, Learning Systems, Intelligent Agents.

Unit 5: Machine Learning methods and models **(07)**

Introduction to Supervised, Unsupervised, semi-supervised Learning, Ensemble Learning, discovery based Learning, Learning by problem solving, Reinforcement Learning, Support vector Machine, Artificial Neural Network : Perceptron, multi-layer perceptron, back propagation Neural Network, Self-organizing map.

Unit 6: Applications in Artificial Intelligence and Machine Learning **(07)**

Game Playing, Expert Systems, Natural Language Processing, Image Understanding & Computer Vision, Pattern Recognition, Virtual Reality, Nature Inspired Computing.

Text Books:

1. Vinod Chandra S. S., Anand Hareendran S., 'Artificial Intelligence and machine learning', PHI, (2014), ISBN 978-81-203-4934-6.
2. Kulkarni P., Joshi P., 'Artificial Intelligence: Building Intelligent Systems', PHI Learning, (2015), ISBN 978-81-203-5046-5.

Reference Books:

1. Peter, Norvig, 'Artificial Intelligence: A Modern Approach', Pearson, (3 rd edition), (2014), ISBN-0-13-103805-2.
2. Elaine Rich, Kevin Knight and Nair, 'Artificial Intelligence', Tata McGraw – Hill, (3rd edition), (2012), ISBN-978-0-07-008770-5.
3. Bratko I., 'Prolog Programming for Artificial Intelligence', Pearson Education, (3rd edition), (2004).
4. Tom M. Michell, 'Machine Learning', McGraw Hill Education, Indian edition (2013), ISBN-13: 978-1-25-909695-2.
5. Ethem Alpaydin, 'Introduction to Machine Learning', PHI, (2006), ISBN-81-203-2791-8.

CE 3203 Software Design And Architecture

Teaching Scheme
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 4

Prerequisite: Data structures and Algorithms II (CE 2201)

Course Objectives:
To facilitate the learner to -

1. Develop familiarity with the basic concepts of software architecture and quality attributes of a system.
2. Model the software requirements of a system using Unified Modeling Language (UML) to understand the architectural, structural and behavioral aspects of the system.
3. Understand and apply various design patterns in creating an object oriented design.
4. Get exposure to the various software testing techniques and methods.

Course Outcomes:
By taking this course, the learner will be able to -

1. Apply and analyze the concepts of software architecture and quality attributes to realize the solution of a system.
2. Build structural and behavioral models using Unified Modeling Language (UML).
3. Apply and analyze various design patterns to understand reusability in object oriented design.
4. Apply various software testing techniques at unit level, suitable to different problem areas.

Unit 1: Introduction to Software Architecture **(06)**
Software Development Life Cycle (SDLC), Software Requirement Specification (SRS), What is Software Architecture, Why Software Architecture is important.

Unit 2: Design Using Unified Modeling Language (UML) **(08)**
Importance of modeling, Use case Diagrams, Activity Diagrams, Class Diagrams, Sequence Diagrams.

Unit 3: Quality Attributes **(08)**
Understanding Quality Attributes, Quality Attribute Scenarios and Tactics - Performance, Security, Usability.

Unit 4: Creational and Structural Design Patterns **(07)**

What is Design Pattern, Classification of Design Patterns, Elements of Design Pattern, Creational Design Patterns - Singleton, Factory Method, Structural Design Patterns - Proxy, Adapter.

Unit 5: Behavioral Design Patterns **(06)**

Observer, Iterator, Model View Controller (MVC), Mediator.

Unit 6: Software Testing **(07)**

Introduction, Verification and Validation, White Box testing - Structural Testing – Unit / Code functional testing, Code coverage testing, Code complexity testing, Black Box testing - Equivalence Class Partitioning, Boundary Value Analysis.

Text books:

1. Len Bass, Paul Clements, Rick Kazman, **'Software Architecture in Practice'**, *Pearson Education,* (3rd Edition)(2013).
2. Grady Booch, James Rumbaugh, Ivar Jacobson, **'The Unified Modeling Language User Guide'**, *Pearson Education,* (2nd edition)(2008).
3. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, **'Design Patterns-Elements of Reusable Object-Oriented Software',** *Pearson Education,* (2002).
4. Srinivasan Desikan, Gopalaswamy Ramesh, **'Software Testing Principles and Practices'**, *Pearson Education*, ISBN 81-7758-121-X (2013).

Reference books:

1. Len Bass, Paul Clements, Rick Kazman, **'Software Architecture in Practice'**, *Pearson Education,* (2nd Edition) (2006).
2. Mary Shaw and David Garlan, **'Software Architecture – Perspectives on an Emerging Discipline'**, *Prentice Hall of India,* (1996).
3. Richard N. Taylor, Nenad M. and Eric M. Dashofy, **'Software Architecture: Foundations, Theory and Practice'**, *Wiley,* (2006).
4. Jim Arlow and Ila Neustadt, **'UML 2 and the Unified Process –Practical Object-Oriented Analysis and Design',** *Pearson Education*, (2nd edition) (2006).
5. Iien Burnstein, **'Practical Software Testing',** *Springer (India) private limited,* (2005).

Example List of Tutorials:

1. Study architectural styles and submit a report on these styles.
2. A case study of any website or any other large system and its architecture for quality attributes requirements such as Performance, Security, Usability and Availability.

3. Design a Software Requirement Specification (SRS) document for a given system.
4. Draw Use case diagrams for capturing and representing requirements of a given system.
5. Draw Activity diagrams to display the business flows for a given system.
6. Draw Class diagrams to identify and describe key concepts like classes, relationships and other classifiers like interfaces.
7. Draw Sequence diagrams to show message exchanges in a given system.
8. Identify suitable design patterns for a given application.
9. Apply various Black Box testing methods for unit testing of a sample application.
10. Apply various White Box testing methods for unit testing of a sample application.

CE 3205 Artificial Intelligence and Machine Learning Laboratory

Teaching Scheme
Practical: 4 Hr/Week

Examination Scheme
Practical: 50 Marks
Credits : 2

Course Objectives:
To facilitate the learners to-
1. Experiment Artificial Intelligence and machine learning concepts from syllabus.
2. Experiment AI searches like A*, Min-max algorithm.
3. Understand monotonic and non-monotonic knowledge representation.
4. Experiment classification and clustering algorithms.

Course Outcomes:
By taking this course, the learner will be able to-
1. Implement and analyse various intelligent searching techniques.
2. Apply Knowledge Management techniques to implement truth maintenance system / Expert system.
3. Choose the appropriate supervised Machine Learning (ML) method and solve the given problem.
4. Choose the appropriate Unsupervised ML method and solve the given problem.

Example list of Assignments:

Assignments Group A (Mandatory)
1. Study: Learning simple statements in Prolog
2. Implement DFS/BFS for simple water jug problem
3. Implement A* algorithm for 8 puzzle problem
4. Implement Unification algorithm
5. Represent knowledge using Prolog by implementing small expert system
6. Implement Best first search algorithm

Assignments Group B (Any 3)
1. Write a program to implement Min-max algorithm for game playing
2. Write a program to implement Perceptron in artificial neural network
3. Write a program to implement SOM
4. Write a program to implement SVM/backpropagation learning algorithm

Assignment Group C
Develop any one machine learning tool for application: character/sign classification

PECE 3201 Software Testing And Quality Assurance

Teaching Scheme
Lectures: 3 Hrs/Week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

Prerequisites: -

Course Objectives:

To facilitate the learner to -

1. Develop familiarity with the fundamental concepts and the process of software testing.
2. Gain comprehensive knowledge about various software testing techniques and methods.
3. Study various software testing strategies.
4. Get exposure to the quality assurance process and its role in software development.
5. Learn the essential features of various automated testing tools used for testing different types of applications.

Course Outcomes:

By taking this course, the learner will be able to -

1. Apply various concepts and process of software testing , testing metrics and quality assurance to different scenarios.
2. Apply and analyze various software testing techniques and strategies to different problem areas.
3. Build the essential test cases at various phases of software testing life cycle.
4. Apply and compare techniques of automated testing and modern testing tools for testing various types of applications.

Unit 1: Introduction **(06)**

Need of testing, Basics of Software Testing, Testing Principles, Goals, Software Testing Life Cycle, Defects, Defect management, Verification and validation, Test Plan.

Unit 2: Black Box Testing **(08)**

Introduction, Need of black box testing, Testing Methods - Requirements based testing, Positive and negative testing, Equivalence Class Partitioning, Boundary value analysis, Decision table / Cause effect graphing, State based testing, Domain testing, Examples of Black-Box testing.

Unit 3: Testing Strategies and System Testing **(07)**

Unit, Integration, System, Acceptance testing, Usability testing, Regression testing, Scenario testing, Adhoc testing, Functional, Performance testing, Stress testing, Security testing, Alpha-Beta testing.

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Unit 4: Testing Metrics and Quality Assurance **(07)**

Testing Metrics and measurements, Types of metrics – Project, Progress, Productivity, Software quality, Quality control and assurance, Quality factors, Software Quality Assurance (SQA) Model - Six Sigma, Ishikawa's Seven Basic Tools.

Unit 5: White Box Testing **(07)**

Introduction, Need of white box testing, Testing types, Static testing, Structural Testing – Unit / Code functional testing, Code coverage testing, Code complexity testing, Challenges in White box testing, Examples of White-Box testing.

Unit 6: Recent Trends and Automated Testing **(07)**

Agile Testing, Model based testing, Need for Automation, Keyword driven automation, Data driven automation, Manual testing versus Automated testing, Automated Testing Tools, Selection of tool, Study of Testing tools and frameworks (such as Selenium, JUnit, Bugzilla).

Text books:

1. Iien Burnstein, **'Practical Software Testing'**, *Springer (India) private limited* (2005).
2. Srinivasan Desikan,Gopalaswamy Ramesh, **Software Testing Principle and Practices'**, *Pearson Education*, ISBN 81-7758-121-X (2013).
3. Nageshwar Rao Pusuluri, **'Software Testing Concepts and Tools'**, *Dreamtech press*, ISBN 81-7722-712-2 (2008).

Reference books:

1. Ron Patton, **'Software Testing'**, *Pearson Education*, ISBN-13: 978-0-672-32798-8 (Second Edition) (2013).
2. Stephen H Kan, **'Metric and Model in Software Quality Engineering'**, *Pearson Education* ISBN 81-297-0175-8 (Second Edition) (2006).
3. William Perry, **'Effective Methods for Software Testing'**, *Wiley Publication*, ISBN 81-265-0893-0 (Third Edition) (2006).
4. Dr. K.V.K.K. Prasad, **'Software Testing Tools'**, *Dreamtech Press* ISBN: 10:81-7722-532-4 (2008).
5. Naresh Chauhan, **'Software Testing Principles and Practices'**, Oxford *University Press*, ISBN 0-19-806184-6 (2011).

Web References

1. http://www.seleniumeasy.com/selenium-tutorials
2. https://www.tutorialspoint.com/junit
3. https://www.bugzilla.org

PECE 3201 Human Computer Interaction

Teaching Scheme
Lectures: 3 Hrs /week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

Course Objectives:
To facilitate the learner to-
1. Identify the main modes of human computer interaction.
2. Identify the common pitfalls in data analysis, interpretation and presentation.
3. Understanding the use of prototyping and evaluation in design.
4. Understand the advanced techniques of Human Computer Interaction.

Course Outcomes:
By taking this course, the learner will be able to:
1. Apply the concepts of HCI to enhance the user experience.
2. Select the appropriate data gathering techniques and establish the requirements for the good design.
3. Apply the fundamental aspects of designing and evaluating the interfaces.
4. Compare the advanced techniques of Human Computer Interaction.

Unit 1: Introcuction to Interactive Design **(08)**
What is HCI – design, models, evaluation, Need to understand people, computers and methods.
Humans – Memory, Attention Span, Visual Perception, psychology, ergonomics.
Computers – speed, interfaces, widgets, and effects on interaction.
Understanding Users, Universal Design, User-centered design.

Unit 2: Design Process and Interaction Styles **(08)**
HCI in the Software Process, HCI design principles and rules, Shneiderman's golden rules, Normans seven principles, Nielsens ten heuristics with example of its use.
Interaction Styles, Direct Manipulation - Menu selection, Form Fill-in and Dialog Boxes

Unit 3: Establishing Requirements **(07)**
Understanding importance of identifying the requirements, Different kinds of requirements, Data gathering for requirements, Data analysis, Data interpretation and presentation, Task description and analysis.

Unit 4: Design, Prototyping, and Construction **(06)**
Prototyping and construction, Conceptual design, Physical design, User Persona, Using scenarios in design, Using prototypes in design and support for design, Handling errors and designing help.

Unit 5: Evaluation Approaches **(06)**
Importance of evaluation, Evaluation approaches and methods, Evaluation case studies, Determine, Explore, Choose, Identify, Decide, Evaluate (DECIDE): A Framework to guide evaluation.

Unit 6: New Interaction Technologies **(07)**
Explicit and Implicit Human Computer Interaction, User Interfaces and Interaction for Four Widely Used Devices, Hidden User Interface via Basic smart Devices, Hidden User Interface via Wearable and Implanted Devices.

Text books:

1. Rogers, Sharp, Preece, 'Interaction Design', Wiley Publications (India), (Third edition), (2014).
2. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, 'Designing the User Interface: Strategies for Effective Human-Computer Interaction', Pearson Education Limited (India),(2010).
3. Stefan Poslad, 'Ubiquitous Computing', Wiley Publications (India), (2014).

Reference Books:

1.Alan Dix, 'Human Computer Interaction', Pearson Education Limited (Third edition), (2004).
2.Wilbert O. Galitz, 'The Essential Guide to User Interface Design', Wiley Publications (Second edition), (2003).
3.John M. Carroll, 'Human-Computer Interaction', Pearson Education Limited, (2002).
4.Don Norman, 'The Design of Everyday Things', Basic Books, A member of the Perseus Books Group, (2013).

PECE 3201 – Multimedia Systems

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:

To facilitate the learners to -

- Understand basics of Multimedia Systems.
- Understand various file formats.
- Learn Multimedia editing tools.
- Analyze various compression techniques.
- Learn advances in multimedia.

Course Outcomes:

By taking this course, the learner will be able to

- Build the knowledge of multimedia systems and its characteristics.
- Utilize text and audio file formats and compression techniques in multimedia applications.
- Apply digital image and video processing techniques useful in multimedia applications.
- Build the knowledge of animation and Virtual reality concepts.
- List and analyse advances in multimedia.

Unit – I: Introduction to Multimedia **(06)**

What is Multimedia? (Text, Graphics, Audio, Video, Animation), Multimedia presentation and production, Multimedia Authoring Tools (Various tools for creation and editing of Multimedia Projects), Hardware and Software requirement for Multimedia, Multimedia Applications

Unit – II: Text and Audio **(08)**

Text - Introduction, About Fonts and Faces, Using Text in Multimedia, Font Editing and Design Tools, Text Compression (HUFFMAN, LZ, LZW), File Formats (TXT, DOC, RTF, PDF, PS), Hypertext and Hypermedia.

Audio – Introduction, Characteristics of Sound, Elements of Sound System, Digital Audio, Synthesizer, MIDI, Audio File Formats (WAV, VOC, MP3) , Audio Processing Softwares.

Unit – III: Images **(07)**

Digital Image, Basic steps for image processing, Image file formats (BMP, TIFF), Image Compression (RLE, JPEG), Image Manipulation, Image processing softwares.

Unit – IV: Video **(07)**

Types of Video Signals, Analog Video, Digital Video, Video File Formats and CODEC (AVI, MPEG), Video Editing Softwares.

Unit – V: Animation and Virtual Reality **(07)**

Animation- Introduction, Uses, Types, Principles, Animation on Web, 3D animation, Rendering, Animation Softwares
Virtual reality - Introduction, Forms, Applications, Software Requirements, Devices, VRML

Unit VI: Introduction to Advances in Multimedia **(07)**

Introduction, Challenges of Multimedia Information processing, Watermarking, Organization, Storage and retrieval Issues, Neural Networks for multimedia processing, Multimedia Processors

Text Books:

1. Ranjan Parekh, **'Principles of Multimedia'**, *McGraw Hills education*, (2nd edition), (2013)
2. Ralf Steinmetz, Klara Nahrstedt, **'Multimedia: Computing, Communications and Applications'**, *Pearson*, (8th Impression 2011)
3. Nigel Chapman & Jenny Chapman, **'Digital Multimedia'**, *Wiley Publications*, (2nd edition) (2004)

Reference Books:

1. Ze-Nian Li, Marks S. Drew, **'Fundamentals of Multimedia'**, *Pearson Education*, (2005)
2. Tay Vaughan , **'Multimedia: Making it work'**, *Tata McGraw-Hill*, (8th edition), (2011)
3. Judith Jeffcoate, **'Multimedia in Practice'**, *Prentice Hall of India*, (2003)

PECE 3202 Data Mining and Data Warehousing

Teaching Scheme
Lectures: 3 Hrs /week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 marks
Credits: 3

Prerequisite: Database Management Systems (CE 3102)

Course Objectives:
To facilitate the learners to -
1. Understand the concepts and techniques of data mining and data warehousing.
2. Apply various data pre-processing and visualization techniques.
3. Design and model a data warehouse and its components.
4. Compare and analyze various Data Mining algorithms based on performance parameters.
5. Understand advances in the field of Data Mining.

Course Outcomes:
By taking this course, the learner will be able to -
1. Demonstrate the need, importance and procedure of building a Data Warehouse (DW) to solve any Business Intelligence (BI) problem
2. Choose and apply appropriate pre-processing techniques to make data ready for further analysis
3. Design a Data warehouse model for the given application
4. Compare and analyze the strengths and weaknesses of various data mining algorithms
5. Understand the advances in the field of Data Mining.

Unit 1: Introduction to Data Warehousing and Data Mining (06)
Introduction to data warehousing and data mining, Evolution of decision support systems, operational data Vs. historical data (Data Warehouse data), importance of data preparation for data mining, types of data mining techniques, various data mining functionalities, data mining task primitives, integration of operational system and Data Warehousing system.

Unit 2: Data Preprocessing (08)
Introduction / overview of data pre-processing; Descriptive data summarization – Measuring central tendency, dispersion, range, quartiles, variance and standard deviation of data, Graphical displays of descriptive data summaries; Data cleaning, Data Integration, Data Transformation, Data Reduction.

Unit 3: Data Warehouse and Online Analytical Processing (OLAP) Technology (07)
3-tier Data Warehouse architecture, data warehouse design process; Modelling subject(s), dimensions and measures, Multidimensional data modelling, Introduction to OLAP, OLAP operations, Data cube generation, Concept hierarchy generation, Case study on designing a Data warehouse for a given application.

Unit 4: Data mining Functionalities – I **(07)**

Data mining process, Types of Data Mining Systems; Cluster Analysis - Types of Data In Cluster Analysis, Categorization of Major Clustering Methods, k-means clustering, Density based Clustering.

Unit 5: Data mining Functionalities – II **(08)**

Classification and Regression, Decision Tree Induction, Bayesian Classification, Nearest Neighbor approach; Mining frequent patterns and Association Rules – Apriori Algorithm, Outlier analysis.

Unit 6: Advances in Data Mining **(06)**

Information Retrieval and Text Mining, Multimedia Data Mining, Graph Mining, Mining World Wide Web, Stream, Time series and Sequence data mining, Applications and trends in Data Mining.

Text Books:

1. Han, J., and Kamber, M., 'Data Mining: Concepts and Techniques', Morgan Kaufmann, (3 rd edition), (2011)
2. Tan P.N., Steinbach M., Kumar V., 'Introduction to Data Mining', Addison Wesley, (2 nd edition), (2006)

Reference Books:

1. W. H. Inmon, 'Building the Data Warehouse', Wiley, (4 th edition).
2. Alex Berson, Stephen J, 'Data Warehousing, Data Mining, & OLAP', Tata McGraw- Hill, (2004).
3. Dunham M.H., 'Data Mining: Introductory and Advanced Topics', Prentice Hall, (2003).
4. Miller T. W., 'Data and Text Mining - A Business Applications Approach', Pearson education, (2008).
5. Maimon O., Rokach L., 'Data Mining and Knowledge Discovery Handbook', Springer, (2009).
6. Pujari A K, 'Data Mining Techniques', Universities Press, (2010).

Web References:

1. www.autonlab.org/tutorials : Statistical Data mining Tutorials
2. www-db.standford.edu/ullman/mining/mining.html : Data mining lecture notes
3. ocw.mit.edu/ocwweb/slon-School-of-management/15-062Data-MiningSpring2003/course home/index.htm : MIT Data mining open course ware
4. www.kdnuggets.com : Data mining resources

PECE 3203 Data Mining and Data Warehousing Laboratory

Teaching Scheme
Practical: 2 Hrs / week

Examination Scheme
Oral: 25 marks
Credit: 1

Course Objectives:
To facilitate the learners to -

1. Model and build a data mart / data warehouse.
2. Study and analyze various open source data sets to pre-process them using open source data mining tools.
3. Implement data mining algorithms to discover interesting patterns.
4. Analyze results of data mining algorithms

Course Outcome:
By taking this course, the learner will be able to –

1. Study and process raw data to model and build a data warehouse, using appropriate schema
2. Experiment with large open source datasets by applying pre-processing tools and techniques
3. Build and analyze various data mining algorithms on real time data
4. Implement advanced Data Mining functionalities such as Text Mining and Mining unstructured data .

Example List of Assignments

Assignments Group A (Mandatory)

1. Explore WEKA Data Mining / Machine Learning Toolkit and perform the following operations: Understand the features of WEKA toolkit, Study the arff file format, explore the available data sets in WEKA.
2. Load any one dataset in Weka and observe the following : List the attribute names and their types, Number of records in each dataset, class attribute (if any), Plot Histogram, Determine the number of records for each class, Visualize the data in various dimensions; Apply various pre-processing tasks; Apply classification OR clustering algorithms on the chosen dataset and observe the results
3. Implement K-means clustering algorithm using a programming language that you are familiar with such as Java / Python. Compare the performance of your algorithm on the dataset, used in Weka, on different parameters such as accuracy, scalability, efficiency etc. by changing input parameter value such as K.

Assignments Group B (Any 2)

1. Implement DBSCAN clustering algorithm. Compare the performance of your algorithm on the dataset, used in Weka, on different parameters such as accuracy, scalability, efficiency etc.
2. Implement a decision tree classification algorithm. Compare the performance of your algorithm on the dataset, used in Weka, on different parameters such as accuracy, scalability, efficiency etc.
3. Implement Apriori, a Frequent Pattern Analysis algorithm. Assume suitable data. Compare the performance of your algorithm on the dataset, used in Weka, on different parameters such as accuracy, scalability, efficiency etc.
4. Implement Information Retrieval using TF / IDF algorithm. Assume suitable data.

Assignments Group C (Any 1)

1. Build a Data Warehouse / Data Mart (using open source tools like Pentaho or other data warehouse tools like Microsoft-SSIS etc.) Identify source tables and populate sample data Analyze which multidimensional model (Star, snowflake and Fact constellation) will be best suited for the given application and design the schema (Example Applications can be Banking, Insurance, Finance, Healthcare, Manufacturing, Automobile, etc.)
2. Study any of the existing data warehouse / data repository / ... and prepare your report based on data / model / tools and techniques / software used etc.
3. Download, install and study the features of any open source data mining
4. compare its features with Weka.

PECE 3202 Elective IV Image Processing

Teaching Scheme
Lecture : 3 Hrs/week

Examination Scheme
In semester : 50 marks
End semester : 50 marks
Credits : 3

Course Objectives:

To facilitate the learner to-

1. Understand basic concepts of digital image processing.
2. Learn and apply image enhancement and Image Segmentation techniques.
3. Understand object Recognition, Image Restoration and reconstructions.
4. Learn and apply image compression techniques and Understand image processing applications.

Course Outcome:

By taking this course, the learner will be able to -

1. Identify basic steps of digital image processing.
2. Select, Examine, Justify the image enhancement techniques and Image Segmentation techniques on images.
3. Identify Image Restoration, reconstructions techniques.
4. Examine image compression techniques. Identify fundamental steps required for different image processing applications.

Unit 1: Introduction to Image Processing **(07)**

Introduction to digital image processing: Origin, usage and application of image processing, Fundamental steps and component of image processing system,introduction to Human Visual System,Image sensing and acquisition,Basic concepts in sampling and quantization,representation of digital images. Elements of matrix theory

Unit 2: Image Enhancement Techniques **(08)**

Basic image preprocessing (contrast enhancement, simple noise reduction, color balancing), some basic gray level transformations,Histogram Processing,Arithmetic Operations,Spatial filtering, Smoothing and Sharpening Spatial filters,Image Enhancement in the Frequency Domain, Gaussian filters,Homomorphic filtering.

Unit 3: Image Compression **(07)**

Introduction to Image Compression and its need, Coding Redundancy,Classification of Compression Techniques (Lossy and Losless - JPEG,RLE, Huffman, Shannon fano), Scalar & Vector Quantization.

Unit 4: Image Restoration & Reconstruction. **(06)**

Model of Image degradation, Noise Models,Classification of image restoration techniques,Blind-deconvolution techniques,Lucy Richardson Filtering, Wiener Filtering.

Unit 5:

Image Segmentation, Analysis and Object Recognition. **(08)**

Introduction to feature extraction: Edges, Lines & corners detection,Texture & shape measures.
Segmentation & thresholding, region extraction, edge (Canny) and region based approach, use of motion in segmentation.
Introduction to Object Recognition, Object Representation(Signatures, Boundary Skeleton), Simple Boundary Descriptors, Regional descriptors (Texture).

Unit 6: Advances in Image processing Applications **(06)**

Medical Image Processing, Face detection, Iris Recognition, Remote Sensing, Synthetic-aperture radar (SAR) Image Processing

Text Books:

1. R.C. Gonzalez, R.R. Woods, **'Digital Image Processing'**, ISBN 978-81-317-2695-2,*Person (*Third Edition) ,(2011)(62 copies)
2. S.Jayaraman, S. Esakkirajan,T. Veerakumar , **'Digital Image processing',**ISBN 978-0-07-014479-8, *Mcgraw Hills Publication (Tenth reprint),(2013)*

References:

1. Sonka, Hlavac, Boyle, '**Digital Image Processing and Computer Vision',** ISBN 978-81-315-0555-7,*Cenage Learning* (Sixth Indian Reprint) ,(2011)
2. B. Chanda, D.Datta Mujumdar '**Digital Image Processing And Analysis',** *PHI,* ISBN 978- 81-203- 4325-2, (Second Edition),(2013)
3. Sridhar S. '**Digital Image Processing',** *Oxford University Press, (Second Edition),(2016)*
4. Anil Jain, '**Fundamentals of Digital Image Processing'**, *PHI,* ISBN-81-203-0929-4 (Indian Reprint) ,(1995)

5Basudeb Bhatta ' **Remote Sensing and GIS'** *Oxford University Press,* ISBN 978-0-19-807239-3 (Second Edition)(2014)

PECE 3203 Elective IV Image Processing Laboratory

Teaching Scheme
Practical: 2Hrs/week
Credits: 1

Examination Scheme
Oral : 25 Marks

Course Objectives:

To facilitate the learners to -

1. Learn Basics Image Processing operations like image Read, Write, add, subtract.
2. Understand and apply algorithms used for image enhancement, edge detection.
3. Design Image Processing application using various techniques.
4. Learn and use different Image Processing Tools.

Course Outcome:

By taking this course, the learner will be able to –

1. Make use of basic operations of image processing on the given image.
2. Apply and analyze image enhancement techniques and image segmentation techniques
3. Develop small image processing application
4. Make use of Image Processing tool.

Example list of Assignments:

Group A: (Mandatory)

1. Write a program to create a simple image file in .tiff format, and display it .
2. Write a program to perform Intensity Transformation techniques on given image.
3. Write a program for image enhancement techniques.

Group B: (Any Three)

1. Write a program using derivative filtering techniques for edge detection .
2. Write a program to illustrate Morphological transformation using Dilation.
3. Write a program to illustrate Morphological transformation using Erosion.
4. Write a program to illustrate Image Restoration techniques.

Group C: (Any One)

Develop any one of the Image processing application using MATLAB/OpenCV (in Limited Scope).

1. Medical Image Processing
2. Face detection
3. Iris Recognition
4. Finger Print detection

CE 3204 SEMINAR

Teaching Scheme
Practical : 4 Hrs./week

Examination Scheme
In semester : 25 marks
Oral : 25 marks
Credits : 2

Course Objectives:
To facilitate the learners :-

1. To identify the topic based on current engineering trends/ social problems/ new technologies.
2. To explore the basic principles of communication (verbal and non verbal) and active, empathetic listening, speaking and writing techniques.
3. To produce relevant technical documents by following best practices of technical writing.
4. To understand the basic principles of presentation, technical writing techniques for seminar.

Course Outcome:
By taking this course, the learner will be able to :

1. Select appropriate/reserach topic and write a technical report and present it to audience.
2. Be familiar and use the basic technical writing concepts and terms such as audience analysis, jargon, format, visuals and presentation.
3. Improve skills to read, understand and interpret material on technology.
4. To enhance technical communication and presentation skills.

General Guidelines for Seminar:

- Seminar is an individual student activity.
- The area/domain must be selected under the guidance of institute guide.
- Each student will select a topic in the current/new trends of Computer Engineering and Technology beyond the scope of syllabus avoiding the repetition in consecutive years.
- Student should do - literature survey based on IEEE/ACM/Springer/Digital Library papers or technical Magazines/books, specify knowledge area, brief technical knowledge about the topic.
- Each student will make a seminar presentation based on the domain topic using audio/video aids for a duration of 20-25 minutes.
- Student have to submit the technical seminar report in the department.

Guidelines for assessment:

- Internal guide will evaluate students on understanding of topic, punctuality and Timely Completion of Report, Paper presentation/Publication and Attendance.
- An external examiner(s) panel will be assessing the seminar work based on these parameters - Understanding of Topic, flow of Contents, Presentation, report, Paper presentation/Publication, Question and Answers, Active Participation.

References:

1. Research papers from reputed journals/transactions- references necessary for the Project.
2. Reference books/Magazines for conceptual technical support.