Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology

Vidyanagari, Baramati, Dist. – Pune 413133
An Autonomous Institute Approved by AICTE and affiliated to SPPU,Pune

Department of Computer Engineering

Curriculum Structure and Syllabus of Third Year B. Tech Computer Engineering (Course 2024)

With effective from Academic Year 2026-27

INSTITUTE VISION AND MISSION

VISION

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

MISSION

1. To ensure holistic development of students as lifelong learners and problem solvers through value based quality education.

2. To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards co- creation of knowledge

3. To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.

4. To partner with industry for mutually beneficial relations to generate employable and deployable workforce.

5. To fulfill the aspirations of alumni, parents, society, region and nation at large by generating technically competent.

DEPARTMENT VISION AND MISSION

VISION

To achieve excellence in the field of Computer Engineering with consistent and collaborative efforts of every individual

MISSION

1. To develop students with fundamental advanced tools and technologies to work as skilled Computer professionals with ethical values.

2. To promote faculty for higher education and expose them to current trends to enrich educational quality.

3. To provide appropriate environment with required resources to achieve academic excellence.

4. To develop hand-in-hand relations with industries for catering institute-industry needs.

5. To apply collaborative efforts to make students competent to provide solutions to social problems.

Program Specific Outcomes (PSO)

PSO1: Professional Skills

- Apply knowledge of algorithms, web design, databases, operating systems, data analytics, and networking to understand, analyze, and develop computer programs for the efficient design of computer-based systems with varying levels of complexity

PSO2: Problem-Solving Skills

- The capability to implement standard practices and strategies in software project development within open-ended programming environments, capability to utilize modern programming languages, environments, and platforms to build innovative career paths, pursue entrepreneurship, and foster enthusiasm for higher studies.

Program Educational Objectives (PEO)

1. Students will be able to apply the fundamentals, domain knowledge and modern technology of computer engineering to a provide effective and innovative solutions to engineering problems

2. Students will be able to solve societal challenging and multidisciplinary problems applying suitable resources

3. Students will be able to work as competent professional as an individual and a team member

Program Outcomes (POs)

PO1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	**Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	**The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	**Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	**Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Computer Engineering
Syllabus: Third Year (TY B. Tech.) Computer Engineering
2024 Pattern w.e.f. AY:2026-2027
SEMESTER-V

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	CO24301TH	Theory of Computation	3	-	-	10	30	60	-	-	-	100	3	-	-	**3**
PCC	CO24302TH	Deep Learning	3	-	-	10	30	60	-	-	-	100	3	-	-	**4**
PCC	CO24302PR	Deep Learning	-	2	-	-	-	-	-	30	-	30	-	1	-	
PCC	CO24303TH	Database Management System	3	-	-	10	30	60	-	-	-	100	3	-	-	**4**
PCC	CO24303PR	Database Management System Lab	-	2	-	-	-	-	-	30	-	30	-	1	-	
PEC	CO24304TH	Program Elective Course-I	3	-	-	10	30	60	-	-	-	100	3	-	-	**4**
PEC	CO24304PR	Program Elective Course-I	-	2	-	-	-	-	-	-	30	30	-	1	-	
MDM	MD240XTH	Multi-disciplinary minor	3	-	-	10	30	60	-	-	-	100	3	-	-	**4**
MDM	MD240XPR	Multi-disciplinary minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
VSEC	CO24305PR	Java Programming	-	2	1	10	-	-	30	30	-	70		2	-	**2**
	Total		**15**	**10**	**1**	**60**	**150**	**300**	**60**	**90**	**30**	**690**	**15**	**6**	**-**	**21**

List of Electives, Multi-Disciplinary Minor

Code	Program Elective-I
CO24304A	Information Retrieval
CO24304B	Artificial Intelligence
CO24304C	Internet of Things

Academic Coordinator	Head of Department	Dean Academics	Principal
Dr. M. D. Shelar	Dr. A. M. Jagtap	Dr. S. M. Bhosle	Dr. S. B. Lande

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Computer Engineering
Syllabus: Third Year (B. Tech.) Computer Engineering
2024 Pattern w.e.f. AY:2026-2027
SEMESTER-VI

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	CO24311TH	Computer Networks	3	-	-	10	30	60	-	-	-	100	3	-	-	**4**
PCC	CO24311PR	Computer Networks	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	CO24312TH	Design Analysis of Algorithms	3	-	-	10	30	60	-	-	-	100	3	-	-	**3**
PEC	CO24313TH	Program Elective Course-II	3	-	-	10	30	60	-	-	-	100	3	-	-	**4**
PEC	CO24313PR	Program Elective Course-II	-	2	-	-	-	-	-	-	30	30	-	1	-	
PEC	CO24314TH	Program Elective Course-II	3	-	-	10	30	60	-	-	-	100	3	-	-	**4**
PEC	CO24314PR	Program Elective Course-II	-	2	-	-	-	-	-	-	30	30	-	1	-	
MDM	X24XXXTH	Multi-disciplinary minor	2	-	-	10	-	60	-	-	-	70	2	-	-	**3**
MDM	X24XXXPR	Multi-disciplinary minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
OE	OE240XX	Open Elective	3	-	-	10	30	60	-	-	-	100	3	-	-	**3**
	Total		**17**	**8**	**-**	**60**	**150**	**360**	**30**	**-**	**90**	**690**	**17**	**4**	**-**	**21**

List of Electives, Multi-Disciplinary Minor and Open Elective

Code	Program Elective-II	Code	Program Elective-III
CO24313A	Parallel and Distributed Systems	CO24314A	Software Architecture & Design Pattern
CO24313B	Web Technology	CO24314B	Software Testing and Quality Assurance
CO24313C	Data Mining	CO24314C	Foundation of Cloud Computing

Academic Coordinator	Head of Department	Dean Academics	Principal
Dr. M. D. Shelar	Dr. A. M. Jagtap	Dr. S. M. Bhosle	Dr. S. B. Lande

Multi-Disciplinary Minor and Open Elective

Multidisciplinary Minor (MDM) Subjects 2024 Pattern			
AI24051	Data Processing and Analysis	ET24053	Internet of Things
AI23052	Fundamentals of Programming Language	ET24054	Microprocessor Architecture
CO24051	Computer Graphics & Gaming	CE24051	Waste Management
CO24052	Object Oriented Programming	CE24052	Green Building & Smart Cities
IT24051	Cyber Security	ME24051	Introduction to 3D Printing Technologies
IT24052	Full Stack Development	ME24052	Introduction to Robotics & Automation
IT24053	Data Structures	ME24053	3D Printing
ET24051	Embedded Systems	ME24054	Robotics & Automation
ET24052	Drone Technology	EL24051	Solar Technology

Open Electives (OE) Subjects			
OE23001	Digital Marketing	OE23011	Biotechnology
OE23002	Professional Leadership	OE23012	International Relations
OE23003	Organizational Behavior	OE23013	Universal Human Values
OE23004	Industrial Management	OE23014	Education Technology
OE23005	Disaster Management	OE23015	Design Thinking
OE23006	Energy Economic & Management	OE23016	Financial Literacy for Bharat#
OE23007	Operation Research	OE23017	Sustainability & Climate Change
OE23008	Intellectual Property Rights	OE23018	Agriculture Technology
OE23009	Cyber Laws	OE23019	Architectural Technology
OE23010	Bioinformatics		

Semester I

CO24301 : Theory of Computation

Teaching Scheme	Credit: 04	Examination Scheme
TH 03 Hrs/Week	TH Credit :03 PR Credit :01	Course Activity: 10 Mark In Semester: 30 Mark End Semester: 60 Mark Term work: 30 Mark

Prerequisite: Discrete Mathematics, Problem solving knowledge

Course Objective:

- To make students understand the concept of language.
- To make students aware about the representation of languages in Computer.
- To make students compatible to construct Grammar, PDA's and Turing Machine
- To introduce students to the complexity word along with problem classes.

Course Outcomes:

CO1: **Design** of finite automata for the formal language.
CO2: **Construction** of regular expression for the regular language and design it's equivalent FA.
CO3: **Design** context free grammar, apply simplification and generate context free language.
CO4 : **Construct** Pushdown Automaton model for the Context Free Language
CO5: **Design** of Turing Machine for the computational problems.
CO6: **Understand** the different classes of problem and NP-completeness

Course Activity (Any one):

- Writing Context free grammar for any Indian language simple statement.
- Study of Scanner and Parser Tools eg. Lex or Yacc
- Design parser for checking expression syntax
- Preparation of charts describing Regular Expression operators and algebraic laws of RE

Course Contents

Mapping of Course Outcomes for Unit I	CO1

UNIT I	Introduction to Language and Finite Automata	07 Hours

Strings and languages: Symbol, Alphabet, String/Word. Formal Language – Definition.
Finite Automata (FA): An informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language, Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA and inter-conversion.
Moore and Mealy machines –Definition, Design, Inter-conversion**.**

Mapping of Course Outcomes for Unit II	CO2

UNIT II	Regular Expressions	07 Hours

Introduction, Operators of RE, Precedence of operators, Algebraic laws for RE,
Language to Regular Expressions, Conversions: RE to NFA, DFA, DFA to RE using Arden's theorem, State elimination method, Pumping Lemma for Regular languages, Closure and Decision properties of Regular languages

Mapping of Course Outcomes for Unit III	CO3

UNIT III	Context Free Language	07 Hours
Introduction to Grammar, Chomsky Hierarchy, formal definition of Context Free Grammar, Sentential form, Derivation and Parse Tree, Ambiguous Grammar, Context Free Language (CFL), writing grammar for language. **Simplification of CFG**, **Normal Forms**: Chomsky Normal Form and Greibach Normal Form, Closure properties of CFL, Decision properties of CFL		
Mapping of Course Outcomes for Unit IV	**CO4**	
UNIT IV	**Pushdown Automata (PDA)**	**07 Hours**
Introduction to PDA, Formal definition of PDA, Acceptance of PDA by final state and empty stack. Non-deterministic PDA (NPDA), PDA and Context Free Language, Equivalence of PDA and CFG, PDA vs. CFL's, Top-down parser, Bottom-up parser		
Mapping of Course Outcomes for Unit V	**CO5**	
UNIT V	**Turing Machines (TM)**	**07 Hours**
Turing Machine Model, Formal definition of Turing Machines, Acceptance by Turing Machines, Design of TM, Description of TM, Techniques for TM Construction, Computing function with Turing Machine, **Variants of Turing Machines**: Multi-tape Turing machines, Nondeterministic Turing machines, **Halting Problem** of Turing Machine, Halting vs. Looping, Turing unrecognizable language		
Mapping of Course Outcomes for Unit VI	**CO6**	
UNIT VI	**Computability and Complexity Theory**	**06 Hours**
Computability Theory: Decidable Problems and Un-decidable Problems, tractable, intractable problem, Post correspondence problem **Reducibility**: Undecidable Problems that is recursively enumerable, A Simple Un-decidable problem **Complexity Classes**: Time and Space Measures, The Class P, The Class NP, NP-completeness, NP-complete, NP-hard problem.		

Books and Other Resources

Text Books:

1. Vivek Kulkarni, "Theory of Computation", Oxford University Press, ISBN 0-19-808458
2. K. L. P. Mishra, N. Chandrasekaran , "Theory of Computer Science :Automata, Languages and Computation, 3rd Edition, Prentice-Hall India, ISBN-81-203-2968-6

Reference Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman,"Introduction to Automata Theory Languages and Computation", Addison-Wesley, ISBN 0-201-44124-1
2. John Martin, "Introduction to Languages and The Theory of Computation", 2nd Edition, McGrawHill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5

NPTEL Course:

1. https://onlinecourses.nptel.ac.in/noc25_cs70/preview
2. https://archive.nptel.ac.in/courses/106/104/106104028/

Guidelines for Term Work Assessment : Term-work will be awarded on following parameters

- Timely submission of tutorial assignments
- Assessment marks awarded to each tutorial
- Theory and Tutorial attendance
- Performance in internal tests and in-semester examination

Tutorial Assignment
Tutorials will be based on the basic concepts covered in five units which includes Mathematical preliminaries (sets, relations, functions, logic), Regular languages and finite automata (DFA, NFA, Regular Expressions), Context-free languages and pushdown automata (CFG, PDA), Turing Machines and decidability. **Guidelines** • Instructor must frame maximum three tutorials on each unit. • Tutorial must include equivalent theory and computational examples. • Case study for the Time complexity and computational problems, NP-Completeness

CO24302 : Deep Learning

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week	TH Credit :03	Course Activity: 10 Mark
PR: 02 Hrs/Week	PR Credit :01	In Semester: 30Mark
		End Semester: 60 Mark
		Practical: 30 Mark

Prerequisite: Students are expected to have a good understanding of Discrete Mathematics, Data Structures and Algorithms

Course Objective:

- To introduce the fundamental concepts of neural networks and deep learning.
- To understand training algorithms and optimization techniques used in deep learning.
- To study different deep learning architectures for image and sequence data.
- To implement deep learning models using modern frameworks.
- To analyze the performance and applications of deep learning models.

Course Outcomes:

1. Explain the fundamentals of artificial neural networks and deep learning models.
2. Apply optimization techniques and regularization methods in neural networks.
3. Implement convolutional neural networks for image processing tasks.
4. Apply recurrent neural networks for sequence and time-series data.
5. Understand transformer-based models and modern NLP techniques.
6. Apply deep learning models to solve real-world applications.

Course Activity :

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Database Mini Project
2. Survey on uses of Advanced Database with emerging technology presentation
3. Industry Visit
4. Seminar
5. Research Paper in database domain

Course Contents

Mapping of Course Outcomes for Unit I		CO1
UNIT I	**Introduction to Deep Learning**	**07 Hours**

Introduction to Artificial Intelligence, Machine Learning and Deep Learning; limitations of traditional machine learning approaches; bias–variance tradeoff; overfitting and underfitting; motivation and advantages of deep learning.

Biological neuron vs artificial neuron; perceptron model; limitations of perceptron; implementation of logical functions (AND, OR, XOR); introduction to multilayer perceptron (MLP); architecture of feedforward neural networks. overview of deep learning frameworks such as TensorFlow and PyTorch;

Mapping of Course Outcomes for Unit II		CO2
UNIT II	**Neural Network Training and Optimization**	**07 Hours**

Activation functions including Sigmoid, Tanh, ReLU and Softmax; loss functions for regression and classification; gradient descent optimization; stochastic gradient descent and mini-batch learning; backpropagation algorithm.

Vanishing and exploding gradient problems; weight initialization techniques; optimization algorithms including Momentum, RMSProp and Adam; regularization methods such as L1/L2 regularization, dropout and early stopping.

Mapping of Course Outcomes for Unit III	**CO3**

UNIT III	**Convolutional Neural Networks (CNN)**	**07 Hours**

Convolution operation; padding and stride; pooling layers (max pooling, average pooling); architecture of CNNs; classic models such as LeNet, AlexNet and VGG; image classification using CNN; data augmentation techniques; introduction to transfer learning.

Mapping of Course Outcomes for Unit IV	**CO4**

UNIT IV	**Recurrent Neural Networks (RNN)**	**07Hours**

Sequential data modeling; basic recurrent neural networks; backpropagation through time; vanishing gradient problem in RNNs; Long Short-Term Memory (LSTM); Gated Recurrent Unit (GRU); sequence prediction tasks; applications in language modeling and time-series forecasting.

Mapping of Course Outcomes for Unit V	**CO5**

UNIT V	**Transformer Model and Modern NLP**	**07 Hours**

Limitations of RNN models; attention mechanism; self-attention concept; introduction to Transformer architecture; positional encoding; overview of pretrained language models such as BERT and GPT; fine-tuning pretrained models for downstream NLP tasks.

Mapping of Course Outcomes for Unit VI	**CO6**

UNIT VI	**Applications and Emerging Trends**	**07 Hours**

Applications of deep learning in computer vision including image classification, object detection and image segmentation; applications in natural language processing such as machine translation, sentiment analysis and text summarization; recommendation systems

Introduction to transfer learning and fine-tuning; generative models such as autoencoders and Generative Adversarial Networks (GAN); introduction to transformer models and attention mechanisms; basic concepts of model deployment and inference; ethical issues, bias and challenges in deep learning systems.

Books and Other Resources

Text Books:

1. Goodfellow, I., Bengio, Y., Courville, A. – Deep Learning, MIT Press
2. **Aggarwal, Charu C.** *Neural Networks and Deep Learning: A Textbook*, Springer, 2018. **Publisher:** Springer **ISBN-13:** 978-3319944630
3. **Chollet, François.** *Deep Learning with Python*, 2nd Edition, Manning Publications, 2021.

Publisher: Manning Publications **ISBN-13:** 978-1617296864

Reference Books:

1. **Zhang, Aston; Lipton, Zachary C.; Li, Mu; Smola, Alexander J.** *Dive into Deep Learning*, Cambridge University Press, 2023 (Print Edition). **Publisher:** Cambridge University Press
   ISBN-13: 978-1108470049

2. **Géron, Aurélien.** *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, 2nd Edition, O'Reilly Media, 2019. **Publisher:** O'Reilly Media
   ISBN-13: 978-1492032649

Guidelines for Term Work Assessment :

Term work assessment will be based on overall performance of Laboratory assignments performed by a students. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, efficient codes, and punctuality.

Guidelines for Practical Examination :

Problem statements will be formed based on assignments and performance will be evaluated by Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation..

Guidelines for Laboratory Conduction :

Use of open source software is encouraged. Based on the concepts learned.
Operating System recommended :- 64-bit Open source Linux or its derivative Programming
Tools recommended: - Python, TensorFlow, PyTorch

Practical Assignments

1. Classify flower species into **three categories (Setosa, Versicolor, Virginica)** using input features such as sepal length, sepal width, petal length, and petal width. Implement a multilayer perceptron model and evaluate classification accuracy. Use **Iris Dataset** from Link: https://archive.ics.uci.edu/ml/datasets/iris
2. Image classification using deep neural networks. Example: Build a model to recognize **handwritten digits (0–9)** from grayscale images. Train and evaluate the model using fully connected neural networks and compare performance with CNN-based approaches. Use **MNIST Dataset** from Link: https://www.kaggle.com/datasets/hojjatk/mnist-dataset
3. Use a pretrained convolutional neural network model such as **VGG16 or ResNet** and fine-tune it to classify images into different categories such as animals or objects. The objective is to understand how pretrained models can be reused for new tasks with limited data. Use **Intel Image Classification Dataset** from Link: https://www.kaggle.com/datasets/puneet6060/intel-image-classification
4. Classify movie reviews into **positive reviews and negative reviews** based on the text content using recurrent neural networks such as LSTM. Perform text preprocessing and evaluate classification performance. Use **IMDB Movie Reviews Dataset** from Link: https://www.kaggle.com/datasets/lakshmi25npathi/imdb-dataset-of-50k-movie-reviews
5. Predict **future airline passenger numbers** based on historical data using LSTM models. Visualize

predictions and compare predicted values with actual values. Use **Airline Passenger Dataset** from Link:
https://www.kaggle.com/datasets/rakannimer/air-passengers

6. Develop a model that predicts **movie ratings for users** based on previous rating patterns and recommend movies accordingly. Use **MovieLens Dataset** from Link:
https://grouplens.org/datasets/movielens/
7. Generate descriptive captions for images using CNN for feature extraction and RNN/LSTM for text generation. Use **Flickr8k Dataset** from Link:
https://www.kaggle.com/datasets/adityajn105/flickr8k
8. Classify **SMS messages into spam or ham (not spam)** using deep learning models. Perform text preprocessing, feature extraction and train a neural network classifier to detect unwanted messages. Use **SMS Spam Collection Dataset** from Link:
https://archive.ics.uci.edu/ml/datasets/sms+spam+collection
9. Predict **human activities such as walking, sitting, standing and climbing stairs** using smartphone sensor data. Implement a neural network model to classify activities based on accelerometer and gyroscope signals. Use **Human Activity Recognition Dataset** from Link:
https://archive.ics.uci.edu/ml/datasets/human+activity+recognition+using+smartphones

CO24303: Database Management Systems

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week		Course Activity: 10 Mark
PR: 02 Hrs/Week		In Semester: 30 Mark
		End Semester: 60 Mark
		Practical: 30 Mark

Prerequisite:

Students are expected to have a good understanding of Discrete Mathematics, Data Structures and Algorithms

Course Objective:

- To understand the fundamental concepts of Database Management Systems
- To acquire the knowledge of database query languages and transaction processing
- To understand systematic database design approaches
- To acquire the skills to use a powerful, flexible, and scalable general-purpose databases to handle Big Data
- To be familiar with advances in databases and applications

Course Outcomes:

1. Analyze and design Database Management System using ER model
2. Implement database queries using database languages
3. Normalize the database design using normal forms
4. Apply Transaction Management concepts in real-time situations
5. Use NoSQL databases for processing unstructured data
6. Use advanced database Programming concepts

Course Activity :

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Database Mini Project
2. Survey on uses of Advanced Database with emerging technology presentation
3. Industry Visit
4. Seminar
5. Research Paper in database domain

Course Contents

Mapping of Course Outcomes for Unit I	CO1

UNIT I	Introduction to Database Management Systems and ER Model	07 Hours

Introduction, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models. **Database Design and ER Model**: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity-Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting ER and EER diagram into tables.

Mapping of Course Outcomes for Unit II	CO2

UNIT II	SQL and PL/SQL	07 Hours

SQL: Characteristics and Advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators. **Tables**: Creating, Modifying, Deleting, Updating. **SQL DML Queries**: SELECT Query and clauses, Index and Sequence in SQL. **Views**: Creating, Dropping, Updating using Indexes, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, SQL Functions, Nested Queries. **PL/SQL**: Concept of Stored Procedures and Functions, Cursors, Triggers, Assertions, Roles and Privileges.

Mapping of Course Outcomes for Unit III	**CO3**

UNIT III	**Relational Database Design**	**07 Hours**

Relational Model: Basic concepts, Attributes and Domains, CODD's Rules. **Relational Integrity:** Domain, Referential Integrities, Enterprise Constraints. **Database Design:** Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.

Mapping of Course Outcomes for Unit IV	**CO4**

UNIT IV	**Database Transaction Management**	**07Hours**

Introduction to Database Transaction, Transaction states, ACID properties, Concept of Schedule, Serial Schedule. **Serializability:** Conflict and View, Cascaded Aborts, Recoverable and Non- recoverable Schedules. **Concurrency Control**: Lock-based, Time-stamp based Deadlock handling. **Recovery methods**: Shadow-Paging and Log-Based Recovery, Checkpoints. **Log-Based Recovery**: Deferred Database Modifications and Immediate Database Modifications.

Mapping of Course Outcomes for Unit V	**CO5**

UNIT V	**NoSQL Databases**	**07 Hours**

Introduction to Distributed Database System, Advantages, disadvantages, CAP Theorem. **Types of Data:** Structured, Unstructured Data and Semi-Structured Data. **NoSQL Database:** Introduction, Need, Features.

Types of NoSQL Databases: Key-value store, document store, graph, wide column stores, BASE Properties, Data Consistency model, ACID Vs BASE, Comparative study of RDBMS and NoSQL. **Mongo DB** (with syntax and usage): CRUD Operations, Indexing, Aggregation, MapReduce, Replication, Sharding.

Mapping of Course Outcomes for Unit VI	**CO6**

UNIT VI	**Advances in Databases**	**07 Hours**

Emerging Databases: Active and Deductive Databases, Semantic Databases. **Complex Data Types:** Semi-Structured Data **Nested Data Types**: JSON, XML. **Spatial Data:** Geographic Data, Geometric Data. Introduction to Big Data, **HADOOP:** HDFS, Map Reduce.

Books and Other Resources

Text Books:

1. "Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. "Connally T, Begg C., "Database Systems", Pearson Education, ISBN 81-7808-861-4
3. "Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled, Addison Wesley", ISBN- 10: 0321826620, ISBN-13: 978-0321826626

Reference Books:

1. "C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719
2. "S.K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
3. "Kristina Chodorow, Michael Dierolf, "MongoDB: The Definitive Guide", O'Reilly Publications, ISBN: 978-

1-449-34468-9
4. "Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More", Emereopty Limited, ISBN: 1743045743, 9781743045749
5. "Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications ISBN: 9788176569644, 9788176569644

Guidelines for Term Work Assessment

Term work assessment will be based on overall performance of Laboratory assignments performed by a students. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, efficient codes, and punctuality.

Guidelines for Practical Examination

Problem statements will be formed based on assignments and performance will be evaluated by Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation.

Guidelines for Laboratory Conduction

Use of open source software is encouraged. Based on the concepts learned.
Operating System recommended :- 64-bit Open source Linux or its derivative Programming
Tools recommended: - MYSQL/Oracle, MongoDB, ERD plus, ER Win

Practical Assignments

1. Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym.
2. Write at least 10 SQL queries for suitable database application using SQL DML statements.
3. Write a PL/SQL code block to calculate the area of a circle for a value of radius varying from 1 to 10. Store the radius and the corresponding values of calculated area in an empty table named areas, consisting of two columns, radius and area using procedure and function.
4. Write a PL/SQL block of code to calculate grades of students and separate all students grades wise using Cursor.
5. Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library Audit table
6. Write a program to implement MySQL/Oracle database connectivity with any front end language to implement Database navigation operations (add, delete, edit and Display etc.)
7. Design and Develop Mongo DB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators etc.).
8. Design and Develop Mongo DB Queries using aggregation and indexing with suitable example using Mongo DB.
9. Implement Map reduces operation with suitable example using Mongo DB.
10. Write a program to implement Mongo DB database connectivity with any front end language to implement Database navigation operations (add, delete, edit, Display)

CO24304B : Artificial Intelligence

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week	TH Credit :03	Course Activity: 10 Mark
PR: 02 Hrs/Week	PR Credit :01	In Semester: 30 Mark
		End Semester: 60 Mark
		Oral : 30 Mark

Prerequisite: Programming and Problem solving, Data Structures and Algorithms

Course Objective:

- To understand the concept of Artificial Intelligence (AI) in the form of various Intellectual tasks
- To understand Problem Solving using various peculiar search strategies for AI
- To understand multi-agent environment in competitive environment
- To acquaint with the fundamentals of knowledge and reasoning
- To devise plan of action to achieve goals as a critical part of AI
- To develop a mind to solve real world problems unconventionally with optimality

Course Outcomes:

1. Identify and apply suitable Intelligent agents for various AI applications
2. Build smart system using different informed search / uninformed search or heuristic approaches
3. Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem
4. Apply suitable AI algorithms and implement modern logical inference techniques to solve complex AI problems.
5. Understand planning methods and AI system design.
6. Develop AI-based solutions for real-world applications.

Course Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Implement a Simple AI Model
2. AI in Games – Implement a Simple Game AI
3. AI Ethics and Bias Case Study
4. Industry Visit
5. Research and Presentation on AI Trends
6. MOOC Courses.

Course Contents

Mapping of Course Outcomes for Unit I	CO1

UNIT I	Introduction	07 Hours

Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Intelligent Agents, Agents and Environments, Good Behavior: Concept of Rationality, Nature of Environments, Structure of Agents

Mapping of Course Outcomes for Unit II	CO2

UNIT II	Problem-solving and Searching	07 Hours
Steps of problems solving, Types of Problem, Problem solving strategies, Problem-Solving Agents, steps performed by problem solving agent, Problem solving by searching – 8 Puzzle problem , 8 Queen Problem, Search Algorithms - Properties, Uninformed Search Strategies: Breadth First Search, Depth First Search, Unified Cost Search, Depth Limited Search, Iterative Deeping Depth First Search, Bi-Directional Search, Informed (Heuristic) Search Strategies : Heuristic Functions, Best First Search, A* Search, AO*, Local Search and Optimization Problems.		
Mapping of Course Outcomes for Unit III	**CO3**	
UNIT III	**Adversarial Search and Games**	**07 Hours**
Adversarial Search , Game Theory ,Types of Game, Game Tree, Optimal Decisions in Games, Min Max Algorithm, Alpha–Beta Pruning, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms, Constraint Satisfaction Problems (CSP) : Crypto arithmetic Problem, Graph Coloring Problem, 8-Queen Problem.		
Mapping of Course Outcomes for Unit IV	**CO4**	
UNIT IV	**Knowledge Representation and Reasoning**	**07Hours**
Knowledge and Knowledge Representation, Knowledge Engineering, Knowledge Representation Techniques, Knowledge-Based Agents, The Wumpus World, Propositional Logic, First-Order Logic, Quantifiers in First Order Logic, Syntax and Semantics of First-Order Logic, Inference Rules and Types in FOL, Reasoning: Inference Engine – Forward and Backward Chaining, Unification and Resolution, Proposition Vs First Order Logic.		
Mapping of Course Outcomes for Unit V	**CO5**	
UNIT V	**Planning**	**07 Hours**
Automated Planning, Classical Planning, Algorithms for Classical Planning, Heuristics for Planning, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Time, Schedules, and Resources, Analysis of Planning Approaches, Limits of AI, Ethics of AI, Future of AI, AI Components, AI Architectures.		
Mapping of Course Outcomes for Unit VI	**CO6**	
UNIT VI	**AI Applications and Intelligent Systems**	**07 Hours**
AI in Healthcare, Agriculture, Education, Finance, Cybersecurity, Robotics and Automation, Computer Vision, Generative AI Applications, Ethics of AI, Future of AI, Case Study: Design and Implementation of AI-based Academic Assistant System		
Books and Other Resources		

Text Books:

6. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Third edition, Pearson, 2003, ISBN :10: 0136042597
7. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
8. Elaine Rich, Kevin Knight and Nair, “Artificial Intelligence”, TMH, ISBN-978-0-07-008770-5

Reference Books:

1. Nilsson Nils J , “Artificial Intelligence: A new Synthesis”, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, “Artificial Intelligence”, Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
4. Dr. Lavika Goel, “Artificial Intelligence: Concepts and Applications”, Wiley publication, ISBN: 9788126519934
5. Dr. Nilakshi Jain, “Artificial Intelligence, As per AICTE: Making a System Intelligent”,Wiley publication, ISBN: 9788126579945

e-Book :

1. https://cs.calvin.edu/courses/cs/344/kvlinden/resources/AIMA-3rd-edition.pdf
2. https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf
3. http://aima.cs.berkeley.edu/

MOOCs Courses link:

1. https://nptel.ac.in/courses/106/102/106102220/
2. https://nptel.ac.in/courses/106/105/106105077/
3. https://nptel.ac.in/courses/106/105/106105078/
4. https://nptel.ac.in/courses/106/105/106105079/

Guidelines for Term Work Assessment:

Term work assessment will be based on overall performance of Laboratory assignments performed by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, efficient codes, and punctuality.

Guidelines for Practical Examination:

Problem statements will be formed based on assignments and performance will be evaluated by Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation..

Guidelines for Laboratory Conduction:

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System recommended: - 64-bit Windows OS and Linux

Programming tools recommended: - Python with latest version, Anaconda, Jupyter Nootbook, Visual Studio, Pycharm etc.

Practical Assignments

1. Implement **Depth First Search** algorithm and **Breadth First Search** algorithm, Use an undirected graph and develop a recursive algorithm for searching all the vertices of a graph or tree data structure.

2. Implement **Breadth-First Search (BFS)** for an **8-puzzle game**.

3. Implement **A Star** Algorithm.

4. Develop an elementary **Chabot** for any suitable customer interaction application.

5. Implement a solution for a Constraint Satisfaction Problem (CSP) using Branch and Bound and Backtracking for **8-queen's problem**.

6. Implement any one of the following **Expert System's:**
   I. Information management
   II. Hospitals and medical facilities
   III. Help desks management
   IV. Employee performance evaluation
   V. Stock market trading
   VI. Airline scheduling and cargo schedules etc.

7. **Mini Project** : Implement any latest AI model.

CO-PO-PSO Mapping Matrix

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	1	2	2	2	2	3	3	2
CO2	3	3	3	3	3	2	1	1	2	2	2	2	3	3	2
CO3	3	3	2	3	2	2	1	2	2	2	2	3	3	3	2
CO4	3	3	3	3	3	2	1	2	2	2	2	2	3	3	2
CO5	3	3	2	3	3	2	2	2	2	2	2	2	3	3	2
CO6	3	2	2	2	3	2	2	2	3	3	3	3	3	3	3

CO24304C: Internet of things (Elective I)

Teaching Scheme:	**Credit: 04**	**Examination Scheme:**
TH: 03 Hrs/Week	TH Credit :01	Course Activity: 10 Mark
PR: 02 Hrs/Week	PR Credit :01	In Semester: 30 Mark
		End Semester: 60 Mark
		Oral : 30 Mark

Prerequisites Courses: Digital Electronics and Logic Design

Companion Course, if any: - Internet of Things Laboratory

Course Objectives:

- To understand fundamentals of Internet of Things (IoT) and Embedded Systems
- To learn advances in Embedded Systems and IoT
- To learn methodologies for IoT application development
- To learn the IoT protocols, cloud platforms and security issues in IoT
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples.

Course Outcomes:

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

1. Understand the fundamentals and need of Embedded Systems for the Internet of Things
2. Apply IoT enabling technologies for developing IoT systems
3. Apply design methodology for designing and implementing IoT applications
4. Analyze IoT protocols for making IoT devices communication
5. Design cloud based IoT systems
6. Design and Develop secured IoT applications

Course Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activities for course coordinator

1. Mini Project (Arduino UNO/ Raspberry Pi)
2. Industry Visit
3. Seminar
4. Research Paper in Embedded system and internet of things domain

Course Contents

Unit I	**Introduction to Embedded Systems**	**(07 Hours)**

Definition, Characteristics of Embedded System, Real time systems, Real time tasks. **Processor basics**: General Processors in Computer Vs Embedded Processors, Microcontrollers, Microcontroller Properties, Components of Microcontrollers, System-On-Chip and its examples, Components of Embedded Systems, Introduction to embedded processor.

Unit II	**Introduction to IOT**	**(07 Hours)**

Introduction to Internet of Things (IoT): Definition, Characteristics of IoT, Vision, Trends in Adoption of IoT, IoT Devices, IoT Devices Vs Computers, Societal Benefits of IoT, Technical Building Blocks. **Physical Design of IoT**: Things in IoT, Interoperability of IoT Devices, Sensors and Actuators, Need of Analog / Digital Conversion. **Logical Design of IoT**: IoT functional blocks, IoT enabling

technologies, IoT levels and deployment templates, Applications in IoT.

Unit III	IoT: Design Methodology	(07 Hours)

IoT Design Methodology: Steps, Basics of IoT Networking, Networking Components, Internet Structure, Connectivity Technologies, IoT Communication Models and IoT Communication APIs, Sensor Networks, Four pillars of IoT: M2M, SCADA, WSN, RFID.

Unit IV	IoT: Protocols	(07 Hours)

Protocol Standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. **IP based Protocols**: MQTT (Secure), 6LoWPAN, LoRa.

Unit V	IoT: Cloud Platforms	(07 Hours)

Software Defined Networking, Introduction to Cloud Storage Models, Communication API. **WAMP**: Auto Bahn for IoT, Xively Cloud for IoT. **Python Web Application Framework**: Django Architecture and application development with Django, Amazon Web Services for IoT, Sky Net IoT Messaging Platform, RESTful Web Service

Unit VI	Security in IoT	(07 Hours)

Introduction, Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling. **Key elements of IoT Security**: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT, Challenges in designing IOT applications, Lightweight cryptography.

Learning Resources

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515.
2. Lyla B. Das, "Embedded Systems: An Integrated Approach" Pearson , ISBN: 9332511675, 9789332511675
3. Olivier Hersent, David Boswarthick, and Omar Elloumi, ―The Internet of Things: Key Applications and Protocols, Wiley Publications
4. Vijay Madisetti and Arshdeep Bahga, ―Internet of Things (A Hands-On-Approach), 1st Edition, VPT, 2014.

Reference Books:

1. Sriram V. Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw-Hill, ISBN: 13: 9780070482845
2. David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 2017
3. Charles Crowell, "IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT", ISBN-13: 979-8613100194
4. David Etter, "IoT Security: Practical guide book", amazon kindle Page numbers, source ISBN: 1540335011.
5. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Second Edition Packt Publishing, ISBN: 9781788625821
6. Dr. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, "Internet of Things", Wiley publication, 2nd Edition, ISBN: 9789388991018

eBooks :

- https://www.iotforall.com/ebooks/an-introduction-to-iot
- https://www.qorvo.com/design-hub/ebooks/internet-of-things-for-dummies

MOOCs Courses link

- https://nptel.ac.in/courses/106/105/106105166/
- https://www.udemy.com/course/a-complete-course-on-an-iot-system-design-and-development/
- https://www.coursera.org/learn/iot

https://nptel.ac.in/courses/108/108/108108098/

CO24305 : Java Programming

Teaching Scheme:	Credit: 02	Examination Scheme:
TUT: 01 Hrs/Week	TH Credit :01	Course Activity: 10 Mark
PR: 02 Hrs/Week	PR Credit :01	Term Work : 30 Mark
		Practical: 30 Mark

Prerequisite: Students are expected to have a good understanding of Programming and Problem Solving(PPS) Python Programming.

Course Objective:

- To learn the basic concept of Java Programming.
- To learn Object Oriented Programming(OOP) principles using Java Programming Language
- To learn Exception handling concepts of Java Programming
- To learn Applet and Multithreading concepts of Java Programming
- To learn AWT concepts of Java Programming.

Course Outcomes:

1. Develop programs using an Object Oriented concepts.
2. Demonstrate Packages and Interfaces
3. Demonstrate Exception handling and file operations
4. Develop application using Applet and AWT.

Course Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

7. Mini Project using Java Language
8. Industry Visit
9. Seminar

Course Contents

Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Introduction to Java**	**04 Hours**

Features of Java ,JDK Environment Difference between C++ and JAVA, Structure of Java program ,Data types ,Variables ,Operators , Keywords , Decision Making (if, switch), Looping(for, while) ,,Array Creating an array Types of Array - One Dimensional arrays - Two Dimensional array ,String - Arrays , Methods. Creating Classes and objects , Memory allocation for objects , Constructor , Implementation of Inheritance Simple, Multilevel, Using super: Using super to Call Superclass Constructors.

Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Packages and Exception handling**	**04 Hours**

Packages : Defining a Package , Finding Packages and CLASSPATH, A Short Package Example Packages and Member Access : Example, Importing Packages, **Interfaces :** Defining an Interface, Implementing Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces, Interfaces Can Be Extended.

Exception: Exception types, Using try catch and multiple catch, Nested try, throw , throws and finally, Creating user defined Exceptions

Mapping of Course Outcomes for Unit III		CO3
UNIT III	**Applet and AWT Programming**	**04 Hours**

Applet : Introduction, Types applet, Applet Life cycle, Creating applet, Applet tag, Applet Classes, Color, Graphics , Font.

AWT : Components and container used in AWT, Layout managers, Listeners and Adapter classes, Event Delegation model

Books and Other Resources

TextBooks:

1. Programming with JAVA - E Balgurusamy
2. Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH,ISBN: 978-0-07-180856-9**.**

Reference Books:

1. The Complete Reference – JAVA Herbert Schildt
2. "Maureen Spankle, "Problem Solving and Programming Concepts", Pearson; 9th edition, ISBN-10: 9780132492645, ISBN-13: 978- 0132492645

Guidelines for Term Work Assessment :

Term work assessment will be based on overall performance of Laboratory assignments performed by a students. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, efficient codes, and punctuality.

Guidelines for Practical Examination :

Problem statements will be formed based on assignments and performance will be evaluated by Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation.

Guidelines for Laboratory Conduction :

- A working computer system with either Windows or Linux (with minimum configurations- HDD:40 GB, RAM: 512M
- Simple Editor Notepad or other editor tools like Edit plus or notepad++.
- A web browser IE/ Firefox/ chrome. ϖ Apache Tomcat web server.
- JVM(Java virtual machine) must be installed on your system
- BDK(Bean development kit) must be also be installed

.

Practical Assignments

1. Write a java program to find the Fibonacci series using recursive and non-recursive functions

2. Write a java program that reads a line of integers and displays each integers and the sum of all integers use String Tokenizer

3. Write a java program to implement Interface using extends keyword.

4. Write a java program to create user defined package.

5. Department maintains a student information. Write a Java program to write records to the file and read students records from file demonstrating I/O management through File and stream classes.

6. A. Create a basic applet that functions as a simple calculator. The applet should accept two numbers and perform operations such as addition, subtraction, multiplication, and division based on user input.

7. Create a basic calculator using Java Swing that can perform basic arithmetic operations like addition, subtraction, multiplication, and division. The calculator should have buttons for numbers, operations, and a display area

8. Build a form for student registration that takes inputs such as name, age, address, and course. Add validation to ensure all fields are filled and the data is in the correct format.

9. Write a program demonstrating multithreading in Java : getName(), getPriority(),setPriority(), join(), isAlive(), synchronized method must be utilized.

10. Write a java program that connects to a database using JDBC and perform Insert, delete, update and display operations.

Mini Project:

Here are some key components mini-project should ideally contain:

- Core Java Concepts
- Connectivity

Semester II

CO24311 : Computer Networks

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week PR: 02 Hrs/Week	TH Credit :03 PR Credit :01	Course Activity: 10Mark In Semester : 30Mark End Semester : 60 Mark Oral : 30 Mark

Prerequisite: Students are expected to have a good understanding of Discrete Mathematics.

Course Objective:

- To understand the fundamental concepts of networking standards, protocols and technologies.
- To understand knowledge of data link layer architecture
- To learn the basics of networking address and routing algorithms used in networks..
- To learn different layer protocols in the protocol stacks
- To understand modern network architectures with respect to design and performance

Course Outcomes:

1. Demonstrate the concepts of data communication at the physical layer and compare ISO - OSI model with TCP/IP model.
2. Elaborate the error control mechanism and medium access control sublayer of data link layer
3. Design the network using IP addressing and subnetting / supernetting schemes
4. Analyze transport layer protocols and congestion control algorithms.
5. Illustrate the role of the application layer with its protocol.
6. Describe the role of Artificial Intelligence in Networking

Course Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

2. Mini Project
3. Survey Report
4. Industry Visit
5. Seminar
6. Research Paper

Course Contents

Mapping of Course Outcomes for Unit I		CO1
UNIT I	**Introduction to Computer Network**	**07 Hours**

Introduction: Goals and applications of networks, Categories of networks, Network structure and architecture (layering principles, services, protocols and standards), The OSI reference model, TCP/IP protocol suite, Network devices and components.

Physical Layer: Network topology design, Types of connections, Transmission media, Line Coding- Manchester and Differential Manchester, Network performance, Switching techniques

Mapping of Course Outcomes for Unit II		CO2
UNIT II	**Data Link Layer and Medium Access Control Sublayer**	**08 Hours**
Introduction and Design Issues, Flow and Error Control, Techniques for Error Detection and Correction, Parity Bits, Hamming Code(11/12-bits) and CRC. Simplex, Stop and Wait, Sliding Window Protocol. Random Access Protocols (ALOHA, CSMA, CSMA/CD, CSMA/CA). Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 Standards		
Mapping of Course Outcomes for Unit III		**CO3**
UNIT III	**Network Layer**	**08 Hours**
Network Layer: Point-to-point networks, IP Protocol: Classes of IP (Network Addressing), IPv4, IPv6, subnetting, Network Address Translation (NAT). Basic internetworking (CIDR, ARP, RARP, DHCP, ICMP,IGMP), Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms. **Routing in MANET**: AODV, DSR, Mobile IP		
Mapping of Course Outcomes for Unit IV		**CO4**
UNIT IV	**Transport Layer**	**07 Hours**
Transport Layer: Process-to-process delivery, Transport layer protocols with Header format (UDP, TCP and SCTP), Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service. **Socket Programming:** TCP and UDP Connection		
Mapping of Course Outcomes for Unit V		**CO5**
UNIT V	**Application Layer**	**06 Hours**
HyperText Transport Protocol (HTTP), Cookies, Simple Mail Transport Protocol (SMTP),MIME, POP3, File Transfer Protocol (FTP). Introduction to various Types of Servers, Dynamic Host Configuration Protocol (DHCP): Header, Working, Domain Name Server (DNS): Working, Proxy Server: Need and Significance, working.		
Mapping of Course Outcomes for Unit VI		**CO6**
UNIT VI	**Artificial Intelligence in Networking**	**06 Hours**
Distributed Computing Network, Necessity of Artificial Intelligence in Networking, Artificial Intelligence Network Challenges and Solution, Load Balancing using AI, AI datacenter Network, AI Cluster Network, AI GPU Network, Artificial Intelligence tool used in Networking. **Case Study:** Banking Application Networking , Education Institute Networking, Network Provider for Small city		
Books and Other Resources		

Text Books:

1. Behrouz Forouzan, “Data Communication and Networking”, McGraw Hill
2. Andrew Tanenbaum “Computer Networks”, Prentice Hall.

Reference Books:

1. William Stallings, “Data and Computer Communication”, Pearson.
2. Kurose and Ross, “Computer Networking- A Top-Down Approach”, Pearson.
3. Peterson and Davie, “Computer Networks: A Systems Approach”, Morgan Kaufmann
4. W. A. Shay, “Understanding Communications and Networks”, Cengage Learning.
5. D. Comer, “Computer Networks and Internets”, Pearson.
6. Behrouz Forouzan, “TCP/IP Protocol Suite”, McGraw Hill.

Guidelines for Practical Examination:

Problem statements will be formed based on assignments and performance will be evaluated by the Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation..

Guidelines for Laboratory Conduction: Use of open source software is encouraged. Based on the concepts learned. Operating System recommended: - 64-bit Open source Linux or its derivative
Programming
Tools recommended: - C, C++,Java, Python, Wireshark, Packet Tracer, Juniper, Arista

Practical Assignments

1. Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool.
2. Demonstrate transfer of a packet from LAN 1(wired LAN) to LAN2(wireless LAN) using switch or router and basic networking commands like ipconfig, netstat, trace, traceroute, lookup, ping.
3. Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC
4. Write a program to simulate Go Back N and Selective Repeat Modes of Sliding Window Protocol in Peer-to-Peer mode.
5. Write a program to demonstrate subnetting and find subnet masks and analyze IP addressing using Wireshark tool.
6. Write a program to implement link state/ Distance vector/Kruskal’s minimum spanning tree routing protocol to find a suitable path for transmission.

7. Use a packet tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP

8. Write a program using TCP socket for wired network for the following:
   a. Say Hello to Each other
   b. File Transfer
   c. Calculator

9. Write a program for DNS lookup. Given an IP address as input, it should return URL and vice-versa

10. Demonstrate configuration of DHCP Server and Firewall using packet tracer tool.

CO24313B : Web Technology

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week PR: 02 Hrs/Week	TH Credit :03 OR Credit :01	Course Activity: 10 Mark In Semester: 30 Mark End Semester: 60 Mark Oral : 30 Mark

Prerequisite: Students Database Management Systems, Computer Networks

Course Objective:

- To learn the fundamentals of web essentials and markup languages
- To use the Client side technologies in web development
- To use the Server side technologies in web development
- To understand the web services and frameworks

Course Outcomes:

7. Implement and analyze behavior of web pages using HTML and CSS
8. Apply the client side technologies for web development
9. Analyze the concepts of Servlet and JSP
10. Analyze the Web services and frameworks
11. Apply the server side technologies for web development
12. Create the effective web applications for business functionalities using latest web development platforms

Course Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

10. Web Technology Mini Project
11. Survey on uses of web Technologies with emerging technology presentation
12. Industry Visit
13. Seminar
14. Research Paper in Web programming domain

Course Contents

Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Web Essentials and Mark-up language- HTML**	**07 Hours**

The Internet, basic internet protocols, the World Wide Web, HTTP Request message, HTTP response message, web clients, web servers.HTML: Introduction, history and versions.HTML elements: headings, paragraphs, line break, colors and fonts, links, frames, lists, tables, images and forms, Difference between HTML and HTML5. CSS: Introduction to Style Sheet, CSS features, CSS core syntax, Style sheets and HTML, Style rule cascading and inheritance, text properties. Bootstrap.

Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Client Side Technologies: JavaScript and DOM**	**07 Hours**

JavaScript: Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers. **DOM:**

Introduction to Document Object Model, DOM history and levels, intrinsic event handling, modifying element style, the document tree, DOM event handling, jQuery

Mapping of Course Outcomes for Unit III	CO3

UNIT III	Java Servlets and XML	07 Hours

Servlet: Servlet architecture overview, A "Hello World" servlet, Servlets generating dynamic content, Servlet life cycle, parameter data, sessions, cookies, URL rewriting, other Servlet capabilities, data storage, Servlets concurrency, databases (MySQL) and Java Servlets. **XML**: XML documents and vocabularies, XML declaration, XML Namespaces, DOM based XML processing, transforming XML documents, DTD: Schema, elements, attributes. **AJAX**: Introduction, Working of AJAX.

Mapping of Course Outcomes for Unit IV	CO4

UNIT IV	JSP and Web Services	07Hours

JSP: Introduction to Java Server Pages, JSP and Servlets, running JSP applications, Basic JSP, JavaBeans classes and JSP, Support for the Model-View-Controller paradigm, JSP related technologies. **Web Services**: Web Service concepts, Writing a Java Web Service, Writing a Java web service client, Describing Web Services: WSDL, Communicating Object data: SOAP. **Struts**: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.

Mapping of Course Outcomes for Unit V	CO5

UNIT V	Server Side Scripting Languages	07 Hours

PHP: Introduction to PHP, uses of PHP, general syntactic characteristics, Primitives, operations and expressions, output, control statements, arrays, functions, pattern matching, form handling, files, cookies, session tracking, using MySQL with PHP, WAP and WML. **Introduction to ASP.NET**: Overview of the .NET Framework, Overview of C#, Introduction to ASP.NET, ASP.NET Controls, Web Services. Overview of Node JS.

Mapping of Course Outcomes for Unit VI	CO6

UNIT VI	AngularJS, ReactJS	07 Hours

Introduction To AngularJS : Features, Angular Application Architecture, Data Binding, Directives, Template Routing, Angular Forms, Services,

Introduction to ReactJS : ReactJSLibrary & directory , React Components , Build a simple React component , Component composition , styling , Routing to create single page app , Hooks, States , Redux , React Bootstrap , Introduction to EJB.

Books and Other Resources

Text Books:

4. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035
5. Robert W. Sebesta," Programming the World Wide Web", 4th Edition, Pearson education, 2008

Reference Books:

1. Marty Hall, Larry Brown, "Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.

2. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
3. Chris Bates, “Web Programming Building Internet Applications”, 3rd Edition, Wiley India, 2006.
4. Xue Bai et al, “The web Warrior Guide to Web Programming”, Thomson, 2003.

e-Books:

1. https://www.w3.org/html/
2. HTML, The Complete Reference http://www.htmlref.com/
3. http://w3schools.org/
4. http://php.net/
5. https://jquery.com/
6. http://www.tutorialspoint.com/css/

Guidelines for Term Work Assessment:

Term work assessment will be based on overall performance of Laboratory assignments performed by a students. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, efficient codes, and punctuality.

Guidelines for Practical Examination:

Problem statements will be formed based on assignments and performance will be evaluated by Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation..

Guidelines for Laboratory Conduction :

Use of open source software is encouraged. Based on the concepts learned.
Operating System recommended:- 64-bit Open source Linux or its derivative Programming
Mini project should be implemented by the students in a group of 2-3 students.

Practical Assignments

11. Case study: Before coding of the website, planning is important, students should visit different websites (Min. 5) for the different client projects and note down the evaluation results for these websites, either good website or bad website in following format: From the evaluation, students should learn and conclude different website design issues, which should be considered while developing a website

12. Implement a web page index.htm for any client website (e.g., a restaurant website project) using following:
    a. HTML syntax: heading tags, basic tags and attributes, frames, tables, images, lists, links for text and images, forms etc.
    b. Use of Internal CSS, Inline CSS, External CSS

13. Design the XML document to store the information of the employees of any business organization and demonstrate the use of:
    a) DTD
    b) XML Schema And display the content in (e.g., tabular format) by using CSS/XSL.

14. Implement an application in Java Script using following:
    a) Design UI of application using HTML, CSS etc.
    b) Include Java script validation
    c) Use of prompt and alert window using Java Script
    e.g., Design and implement a simple calculator using Java Script for operations like addition, multiplication, subtraction, division, square of number etc.

15. Implement the sample program demonstrating the use of Servlet.
    e.g., Create a database table ebookshop (book_id, book_title, book_author, book_price, quantity) using database like Oracle/MySQL etc. and display (use SQL select query) the table content using servlet.

16. Implement the program demonstrating the use of JSP.
    e.g., Create a database table students_info (stud_id, stud_name, class, division, city) using database like Oracle/MySQL etc. and display (use SQL select query) the table content using JSP.

17. Build a dynamic web application using PHP and MySQL.
    a. Create database tables in MySQL and create connection with PHP.
    b. Create the add, update, delete and retrieve functions in the PHP web app interacting with MySQL database

18. Design an application using Angular JS.
    e.g., Design registration (first name, last name, username, password) and login page using Angular JS.

19. Design and implement a business interface with necessary business logic for any web application using EJB. e.g., Design and implement the web application logic for deposit and withdraw amount transactions using EJB.
20. Mini Project: Design and implement a dynamic web application for any business functionality by using web development technologies that you have learnt in the above given assignments

CO24314B : Software Testing and Quality Assurance

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week	TH Credit :03	Course Activity: 10 Mark
PR: 02 Hrs/Week	PR Credit :01	In Semester: 30 Mark
		End Semester: 60 Mark
		Oral: 30 Mark

Prerequisite: Students are expected to have a good understanding of Software Engineering and Software Engineering & Project Management.

Course Objective:

- Introduce basic concepts of software testing.
- Understand the best way to increase the effectiveness, test coverage, and execution speed in software testing.
- Understand white box, block box, object oriented, web based and cloud testing.
- Understand the importance of software quality and assurance software systems development.
- Know in details automation testing and tools used for automation testing.
- To learn and understand the combination of practices and tools that are designed to help QAprofessionals test more efficiently.

Course Outcomes:

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

1. Describe fundamental concepts in software testing such as manual testing, automation testingand software quality assurance.
2. Design and Develop project test plan, design test cases, test data, and conduct test operations.
3. Apply recent automation tool for various software testing for testing software.
4. Apply different approaches of quality management, assurance, and quality standard to software system.
5. Apply and analyze effectiveness Software Quality Tools.
6. Apply tools necessary for efficient testing framework

Course Activity :

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Mini Project
2. Industry Visit
3. Seminar

Course Contents

Mapping of Course Outcomes for Unit I	CO1

UNIT I	Introduction to Software Testing	07 Hours

Introduction: historical perspective, Definition, Core Components, Customers suppliers and process, Objectives of Testing, Testing and Debugging, Need of Testing, Quality Assurance and Testing, Why Software has Errors, Defects and Failures and its Causes and Effects, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, Benchmarking and metrics, Problem Solving Techniques and Software Tools. Software Quality, Constraints of Software product Quality assessment, Quality and Productivity

Relationship, Requirements of Product, Software Development Process, Types of Products, Software Development Lifecycle Models, Software Quality Management, Processes related to Software Quality, Quality Management System's Structure, Pillars of Quality Management System, Important aspects of quality management.

Mapping of Course Outcomes for Unit II	CO2

UNIT II	Test Planning and Quality Management	07 Hours

Test Planning: Artifacts, Strategy, Test Organization –Test Manager & Tester Role, Test plan purpose & contents, Test Strategy and Approach, Test cases & Test Data, Test Entry-Exit criteria, Test Execution Schedule, Use case Testing, Scenario Testing, Test Monitoring & Control- Test Metrics –Test Case Productivity, Test case Coverage, Defect Acceptance & Rejection, Test Efficiency, Efforts and Schedule Variance, Test Efforts biasing Factors, Test Report & configuration Management, Quality Assurance Process, Documentation Risk & Issues.

Mapping of Course Outcomes for Unit III	CO3

UNIT III	Test Case Design Techniques	07 Hours

Software Testing Methodologies: White Box Testing, Black Box Testing, Grey Box Testing. Test Case Design Techniques: Static Techniques: Informal Reviews, Walkthroughs, Technical Reviews, Inspection. Dynamic Techniques: Structural Techniques: Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing Black Box Techniques: Boundary Value Analysis, Equivalence Class Partition, State Transition Technique, Cause Effective Graph, Decision Table, Use Case Testing, Experienced Based Techniques: Error guessing, Exploratory testing .

Levels of Testing: Functional Testing: Unit Testing, Integration Testing, System Testing, User Acceptance Testing, Sanity/Smoke Testing, Regression Test, Retest. Non-Functional Testing: Performance Testing, Memory Test, Scalability Testing, Compatibility Testing, Security Testing, Cookies Testing, Session Testing, Recovery Testing, Installation Testing, Adhoc Testing, Risk Based Testing, I18N Testing, L1ON Testing, Compliance Testing.

Mapping of Course Outcomes for Unit IV	CO4

UNIT IV	Software Quality Assurance and Quality Control	07Hours

Software Quality Assurance: Introduction, Constraints of Software Product Quality Assessment, Quality and Productivity Relationship, Requirements of a Product, Characteristics of Software, Software Development Process, Types of Products, Schemes of Criticality Definitions, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure.

Software Quality Control: Software quality models, Quality measurement and metrics, Quality plan, implementation and documentation, Quality tools including CASE tools, Quality control and reliability of quality process, Quality management system models, Complexity metrics and Customer Satisfaction, International quality standards – ISO, CMM

Mapping of Course Outcomes for Unit V	CO5

UNIT V	Automation Testing Tools / Performance Testing Tools	07 Hours

Automation Testing: What is automation testing, Automated Testing Process, Automation Frameworks, Benefits of automation testing, how to choose automation testing tools. Selenium Automation Tools: Selenium‘s Tool Suite- Selenium IDE, Selenium RC, Selenium Web driver, Selenium Grid. Automation Tools: SoapUI, Robotic Process Automation (RPA), Tosca, Appium.

Mapping of Course Outcomes for Unit VI	**CO6**

UNIT VI	**Testing Framework**	**07 Hours**

Testing Framework: Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan, Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Flow Chart, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness and Process.

Books and Other Resources

Text Books:

1. “M G Limaye”, “Software Testing Principles, Techniques and Tools‖”, Tata McGraw Hill, ISBN:9780070139909 0070139903
2. “Srinivasan Desikan, Gopal Swamy Ramesh”, “Software Testing Principles and Practices‖”, Pearson,ISBN-10: 817758121X

Reference Books:

9. “C J Date, “An Introduction to Database Systems”, Addison-Wesley, ISBN: 0201144719
10. “S.K.Singh, “Database Systems: Concepts, Design and Application”, Pearson Education, ISBN 978-81-317-6092-5
11. “Kristina Chodorow, Michael Dierolf, “MongoDB: The Definitive Guide”, O‘Reilly Publications, ISBN: 978-1-449-34468-9
12. “Kevin Roebuck, “Storing and Managing Big Data - NoSQL, HADOOP and More”, Emereopty Limited,ISBN: 1743045743, 9781743045749
13. “Ivan Bayross, “SQL, PL/SQL the Programming Language of Oracle”, BPB Publications ISBN: 9788176569644, 9788176569644

Guidelines for Laboratory Conduction :

Use of open source software is encouraged. Based on the concepts learned.
Operating System recommended :- 64-bit Open source Linux or its derivative Programming
Tools recommended: - Selenium grid and selenium Web driver java eclipse (automation tools),Chrome

Practical Assignments

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory

Group 1:

1. Write TEST Scenario for Gmail Login Page
2. Test Scenario for Gmail Login Page
3. Write Test cases in excel sheet for Social Media application or website

4. Create Defect Report for Any application or web application

5. Installation of Selenium grid and selenium Web driver java eclipse (automation tools).

6. Prepare Software requirement specification for any project or problem statement

Group 2:

21. **Mini Project :** Software Testing and Quality Assurance Mini Project Dynamic website of covid19 information using HTML, CSS, JAVASCRIPT And PHP, MySQL database used to store user account, comment, and registration form details. Regular Expression testcases for testing purpose

22. **Mini Project:** Create a small application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Prepare Test Cases inclusive of Test Procedures for identified Test Scenarios

23. **Mini Project :** Create a small web-based application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Narrate scripts in order to perform regression tests. Identify the bugs using Selenium WebDriver and IDE and generate test reports encompassing exploratory testing.

CO24314C : Foundation of Cloud Computing

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week PR: 02 Hrs/Week	TH Credit :03 PR Credit :01	Course Activity: 10 Marks In Semester: 30 Marks End Semester: 60 Marks Oral: 30 Marks

Prerequisite: Students are expected to have a good understanding of Discrete Mathematics, Data Structures and Algorithms

Course Objectives:

- To provide students with the fundamentals and essentials of cloud computing
- To learn basics of virtualization and its importance in cloud computing
- To understand storage mechanisms and security challenges in cloud environments.
- To explore cloud migration strategies and implementation approaches
- To enable students exploring cloud computing architectures and application
- To analyse emerging trends and the future scope of cloud computing.

Course Outcomes:

CO1: Articulate the main concepts, key technologies and fundamentals of cloud computing.
CO2: Understand virtualization technology in cloud computing
CO3: Analyze various data storage techniques and security challenges in cloud environments.
CO4: Analyze cloud migration strategies and evaluate their impact on organizations.
CO5: Understand cloud architectures and identify their applicability in different real-world scenarios.
CO6: Explore future trends of cloud computing.

Course Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Mini Project
2. Industry Visit
3. Seminar
4. Research Paper in cloud computing domain
5. Group Discussion

Course Contents

Mapping of Course Outcomes for Unit I		CO1
UNIT I	**Fundamentals of Cloud Computing**	**07 Hours**

Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Types of Clouds, Pros and Cons of Cloud computing

Mapping of Course Outcomes for Unit II		CO2
UNIT II	**Virtualization in Cloud Computing**	**07**

		Hours
Introduction to Virtualization Technologies, Types of Virtualization, Virtualization Architecture and Software, Understanding Hyper visors, Types of Hypervisors, Load Balancing and Virtualization, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation, Virtualization Application, Pitfalls of Virtualization.		
Mapping of Course Outcomes for Unit III	**C O3**	
UNIT III	**Data Storage and Security in Cloud**	**07 Hours**
Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. **Cloud Storage**: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. **Securing the Cloud**- General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats.		
Mapping of Course Outcomes for Unit IV	**C O4**	
UNIT IV	**Migrating into a Cloud**	**07Hours**
Introduction, Challenges while migrating to Cloud, Broad approaches to migrating into the cloud, the Seven-step model of migration into a cloud, Migration Risks and Mitigation, Enterprise cloud computing paradigm, Deployment Models for Enterprise Cloud Computing, Adoption and Consumption Strategies, issues for enterprise applications on the cloud		
Mapping of Course Outcomes for Unit V	**C O5**	
UNIT V	**Cloud Architectures and Cloud Applications**	**07 Hours**
Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). **Microsoft Cloud Services**: Azure core concepts, SQL Azure, Windows Azure Platform Appliance. **Google Cloud Application:** Google App Engine. **Cloud Computing Applications**: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking		
Mapping of Course Outcomes for Unit VI	**C O6**	
UNIT VI	**Future of Cloud Computing**	**07 Hours**
Future Trends of Cloud Computing, Ten emerging future trends in cloud computing, Next generation networking, Next generation Services, Mobile Cloud Computing, Autonomic Cloud Engine, Multimedia Cloud, Cloud Computing Energy Efficiency, Jungle Computing.		
Books and Other Resources		
Text Books:		

1. Thomas Erl, ZaighamMahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1 st Edition
2. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach",2010, The McGraw-Hill.

Reference Books:

1. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill, ISBN: 978 1259029950, 1259029956.
2. GautamShrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, ISBN: 9780511778476
3. Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN :9788131776513.
4. Ronald L. Krutz and Russell D. Vines, Cloud Security: A Comprehensive guide to Secure Cloud Computing, Wiley, ISBN: 9788126528097.
5. Scott Adkins, John Belamaric, Vincent Giersch, Denys Makogon, Jason E. Robinson, OpenStack:Cloud Application Development, Wrox, ISBN :9781119194316.
6. KailashJayaswal, JagannathKallakurchi, Donald J. Houde, Cloud Computing Black Book ,Wiley Dreamtech,ISBN:9789351194187

Guidelines for Laboratory Conduction :

Use of open source software is encouraged. Based on the concepts learned.
Operating System recommended :- 64-bit Open source Linux or its derivative Programming
Tools recommended: - Cloud Providers

Practical Assignments

1. To study of cloud service providers (aws, google & Microsoft-azure)
2. To make spreadsheet and notes using Google drive
3. To demonstrate Software as a service using any cloud provider.
4. To demonstrate Platform as a service using any cloud provider.
5. To demonstrate Storage as a service using any cloud provider.
6. Installation of VMWARE work station & access the tools.
7. To implement a program for web feed.
8. Creating an Application (Linear Search program) in SalesForce.com using Apex Programming Language.

CO-PO-PSO Mapping Matrix

CO / PO / PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	1	2	1	-	1	-	-	-	-	1	-	1	2	1	1

CO 2	1	2	1	-	2	1	1	1	1	2	2	2	2	1	1
CO 3	1	2	2	1	1	1	1	1	1	2	2	1	2	1	1
CO 4	1	2	2	2	1	1	1	1	1	1	2	1	2	1	1
CO 5	2	1	2	2	2	1	1	2	2	2	2	2	2	2	2
CO 6	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2