Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure& Syllabus of

B.Tech.

(Information Technology)

Effective from Academic Year 2021-22

Prepared by: - Board of Studies in Information Technology

Approved by: -Academic Board, Vishwakarma Institute of Technology, Pune

Signed by

Chairman– BOS **Chairman–Academic Board**

B.Tech. Information Technology (applicable w.e.f. AY21-22)

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Institute Vision

"To be globally acclaimed Institute in Technical Education and Research for holistic Socio-economic development".

Institute Mission

- To ensure that 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, Civil / Defense Services / Govt. Jobs and other areas like Sports and Theatre.
- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
- Promote Research Culture among Students and Faculty through Projects and Consultancy.
- To make students Socially Responsible Citizen.

Department Vision

"To provide student-centered state-of-the-art academically enriched environment for productive careers in the world of computing through creativity and innovation"

Department Mission

- To promote aspiring ethically conscious engineers demonstrating sustainable employability and entrepreneurship.
- To impart quality education with the focus on analytical and problem-solving skill development.
- To foster inspired scholarly environment through active student-faculty participation in research and development resulting in new knowledge-base or insights.
- To prepare students to shoulder social responsibilities by application of their skill set for betterment of society.

Program Education Objectives (PEO)

PEO	PEO Focus	PEO Statement
PEO1	Preparation	To prepare the students with a commitment towards meeting the needs of users within an organizational and societal context through the selection, creation, application, integration and administration of Information Technology projects.
PEO2	Core competence	To facilitate students with foundation of mathematical & engineering fundamentals along with knowledge of Information Technology principles and applications and be able to integrate this knowledge in a variety of business and inter-disciplinary setting.
PEO3	Breadth	To enable student to exercise problem solving capacity with effective use of analysis, design, development that address idea realization.
PEO4	Professionalism	To inculcate students with professional and ethical values with effective skills leading to participative teamwork having multidisciplinary knowledge useful to the society.
PEO5	Learning Environment	To provide students an academic environment that develops leadership qualities, excellence in subject areas of Information Technology and lifelong learning in every sphere of their life.

List of Programme Outcomes [PO]

Graduates will be able

PO	PO Statement
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to

	assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO	**PSO Statement**
PSO1	Apply information science theory, algorithmic and programming principles for comprehending technological trade-off in order to determine conceptual aspects of real world problems in information technology.
PSO2	Analyze and create problem frames in order to formulate decomposition structure of information technology problem with correct resources, infrastructure and technology requirements determination for solution realization.
PSO3	Compose technical design specifications using template based approaches for formally expressing the solution implementation by applying techniques and methods to create, enhance, and deliver IT tools with appropriate CASE tools selection.
PSO4	Exercise research and development aptitude focusing knowledge creation and dissemination through engineering artifacts construction, preparation and presentation of engineering evidences using procedures, techniques, guidelines, and standards considering technology migration and evolution.

B.Tech. Information Technology Structure

(Applicable w.e.f.AY21-22)

SY IT Module-III

Subject head	Course code	Course name	Contact hours per week			Credits
			Theory	Lab	Tut	
S1	MD2201	Data Science	3	2	1	5
S2	CS2221	Internet of Things	3	2	1	5
S3	CS2218	Object Oriented Programming	3	2	1	5
S4	IT2201	Computer Organization and Architecture	3	2	1	5
S5	IT2260	Engineering Design & Innovation – III	1	6	-	4
S6	IT2259	Software Development Project – I	-	6	-	3
		Total				**27**
						Total Credits: 27

SY IT Module-IV

Subject head	Course code	Course name	Contact hours per week			Credits
			Theory	Lab	Tut	
S1	IT2265	Advanced Data Structures	3	2	1	5
S2	IT2202	Discrete Structure and Automata Theory	3	2	1	5
S3	IT2266	Computer Network	3	2	1	5
S4	IT2203	Database Management and Data Mining (Honor course)	3	2	1	5
S5	IT2253	Software Development Project-II	-	6	-	3
S6	IT2254	Engineering Design And Innovation	1	6	-	4
		Total				**27**

FF No.: 654

MD2201: DATA SCIENCE

Course Prerequisites:

1. Linear Algebra Basics
2. Central Tendency & Measures of Dispersion – Mean, Mode, Median
3. Probability
4. Some exposure to programming environment – C programming; Python

Course Objectives:

1. Understand data processing pipeline
2. Perform dimensionality reduction operations
3. Optimize the performance of functions
4. Apply descriptive statistics tools
5. Deduce meaningful statistical inferences
6. Use unsupervised classification algorithms
7. Use supervised classification algorithms
8. Utilize the data science principles for an entire project life cycle as a case study

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: **2** Hours/Week

Course Relevance:

The course is offered in S.Y. B.Tech. to all branches of Engineering
Data Science is a multidisciplinary field. It uses scientific approaches, procedures, algorithms and frameworks to extract knowledge and insight from a huge amount of data.
Data Science uses concepts and methods which belong to fields like information technology, Mathematics, Statistics, Computer Science etc.
Data Science influences the growth and improvements of the product by providing a lot of intelligence about customers and operations, by using methods such as data mining and data analysis.
The course is relevant to all branches of Engineering and beyond, since data is generated as an obvious outcome of many processes.

SECTION-1

Introduction to Data Science

Role of data scientist, introduction to R, R studio; introduction to univariate and multivariate systems, understanding databases, Data Processing - Data collection; Data preparation; Data visualization techniques and inferences - scatter plot, scatter matrix, histogram, box plot.

Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, hypothesis testing, inference for numerical data – t-distribution, paired data, ANOVA

Vector norms, distances & projections, discriminants, Principal Component Analysis, Optimization: constrained and unconstrained, Gradient Descent

SECTION-2

Supervised Learning – line fitting, residuals, correlation; line fitting by least squares regression; outliers in linear regression; Inference for linear regression; Multiple regression; Model selection; Logistic regression, Nearest Neighbor Classification – Knn; Naïve Bayes Classification – Bayesian methods, Bayes algorithm; Classification using decision trees and learners

Unsupervised Clustering - K-means clustering; Evaluation of model performance – Confusion matrices, sensitivity, specificity, kappa statistics, precision, recall, F-measure, ROC curve etc.; Methods of cross-validation, Bootstrapping; Meta-learning through ensemble approach – Bagging, boosting, Random Forests strategies.

Classifier performance measurement metrics – Training & Testing strategies – Resubstitution, Hold-out, Cross validation, Bootstrap ; Confusion matrix, Performance measures – Accuracy, Error rate, Sensitivity, Specificity, Precision, Recall, F-Measure, Receiver Operating Characteristics curves

List of Tutorials:

1. Data Visualization
2. Distances and Projections
3. Singular Value Decomposition
4. Principal Component Analysis
5. Optimization
6. Normal & Binomial Distribution
7. Hypothesis Testing
8. ANOVA test
9. Linear Regression

10. Logistic Regression
11. Nearest Neighbor Classification
12. Decision Trees based classification
13. Naive Bayes classification
14. Clustering
15. Evaluation of model performance
16. Bagging & Boosting approaches

List of Practicals: (Any Six)

1. Data visualization
2. Unconstrained Optimization
3. Hypothesis Testing
4. Linear regression
5. Logistic Regression
6. Nearest Neighbor classification
7. Naive Bayes classification
8. Clustering
9. Classifier performance using Confusion matrix and other attributes
10. Cross Validation methods

List of Course Projects:

1. Movie recommendation system
2. Customer Segmentation using Machine Learning
3. Sentiment analysis
4. Uber Data analysis
5. Loan prediction
6. HVAC needs forecasting
7. Customer relationship management
8. Clinical decision support systems
9. Development of machine learning solutions using available data sets (multiple projects)
10. Fraud detection

List of Course Seminar Topics:

1. Data wrangling
2. Predictive modeling
3. Data analytics in life science (multiple topics)
4. Ensemble modeling techniques
5. Text pre-processing
6. Feature scaling for machine learning
7. Multivariate normal distribution applications
8. Distance metrics and their applications
9. Visualization techniques such as Chernoff's faces
10. Tree based algorithms
11. Ridge regression
12. LASSO

List of Course Group Discussion Topics:

1. PCA and ICA
2. Hierarchical and nonhierarchical systems
3. Linear - Non linear regression
4. Parametric-non parametric estimation
5. Overfitting and underfitting in the context of classification
6. Linear and Quadratic discriminant analysis
7. Regression v/s classification
8. Classifier performance measures
9. Supervised and unsupervised learning
10. Various clustering approaches
11. Classifiers and classifier combinations
12. Balancing errors in hypothesis testing
13. Standard sampling practices for a successful survey for reliable sample data

List of Home Assignments:

Case Study: A very large number of resources are available for data generated out of case study. Unique Home assignments will be set up for all groups
Surveys: Principles of surveying will be implemented by groups to demonstrate use of data science principles in home assignments

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks

Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Text Books:

1. *'A Beginner's Guide to R' – Zuur, Leno, Meesters; Springer, 2009*
2. *'Introduction to Data Science' – Igual, Segui; Springer, 2017*
3. *'Mathematics for Machine Learning' – Diesenroth, Faisal, Ong; Cambridge University Press, 2017*
4. *'Machine Learning with R' – Lantz, Packt Publishing, 2018*

Reference Books:

1. *'Elements of Statistical Learning' - Hastie, Tibshirani, Friedman; Springer; 2011*
2. *'Data Science from Scratch' - Grus; Google Books; 2015*
3. *'The art of Data Science' - Matsui, Peng; 2016*
4. *'Machine Learning for absolute beginners' - Theobald; Google Books; 2017*

Moocs Links and additional reading material:www.nptelvideos.in

1. https://www.edx.org/course/machine-learning-fundamentals-2
2. https://www.edx.org/course/foundations-of-data-analysis-part-1-statistics-usi
3. https://www.coursera.org/learn/statistical-inference/home/welcome
4. https://www.coursera.org/learn/data-scientists-tools/home/welcome

Course Outcomes:

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

1. Apply Data processing & data visualization techniques - 3
2. Implement dimensionality reduction & optimization techniques for enhancing data suitability - 5
3. Perform Descriptive and Inferential statistical analysis for building reliable predictions - 4
4. Implement Supervised algorithms for classification and prediction - 4
5. Implement Unsupervised classification algorithms - 3
6. Evaluate the performance metrics of supervised and unsupervised algorithms - 2
7. Demonstrate complete Data Science life cycle with case studies – 4

CO- PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										2	1		2
CO2	2	3	2										3	2	2	2
CO3	3	3	3										2			2
CO4	2	2	3										1	1		2
CO5	2	3	3										1	1		2
CO6	2	3	2										1	1		2

Future Courses Mapping:

1. Deep Learning
2. Reinforcement Learning
3. DBMS
4. Big Data
5. Data Mining
6. Information Retrieval
7. Recommendation Systems
8. Cloud Computing – AWS
9. IOT
10. Artificial Intelligence
11. Pattern Recognition
12. Natural Language Processing
13. Computer Vision
14. Machine Vision
15. Fault Diagnosis
16. Optimization
17. Bioinformatics
18. Computational Biology
19. Econometrics
20. Supply Chain
21. Ergonomics
22. Operations Research
23. Nano-informatics

Job Mapping:

1. Data Scientist
2. Data Analyst
3. AI Engineer
4. Data Architect.
5. Data Engineer.
6. Statistician.
7. Database Administrator.
8. Business Analyst
9. Business Intelligence Developer
10. Infrastructure Architect
11. Enterprise Architect
12. Machine Learning Engineering
13. Machine Learning Scientist

CS2221: INTERNET OF THINGS

Course Prerequisites:
Students should have a basic Understanding of the Internet, Cloud, Networking Concepts and Sensors

Course Objectives:
The student will be able to

1. Understand IoT Architecture and framework.
2. Recognize and differentiate between the various use cases of different sensors, actuators, solenoid valve etc
3. Learn about fundamental concepts of networking and protocols.
4. Understand IoT Physical, Datalink and Higher layer Protocols.
5. Apply theoretical knowledge for Cloud computing.
6. Implement an IoT solution practically

Credits: 5 **Teaching Scheme Theory:** 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:
The Internet of Things is transforming our physical world into a complex and dynamic system of connected devices on an unprecedented scale. Internet of Things is a system of interrelated computing and sensing devices and has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.
Advances in technology are making possible a more widespread adoption of IoT, from pill-shaped micro-cameras that can pinpoint thousands of images within the body, to smart sensors that can assess crop conditions on a farm, to the smart home devices that are becoming increasingly popular.
IoT is highly relevant in this growing ecosystem of internet-enabled devices.IoT offers increasing opportunities to collect, exchange, analyse and interpret data in real-time. This robust access to data will result in opportunities to further enhance and improve operations. In a world which is moving towards an increasingly connected future, Internet of Things (IoT) is the next big thing. Right from our homes to our cars to our cities, everything is being connected and the technology of IoT is right in the middle of it.

SECTION-1
Introduction to IoT Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels & Deployment Templates, IoT and M2M **IOT Platform Design Methodology**

IoT Design Methodology Steps, Home Automation Case Study, Smart Cities, Health Care, Agriculture, Manufacturing and Logistics

IoT Devices

IoT System Design Cycle, Sensors - Terminologies, Calibration, Types, Specification, Use, Actuators - Types and Use, Prototype Development Platform - Arduino / Raspberry pi / Node MCU, Interface with Embedded System

SECTION-1I

Introduction to Wireless Sensor Network

Sensor Node, Smart Sensor Network, Wireless Sensor Network, RFID - Principles and Components, Node MCU

Connectivity Technologies

Network Configuration in IoT, IoT Stack and Web Stack, IEEE 802.15.4 Standard, Zigbee, Bluetooth, Overview of IoT Protocols, MQTT, Cloud Architecture and Types,Cloud Service Providers

Case Studies (Any Three from following List to be covered)

Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, Weather Report Bot, Air Pollution Monitoring, Forest fire Detection, Smart Irrigation, IoT Printer, IoT in Manufacturing Industry, IoT in Process Industry, IoT in Quality, Control Applications in Industry, IoT in Material Handling System in Industry, IoT in Automobile Industry, Navigation System, Connected Vehicles, Industry 4.0

List of Practicals: (Minimum Six)

1. Setting up Arduino / Raspberry Pi/ Node MCU ESP8266 : Basic handling , programming
2. LED Interfacing
3. Sensor interface to Node MCU/Arduino / Raspberry Pi Temperature measurement using LM35
4. Actuator interface to Node MCU /Arduino / Raspberry Pi Traffic Signal Control
5. Node MCU /Arduino / Raspberry Pi wireless communication Raspberry Pi as a web server
6. Node MCU/Arduino / Raspberry Pi Cloud interfacing and programming like Thingspeak Email alert using SMTP protocol
7. Sensor data acquisition on Mobile (Mobile APP) / Developing Application (WEB APP) with Django Text transfer using MQTT protocol
8. Home Automation using Cisco Packet Tracer

List of Course Projects:

1. Smart Agriculture System
2. Weather Reporting System
3. Home Automation System
4. Face Recognition Bot
5. Smart Garage Door
6. Smart Alarm Clock
7. Air Pollution Monitoring System
8. Smart Parking System
9. Smart Traffic Management System
10. Smart Cradle System
11. Smart Gas Leakage Detector Bot
12. Streetlight Monitoring System
13. Smart Anti-Theft System
14. Liquid Level Monitoring System
15. Night Patrol Robot
16. Health Monitoring System
17. Smart Irrigation System
18. Flood Detection System
19. Mining Worker Safety Helmet
20. Smart Energy Grid

List of Course Seminar Topics:

1. IoT Architecture
2. Sensor Characteristics
3. IoT for supply chain management and inventory systems
4. IoT Ethics
5. Security in IoT
6. Cloud Computing Platform
7. IoT Best Practices
8. 5GinIoT
9. Middleware Technology
10. M2Menergyefficiencyroutingprotocol
11. IoT based Biometric Implementation
12. Complete IoT solution using AWS
13. A smart patient health monitoring system
14. IoT for intelligent traffic monitoring
15. Home automation of lights and fan using IoT

List of Group Discussion Topics:

1. Role of Internet of Things in development of India .
2. Manufacturing industries should make efforts to limit contribution to IoT.
3. Should countries put a ban on IoT for children?
4. Should IoT pay more attention to security rather than just expanding its horizon to the extremes?
5. IoT is the next big thing in technology.
6. IoT poses a huge risk to privacy, if they your system is hacked.
7. IoT is the next big thing for hackers trying to have access to your intimate data.
8. Pros and cons of over-usage of IoT at homes and offices.
9. IoT at battlefields will make life of soldiers safer and easier.
10. IoT will make way for robots to rule over humans one day.
11. IoT devices are making people lazier and obese.
12. IoT needs to be regulated before it goes out of limits and poses serious threat.

List of Home Assignments:

Design:

1. Smart City
2. Smart Transportation
3. Smart Healthcare
4. Smart Industry using IoT
5. Design of IoT framework

CaseStudy:

1. Open Source in IoT
2. IoT solutions for automobile
3. Cloud Computing
4. AWS
5. Microsoft Azure

Blog:

1. Network Selection for IoT
2. Need of secure protocols
3. Future of IoT
4. IIoT
5. IoT and Industry4.0

Surveys:

1. AutonomousVehicles
2. ListofIndiancompanieswhichofferIoTsolutionsforagricultureandfarming.Describetheproblem they are addressing and their solution.
3. Make a list of Indian companies which offer IoT solutions for healthcare. Describe the problem they are addressing and their solution.

4. Make an exhaustive list of everything inside, just outside(immediate surroundings)and on the auto body which must be "observed" for safe and comfortable driving using autonomous vehicles.
5. Compare different Cloud Service providers in the market.

TextBooks:

1. *ArshdeepBahgaand VijayMadisetti,"InternetofThings:AHands-on Approach",(UniversitiesPress)*
2. *PethuruRajandAnupamaC.Raman,"TheInternetofThings:EnablingTechnologies,Platforms,and UseCases", (CRC Press)*

ReferenceBooks:

1. *Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", Wiley*
2. *OvidiuVermesan&PeterFriess"InternetofThingsApplications-FromResearchandInnovationtoMarket Deployment", ISBN:987-87-93102-94-1,RiverPublishers*
3. *JoeBironandJonathanFollett,"FoundationalElementsofanIoT Solution,"byJoeBiron*

MOOCs Links and additional reading material:

1. https://proed.stanford.edu/course/view.php?id=191
2. https://nptel.ac.in/courses/106/105/106105166/
3. https://create.arduino.cc/projecthub/electropeak/getting-started-w-nodemcu-esp8266-on-arduino-ide-28184f

Course Outcomes

1. Demonstrate fundamental concepts of Internet of Things(CO Attainmentlevel:2)
2. Recognize IoT Design Methodology Steps(COAttainmentlevel:3)
3. Select sensors for different IoT applications (COAttainmentlevel:3)
4. Analyze fundamentals of networking (COAttainmentlevel:4)
5. Apply basic Protocols in IoT(CO Attainmentlevel:4)
6. Provide IoT solutions practically with the help of case study(COAttainmentlevel:5)

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2				3							3			

CO2	**3**		**3**		**3**	**3**	**2**	**2**	**3**						**3**	**3**
CO3	**3**		**3**		**3**		**2**	**2**	**2**						**3**	
CO4	**2**	**2**		**3**										**3**		
CO5	**3**		**3**		**3**		**2**	**2**	**2**	**3**	**3**				**3**	
CO6	**2**	**2**				**3**						**3**				**2**

FutureCoursesMapping:

Other courses that can be taken after completion of this course

1. Ad-HocNetworks
2. Cyber Security
3. Wireless Networks
4. Industry 4.0
5. Big Data

Job Mapping:

The Internet of Things (IoT) is the most emerging field in today's world. It is revolutionizingevery industry, from home appliances to agriculture to space exploration. Since the advent ofcloud computing, there hasbeen an exponential growth in the number of sensor-enabledevices connected to the internet and expecting further growth accelerating in the comingyears. There are diversified career opportunities in this field. The various career positionsavailableasIoTResearchDeveloper,IoTDesignEngineer,IoTProductManager,IoTSoftwareDeveloper, IoTSolutionArchitect, IoTServiceManager andmany more.

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

FF No.: 654

CS2218: OBJECT ORIENTED PROGRAMMING

Course Prerequisites:
Basic course on programming

Course Objectives:

1. Understand Object Oriented programming concepts
2. Demonstrate Object Oriented programming concepts by writing suitable Java programs
3. Model a given computational problem in Object Oriented fashion
4. To develop problem solving ability using Object Oriented programming constructs like multithreading
5. Develop effective solutions using for real world problems using the concepts such as file handling and GUI
6. Implement applications using Java I/O and event-based GUI handling principles

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:
This is an important course for engineering students. It develops computational problem solving and logic building capability of students. Acquiring programming skills has a high relevance in all branches of Engineering. Once the student gains expertise in coding, this course proves to be beneficial to them to excel in industry demanding coding in specific software.

SECTION-1

Introduction:
What is Object Oriented Programming (OOP)? The need of OOP, Characteristics of OOP.

Java overview: Classes and Objects, Java object storage, Different ways to create objects in Java, Access Modifiers, this reference, main method, Static vs Instance block, Static methods vs Instance methods in Java, Object class, Static class in Java, operators, keywords in java.

Constructors: Constructors in Java, Default constructor, Parameterized constructor, Copy Constructor, Private Constructors and Singleton Classes.
Garbage Collection: Garbage Collection, How to make object eligible for garbage collection in Java?

Input and Output: Byte Stream vs Character Stream, Command Line arguments, use of Scanner Class, Scanner vs BufferReader Class, Formatted output, Reading input from console.

Arrays in Java: Arrays in Java, initialization, Default Array values, multi dimensional array, passing array to a function, Jagged arrays, java.util.Arrays class, string class, string buffer, string builder.

Methods in Java: Methods, Parameters passing, Returning Multiple values, Throwable fillInStackTrace() method in Java, Valid variants of main(), Variable Arguments (Varargs) method

Inheritance: Inheritance in Java, Types, Constructor in Inheritance, Using final with Inheritance, Accessing superclass member, Override private methods, Parent and Child classes having same data member, Base vs derived class reference. Polymorphism: Method Overloading, Overloading main(), Static vs Dynamic Binding, Method Hiding. Private and final methods, Passing and Returning Objects in Java

SECTION-2

Exception Handling: Exceptions, types, types of handling exception, Checked vs Unchecked Exceptions, Throw and Throws, User-defined Exception, Chained Exceptions.

Interfaces and Abstract Classes: Interface and its usage, Abstract Class and its usage, Difference between Abstract Class and Interface, Nested Interface, Nested Class, Inner class, Anonymous Inner class, Marker interface.

Java Packages: Packages Introduction, default access specifier use, dealing with package.

Collection in Java: Collections Class, Enumeration, Iterators and ListIterator, Using Iterators, Iterator vs Foreach, ArrayList, Vector, Map, Set.

Multithreading: Thread life Cycle, Thread Priority, Thread Methods, Inter-thread Communication, Synchronization, Method and Block Synchronization, Deadlock situation in threading.

File Handling & Database connectivity: File Processing, Primitive Data Processing, Object Data Processing,Wrapper classes, Connecting Java with database (JDBC/ODBC).

Java GUI: AWT, Swing, Components, design patterns. Layout Manager: Flow, Border, Grid and Card. Label, Button, Choice, List, Event Handling (mouse, key), Menus, Tables

List of CourseSeminar Topics:

1. Introduction of Arrays and 1D Array programming examples
2. Multidimensional arrays
3. Variants of main() and command line arguments
4. Input and Output stream classes
5. String concepts and various methods of comparing strings
6. Methods in Java
7. Java String Methods
8. Passing array to a function and Jagged array examples
9. Reading input using Scanner and BufferReader Class
10. String, String buffer and String builder
11. Types of Inheritance in Java
12. Implementation of Types using Constructor in Inheritance
13. Using final with Inheritance
14. Base vs derived class reference in Inheritance
15. Using final with Inheritance, Accessing superclass member
16. Parent and Child classes having same data member
17. Overriding, Hiding Fields & Methods
18. Static vs Dynamic Binding & Hiding Methods
19. Private and final methods
20. Passing and Returning Objects in Java
21. Java Memory Management
22. File handling in Java vs C++
23. Data types used in Java vs C++
24. Java Object Serialization and Deserialization
25. Operator precedence
26. Use of Object Class Methods
27. Garbage collection in JAVA
28. Use of Static Blocks in various applications
29. Keywords used in JAVA
30. Types of Variables In JAVA

List of Group Discussion Topics:

1. Checked and unchecked exception, user defined and standard exception
2. Abstraction in Java and different ways to achieve Abstraction
3. Packages in Java – Types, Advantages & Techniques to Access Packages
4. Inner classes, nested interfaces in Java
5. Difference between Interfaces and abstract classes in Java
6. Exception Handling in Java Vs CPP
7. Difference between 1) throw and throws. 2) Final, finally and finalize in Java

8. Discuss Exception propagation and Discuss Exception handling with method overriding in Java
9. Discuss Packages, Access specifiers and Encapsulation in java.
10. Difference between abstraction and encapsulation in Java.
11. Daemon Threads Vs user threads
12. Preemptive scheduling Vs slicing
13. Is it possible to call the run()method directly to start a new thread? pls comment
14. Arraylist Vs Vector
15. Arrays Vs Collections
16. is Iterator a class or an Interface? what is its use?
17. List Vs Set
18. BufferedWriter and BufferedReader classes in java
19. BufferedReader Vs Scanner class in java
20. Buffered Reader Vs FileReader in java
21. Instanceofjava
22. Difference between CPP and JAVA
23. Difference between JDBC and ODBC connectivity
24. file processing in java
25. Difference between premitive data processing and object data processing
26. Creating GUI using swing
27. comparision between Swing, SWT, AWT, SwingX, JGoodies, JavaFX, Apache Pivot
28. Introduction To JFC And GUI Programming In Java
29. Introduction to wrapper classes
30. Why java uses Unicode System?

List of Practicals:

1. Implement Student class using following Concepts
   - All types of Constructors
   - Static variables and instance variables
   - Static blocks and instance blocks
   - Static methods and instance methods

2. There is a class Adder which has two data members of type 1D int array and int variable. It has two functions: getdata and numsum. Function getdata accepts non-empty array of distinct integers from user in 1D int array data member and a targetsum in another data member. The function numsum adds any two elements from an input array which is equal to targetsum and return an array of resulting two elements, in any order. If no two numbers sum up to the target sum, the function should return an empty array. Note that the target sum is to be obtained by summing two different integers in the array; you can't add a single integer to itself in order to obtain the target sum. You can assume that there will be at most one pair of numbers summing

up to the target sum. Use constructor. Use extra variables if needed

Input:
Array=[3,5,-4,8,11,1,-1,7] targetsum=15
Output: [8,7]
Input:
Array=[3,5,-4,8,11,1,-1,6] targetsum=15
Output: []

3. Write Java program to calculate area of triangle, square & circle using function overloading. Function parameter accept from user (Use function Overloading concepts and Inheritance).

4. Write a program for following exception, develop a suitable scenario in which the following exceptions occur:
    a. divide by zero
    b. Array index out of bounds exception
    c. Null pointer Exception
5. Write a java program to solve producer-consumer problem where there are two producer threads and one consumer thread.

6. Implement various operations using JDBC Connectivity.
7. Display bank account information (Use interface and inheritance using java)
8. Develop a GUI in java which reads, update the file.

List of Course Projects:

Topics of Course Project would be discussed in Lab session.

List of Home Assignments:

Blog:

1. Single and Multidimensional arrays in Java
2. Comparison Inheritance & Polymorphism
3. Need of abstract classes and interfaces in Java
4. Multithreading concept in Java
5. Signed & Unsigned arithmetic operations using JAVA
6. Role of start() and run() methods in multithreading

Survey:

1. Strategies for Migration from C++ to Java
2. Product development using Inheritance and Polymorphism in Industry
3. on Java/OOP features popular amongst developers
4. Which other (non-JVM) languages does your application use?
5. How Java Impacted the Internet
6. How can an ArrayList be synchronised without using vector?

Design:

1. Implementation of Singleton design pattern in Java
2. Notes Repository System for Academic
3. Design for employee management system
4. Design for student management system
5. Inventory Management System
6. Write a program to delete duplicate numbers from the file

Case Study:

1. Java development milestones from 1.0 to 16.0
2. Implementation of Different Methods in Polymorphism
3. Real world systems which use java for its implementation
4. Drawing a flag using java
5. Use of different methods of Class object
6. Drawing a flag using java

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Text Books:

1. *Herbert Schildt, "JAVA- The Complete Reference", 11th Edition, McGraw Hill Education*

Reference Books:

1. *Bruce Eckel, "Thinking In Java – The Definitive Introduction to Object-Oriented Programming in the Language of the World-Wide Web", Fourth Edition, Pearson Education, Inc.*

2. *R. Morelli and R. Walde, "Java, java, Java – Object-Oriented Problem Solving", 3rd edition, Pearson Education, Inc.*

Moocs Links and additional reading material:

Programming using Java| Java Tutorial | By Infosys Technology
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01304972186110361645_shared/overview

An Introduction to Programming through C++ – Prof A.G. Ranade- NPTEL- computer science and engineering – NOC https://nptel.ac.in/courses/106/101/106101208/#

Course Outcomes:

The student will be able to –
1. Understand object-oriented programming features
2. Develop real world applications using class, inheritance and polymorphism
3. Adapt Best Practices of Class Design by using Standard Templates Library
4. Solve computing problems by applying the knowledge of Exception handling and Multithreading
5. Design solutions by choosing suitable data structures such as Array, Vector, Map etc
6. Implement applications using Java I/O and event-based GUI handling principles

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2				3							3			
CO2	3		3		3	3	2	2	3						3	3
CO3	3		3		3		2	2	2						3	
CO4	2	2		3										3		
CO5	3		3		3		2	2	2	3	3				3	
CO6	2	2				3						3				2

Future Courses Mapping:

Advanced Data Structures, Advanced Java, Spring Frame Work, Grails Frame Work

Job Mapping:

Java Programmer, Application Developer, Design Engineer, Senior Software Developer

FF No.: 654

IT2201: COMPUTER ORGANIZATION AND ARCHITECTURE

Course Prerequisites:

Basics of computer system and any programming language.

Course Objectives:

1. To study the fundamental concepts of structural Computer system and Computer Arithmetic
2. To understand the basic concepts and functions of Microprocessor
3. To gain knowledge of Computer Memory System
4. To get familiar with GPU and CPU architecture
5. To identify solutions for real world design issues using processors.

Credits: 5 **Teaching Scheme** **Theory: 3** Hours/Week
Tut: 1 Hours/Week
Lab: **2** Hours/Week

Course Relevance:

Modern computer technology requires an understanding of both hardware and software, since the interaction between the two offers a framework for mastering the fundamentals of computing.

The purpose of this course is to cultivate an understanding of modern computing technology through an in-depth study of the interface between hardware and software.

In this course, you will study the history of modern computing technology before learning about modern computer architecture and a number of its essential features, including instruction sets, processor arithmetic and control, the Von Neumann architecture, pipelining, memory management, storage, and other input/output topics.

The course will conclude with a look at the recent switch from sequential processing to parallel processing by looking at the parallel computing models and their programming implications.

SECTION I

Basic concepts of Digital Electronics, Organization and Architecture, Structure & Function, Brief History of computers, Von Neumann Architecture, Integer Representation: Fixed point & Signed numbers. Integer Arithmetic: 2’s Complement arithmetic, multiplication, Booth’s Algorithm, Division Restoring Algorithm, Non Restoring algorithm, Floating point representation: IEEE Standards for Floating point representations.

8086 Microprocessor Architecture, Register Organization, Instruction types, Types of operands, Instruction formats, addressing modes and address translation. Near & FAR procedure, Instruction cycles. RISC Processors: RISC- Features, CISC Features, Comparison of RISC & CISC Superscalar Processors. Case study of Processor.

Fundamental Concepts: Single Bus CPU organization, Register transfers, Performing an arithmetic/ logic operations, fetching a word from memory, storing a word in memory, Execution of a complete instruction. Micro-operations, Hardwired Control, Example-Multiplier CU. Micro-programmed Control: Microinstructions, Microinstruction-sequencing: Sequencing techniques, Micro-program sequencing

SECTION II

Need, Hierarchical memory system, Characteristics, Size, Access time, Read Cycle time and address space. Main Memory Organization: ROM, RAM, EPROM, E 2 PROM, DRAM, Design examples on DRAM, SDRAM, DDR3, Cache memory Organization: Address mapping. Basic concepts: role of cache memory, Virtual Memory concept. Pipeline and its performance, Data hazards: operand forwarding, handling data hazards in software, side effects. Instruction hazards: unconditional branches, conditional branches and branch prediction.

Parallelism in Uniprocessor system, Evolution of parallel processors, Architectural Classification, Flynn's, Fengs, Handler's Classification, Multiprocessors architecture basics, Parallel Programming Models : Shared memory, Message passing, Performance considerations : Amdahl's law, performance indications.

Parallel computing architectures (multi-core CPUs, GPUs, traditional multi-processor system, Xeon-Phi, Jetson Kit, Kilocore processor), multiprocessor and multicomputer systems, interconnection networks, Modern GPU architecture (in brief), Performance comparison: Speedup, Gain time and scalability.

List of Practical (Any Six)

1. Study of 8086 Architecture and Execution of sample programs.
2. Write 8086 ALP to access marks of 5 subjects stored in array and find overall percentage and display grade according to it.
3. Write 8086 ALP to perform block transfer operation. (Don't use string operations) Data bytes in a block stored in one array transfer to another array. Use debugger to show execution of program.
4. Write 8086 ALP to find and count zeros, positive number and negative number

from the array of signed number stored in memory and display magnitude of negative numbers.

5. Write 8086 ALP to convert 4-digit HEX number into equivalent 5-digit BCD number.
6. Write 8086 ALP to convert 5-digit BCD number into equivalent 4-digit HEX number.
7. Write 8086 ALP for following operations on the string entered by the user.
   a. String length
   b. Reverse of the String
   c. Palindrome
8. Write 8086 ALP for following operations on the string entered by the user (Use Extern Far Procedure).
   a. Concatenation of two strings
   b. Find number of words, lines.
   c. Find number of occurrences of substring in the given string.
9. Write 8086 ALP to initialize in graphics mode and display following object on screen.
10. Write 8086 ALP to encrypt and decrypt the given message.
11. Write 8086 ALP to perform following operations on file
    a. Open File
    b. Write data in the file.
    c. Delete data in the file.
    d. Close the file.

List of Course Projects:

1. Combinational and Sequential circuits
2. Memory Management
3. Graphics Mode
4. IOT based projects.
5. IoT based atmospheric CO2 administration.
6. IoT based flood risk predictor.
7. Simulate modern traffic control system.
8. Online Parallel Examination.

List of Course Seminar Topics:

1. Computer Architecture VS Computer Organization
2. Evolution of Computing Devices
3. Instructions types , formats and execution
4. Interrupts in Microprocessor
5. Trends in computer architecture
6. RISC Vs CISC architecture : A Case Study

7. ARM processor architecture
8. Latest Technology in Embedded systems
9. Multiplier Control Unit
10. Booth's Encoding Pattern for Fast Scalar Point Multiplication in ECC for Wireless Sensor Networks
11. Internet of Things (IoT) in 5G Wireless Communications
12. State of the art parallel processor design.
13. Memory management in mobile OS.
14. Evolution of processors.
15. Ultra SPARC Processor Architecture.

List of Course Group Discussion Topics:

1. GPU computing: CUDA
2. Memory System
3. Replacement Algorithms
4. Pipelining
5. Cache Coherance
6. Virtural Memory
7. Hazards in pipelining
8. Super Computer
9. Modern computer generations
10. Parallel computing models

List of Home Assignments:

Design:

1. Write the sequence of control steps required for the single bus organization for each of the following instructions:
   1. ADD the (immediate) number NUM to register R1
   2. ADD the contents of memory location NUM to register R1

   Assume that each instruction consists of two words. The first word specifies the operation and addressing mode, and second word contains the number NUM
2. Configure a 32 Mb DRAM chip. Consider cells to be organized in 8K X 4 array. Find out the number of address lines.
3. A set associative cache consists of 64 lines, or slots, divided into four-line sets. Main memory contains 4K blocks of 128 words each. Analyze the format of main memory addresses with proper explanation.
4. A one pipeline system takes 50 ns to process a task. The same task can be processed in 6 segment pipeline with a clock cycle of 10 ns. Determine the speedup ratio of pipeline for 100 tasks. What is maximum speedup ratio?

Case Study:

1. Micro-programmed Control Unit and Hardwired Control Unit.
2. Pipeline Hazards
3. Flynn's architectural classification scheme.
4. Modern Processor units

Survey:

1. New memory technologies and their potential impact on **architecture**
2. Virtual Memory
3. Simulation of a superscalar processor and analyzing impact of design tradeoffs
4. Cache Consistency Models in Modern Microprocessors

Blog:

1. Super Computer
2. Intel Journey
3. New Arm Interconnect technologies
4. Distributed Systems and Parallel Computing

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Text Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", 7th Edition, Pearson Prentice Hall Publication, ISBN 81-7758-9 93-8.
2. C. Hamacher, V. Zvonko, S. Zaky, "Computer Organization", 5th Edition, Tata McGraw HillPublication, ISBN 007-120411-3.
3. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill ISBN 0-07-113342-9
4. Douglas Hall, "Microprocessors and Interfacing", 2nd Edition, Tata McGraw HillPublications, ISBN 0-07-025742-6.
5. Peter Abel, "Assembly Language Programming," 5th Edition, Pearson Education Publications, ISBN 10:013030655.

Reference Books:

1. *Hwang and Briggs,"Computer Architecture and Parallel Processing", Tata McGraw HillPublication ISBN 13: 9780070315563.*
2. A. Tanenbaum, "Structured Computer Organization", Prentice Hall Publication, ISBN 81 –203 – 1553 – 7, 4th Edition.

MOOCs Links and additional reading material:

1. www.nptelvideos.in
2. https://www.udemy.com/
3. https://learn.saylor.org/
4. https://www.coursera.org/
5. https://swayam.gov.in/

Course Outcomes:

Upon completion of the course, post graduates will be able to –

1. Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os. (2)
2. Illustrate the micro operations sequencing. (3)
3. Evaluate various alternatives in processor organization. (3)
4. Understand concepts related to memory & IO organization (2)
5. Adapt the knowledge based on Pipeline and its performance (3)
6. Design real world applications using processors. (4)

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2			3								3			
CO2	2			3	2	3								3		
CO3	2	2		2											3	
CO4	3	2	3	2	2	2	3	3	3	2	2				3	
CO5	3	3												3		
CO6	3	2			3							3				3

CO Attainment Level:

CO1: 1

CO2: 3
CO3: 2
CO4: 1
CO5: 4
CO6: 5

Future Courses Mapping:
Advance Computer Architecture, Advance Operating Systems

Job Mapping*:*
Application Developers, System programmer

IT2259: Software Development Project -I

Course Prerequisites:C, C++, Java, Android and Web Technologies

Course Objectives:

1. To enhance problem solving skills by independent learning
2. To emphasize learning activities that are long-term, interdisciplinary and student-centric.
3. To engage students in rich and authentic learning experiences.
4. To provide every student the opportunity to get involved individually to learn professionalism
5. To inculcate research culture and attitudes towards learning among the students.
6. To improve employability skills of students

Credits: 3 **Teaching Scheme Lab:** 6 Hours/Week

Course Relevance: Software Project Development comes under the category of Project Based Learning (PBL). For better learning experience, along with traditional classroom teaching and laboratory work-based learning, project based learning has been introduced with an objective to motivate students to learn how to solve a problem. Students may work on problems innovatively in different domains like social, technical, cultural and scientific.

Teacher's Role :

- Teacher will act as the facilitator and mentor.
- To utilize the principles of problem solving, critical thinking and metacognitive skills of the students.
- To make the individual aware of time management.
- To Help students to solve technical problems
- To assess and evaluate student performance by monitoring regularly on a weekly basis.

Recommended Guidelines :

1. SDP is a Project Based Learning. PBL is learning through activity. One of the faculty can be appointed as coordinator for SDP.
2. Following are the recommended guidelines that will work as an initiator and facilitator in the process of completion of SDP.
3. In the first week of commencement of semester let the coordinator create awareness about SDP (what, why, and how) among the students. Convey students expected outcomes, assessment process and evaluation criteria.
4. Assign mentor batch wise.
5. Provide guidelines for title identification (Problem can be some real life situation that needs technology solutions. This situation can be identified by meeting people around, visiting various industries, society, and institutes. The solution can be prototype, model, convertible solutions, survey and analysis, simulation, and similar).
6. Let students submit the problem identified in prescribed format (Title, Problem statement, domain, details of a problem undertaken, and what is need of solution to the problem)
7. Coordinator and Mentor can approve the problem statements based on feasibility and learning outcomes expected for second year engineering students.
8. Mentor is to monitor progress of the task during phases of project work. Broadly phases may include- literature survey, requirements gathering, preparing a solution, designing solution, Implementing and testing the solution.
9. Weekly monitoring and continuous assessment record is to be maintained by mentors.
10. Get the IEEE paper format as a report submitted at the end of semester.
11. In semester evaluation will be done by a mentor along with internal faculty as a jury and at the end of semester will be evaluated by industry experts.

Sample Software Project Statement based on Java ,C,C++, Android, Web technologies

1. QR Code bases contactless ordering
2. ATM Simulator
3. Drivers Booking Website
4. Document Scanner app
5. Campus canteen management system
6. movie ticket booking system

7. Covid-19 Live Statistical Analysis

...not limited to.....

Faculty and students are free to include other area which meets the society requirements at large

Course Outcomes:

The student will be able to –

1. Find the real-life problem from societal need point of view
2. Compare different approaches and select the most feasible one.
3. Analyze and synthesize the identified problem from technical viewpoint
4. Design and develop an optimal and reliable solution to meet objectives
5. Validate the solution based on the criteria specified
6. Inculcate long life learning and research attitude among the students

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2				3										
CO2	2			3	1									2		
CO3	3	3							2	3				3		
CO4			3		3		3	3	3		2				3	
CO5		2		2									2			
CO6	3											3				3

CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	4	2	4	5	1	3

Job Mapping: Software Engineer,WebDeveloper,Android Developer

IT2260: Engineering Design and Innovation III

Course Prerequisites: Problem Based Learning

Credits: 4 **Teaching Scheme Theory:** 1 Hour/Week

Lab: 6 Hours/Week

Course Objectives:

1. To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problems.

2. To Evaluate alternative approaches, and justify the use of selected tools and methods,

3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.

4. To engage students in rich and authentic learning experiences.

5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

6.To develop an ecosystem to promote entrepreneurship and research culture among the students.

Course Relevance: Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Along with course based projects, curriculum can be enriched with semester long Engineering Design and Development courses, in which students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City,Smart Energy and Swaccha Bharat Abhiyan. To gain the necessary skills to tackle such projects,students can select relevant online courses and acquire skills from numerous sources under guidance of faculty and enrich their knowledge in the project domain, thereby achieving project centric learning. Modern world sustained and advanced through the successful completion of projects. In short, if students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. Project based learning will also redefine the role of teacher as mentor in the learning process. The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to nalyze, design and apply categories of Bloom's Taxonomy.

SECTION-1

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students;rather they are free to explore their creativity beyond the guideline mentioned herewith. For all courses of ED, laboratory course contents of "Trends in Engineering Technology" are designed as a ladder to extend connectivity of software technologies to solve real world problems using an interdisciplinary approach. The ladder in the form of gradual steps can be seen as below:

Industry Communication Standards, Single Board Computers and IoT, Computational Biology(Biomedical and Bioinformatics), Robotics and Drone, Industry 4.0 (Artificial Intelligence,Human Computer Interfacing, 5G and IoT, Cloud Computing, Big Data and Cyber Securityetc).

Suggest an assessment Scheme:

MSE and ESE

Text Books: (As per IEEE format)

1. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017

2. Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.

Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert RobartCapraro, Mary Margaret Capraro

Reference Books: (As per IEEE format)

1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-basedlearning in engineering. Rotterdam: Sense Publishers. 2007.

2. Project management core textbook, second edition, Indian Edition , by Gopalan.

3. The Art of Agile Development. By James Shore & Shane Warden.

Moocs Links and additional reading material: www.nptelvideos.in

Course Outcomes:

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

CO1: Identify the real life problem from societal need point of view

CO2: Choose and compare alternative approaches to select most feasible one

CO3: Analyze and synthesize the identified problem from technological perspective

CO4: Design the reliable and scalable solution to meet challenges

CO5: Evaluate the solution based on the criteria specified

CO6: Inculcate long life learning attitude towards the societal problems

CO PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2				3										
CO2	2			3	1									2		
CO3	3	3							2	3				3		
CO4			3		3		3	3	3		2				3	
CO5		2		2									2			
CO6	3											3				3

IT2265: Advanced Data Structures

Course Prerequisites: Basic programming Skills (C/C++).

Course Objectives:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques.
3. To construct and implement various data structures and abstract data types including lists, stacks, queues, trees, and graphs.
4. To make understand about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.
5. To emphasize the importance of data structures in developing and implementing efficient algorithms.

Credits:5 **Teaching Scheme Theory:** 3 Hours/Week

Tut:1 Hour/Week

Lab:2 Hours/Week

Course Relevance: This is a basic Course for Computer Engineering and allied branches. This course has a high relevance in all domains of computer engineering such as in Industries, research etc. as a basic prerequisite course.

SECTION-1 **Arrays, Stacks, Queues and Linked Lists**
Arrays: Representation and application of Single and Multidimensional arrays, Time & Space Complexity Analysis. **Sorting Techniques:** Bubble, Selection, Insertion, Merge, Quick, Heap sort with Analysis. **Searching techniques:** Linear Search, Binary search with Analysis. **Stack:** Stack representation and Implementation using arrays and Linked lists. Applications of stack in Recursion, Expression conversions and evaluations. **Queues:** Representation and implementation using array and Linked lists, Types of queues. Applications of Queues: Job Scheduling, Josephus problem etc. **Linked Lists:** Dynamic memory allocation, Singly Linked Lists, doubly linked Lists, Circular linked lists and Generalized linked lists, Applications of Linked list.

SECTION-II

Trees, Graphs and Hashing

Trees: - Basic terminology, representation using array and linked lists. Tree Traversals: Recursive and Non recursive, Operations on binary tree. Binary Search trees (BST).

Advanced Trees: Introduction, AVL tree, R-B tree, B tree and B+ tree.

Graphs: Terminology and representation using Adjacency Matrix and Adjacency Lists, Graph Traversals and Application: BFS and DFS, connected graph, Bipartite Graph, Detecting Cycle in graph. Minimum Spanning tree: Prims and Kruskal's Algorithm, Shortest Path Algorithms, Union Find.

Hashing: Hashing techniques, Hash table, Hash functions. Collision handling and Collision resolution techniques, Cuckoo Hashing.

List of Tutorials: (Any Three)

1. Sorting Techniques: Insertion, Merge sort, Bubble, Shell Sort, Radix Sort.
2. Searching Techniques: Ternary Search, Fibonacci Search.
3. Problem solving using stack (Maze problem, Tower of Hanoi).
4. Expression conversion like infix to prefix and postfix and vice versa.
5. Priority Queues and Job Scheduling Algorithms.
6. Generalized Linked Lists.
7. Threaded Binary tree and Stack less Traversals using TBT.
8. B and B+ Tree.
9. Applications of Graph in Network problems.
10. Design of Hashing Functions and Collision Resolution techniques.
11. Cuckoo Hashing**.**

List of Practicals: (Any Six)

1. Assignment based on Sorting and Searching.
2. Assignment based on Stack Application (Expression conversion etc.)
3. Assignment based on Queue Application (Job scheduling, resources allocation etc.)
4. Assignment based on linked list.
5. Assignment based on BST operations(Create, Insert, Delete and Traversals)
6. Assignment based on various operations on Binary Tree (Mirror image, Height, Leaf node display, Level wise display etc.)
7. Assignment based on AVL and R-B tree.
8. Assignment based on DFS and BFS
9. Assignment based on MST using Prim's and Kruskals Algorithm.
10. Assignment based on Finding shortest path in given Graph.
11. Assignment based on Hashing.

List of Projects:

1. Finding Nearest Neighbors.
2. Calendar Application using File handling.
3. Path finder in Maze
4. Word Completion Using Tire.
5. Bloom Filters.
6. Different Management Systems.
7. Scheduling Applications and Simulation.
8. Shortest Path Applications. (Kirchhoff's Circuit, TSP with Scenario.)
9. Efficient Storage and Data Retrieval Systems.
10. Different Gaming Application.

List of Course Seminar Topics:

1. Asymptotic Notations in Data structures.
2. Hash Table, Heaps and Their applications.
3. Analysis of Merge Sort, Quick Sort and Bubble Sort for Best, Average and Worst Case.
4. Solving N-queen and Josephus Problem using Backtracking , Stack and Queue respectively.
5. Priority Queue in Job Scheduling.
6. Application of Stack in Backtracking problems.
7. Priority Heap and min-Max Heap.
8. Data Structures for Languages and Libraries.
9. Multidimensional and Special Data Structures.
10. Algorithm Design using Divide and Conquer

List of Course Group Discussion Topics:

1. Application based comparison of Sorting Algorithms.
2. Graphs vs Tree Data Structures: Application based comparison? Which is best? Why? How?
3. Advanced trees: which is the best? (AVL,RB,B,B+) when? how? why?
4. Scenario Based Comparison: Kruskals vs Prims Algorithm.
5. Hashing application in today's technology. Is it necessary?
6. Application based comparison: Stack vs Queues.
7. B- Tress VS B+ Trees: Which is to be consider? When ? Why?
8. Need and Role of Different tree Traversals.
9. Graphs vs Tree Data Structures: Application based comparison? Which is best? Why? How?
10. Linked List application in today's technology. Is it necessary?

List of Home Assignments:

Design:

1. Design Single Source multiple destination Shortest Path Algorithm For Driving Application.

2. Expression Tree and Topological Sorting application in Problem solving.

3. Scheduling Algorithms using Queue.

4. Implementation of B and B+ trees for database management.

5. GLL application to Solve problems on Multivariable Polynomial. Consider suitable example.

Case Study:

1. Consider a Suitable Example for Hashing Application. Study its Merits, Demerits and Design.

2. Consider different real life examples where different sorting, Searching techniques have been used. Why used? How? Comparative study.

3. Why there is a need of different tree traversal algorithms? Consider different real life examples where they are used. Why? How?

4. Game Base study for data structures.

5. Compare different graph traversal algorithm by considering different real life examples where they have used.

Blog:

1. Comparative Application of Prims vs Kruskals Algorithm in real life scenarios.

2. AVL Tree vs RB Tree with applications

3. Need of different Sorting techniques.

4. How Hashing is useful in recent technologies? Consider any application related to it.

5. Role of Stacks and Queues in problem Solving.

Surveys:

1.How application of Graph Search Algorithms (DFS and BFS) is there in recent technologies? Consider some real life technologies.

2. How Advanced Trees Data structure plays important role in Database management?

3. Survey of Data Structures for computer Graphics applications.

4. A survey on different hashing Techniques in programming.

5. Graph algorithms in Network Application.

Suggest an assessment Scheme:

MSE, ESE, GD, Seminar, HA, CVV, Lab Assignment, Course Project.

Text Books:

1. E. Horwitz , S. Sahani, Anderson-Freed, " Fundamentals of Data Structures in C",Second Edition, Universities Press.

2. Y. Langsam, M.J. Augenstein, A.M.Tenenbaum, "Data structures using C and C++",Pearson Education, Second Edition.

3. Narasimha karumanchi, "Data Structures and Algorithm Made Easy", Fifth Edition, CareerMonk publication.

Reference Books:

1. *J. Tremblay, P. soresan, "An Introduction to data Structures with applications", TMHPublication, 2nd Edition.*

2. *G. A.V, PAI , "Data Structures and Algorithms ", McGraw Hill, ISBN -13: 978-0-07-066726-6*

Moocs Links and additional reading material:

1. https://nptel.ac.in

2. https://www.udemy.com

3. https://www.coursera.org

4. www.geeksforgeeks.org

The student will be able –

1)To interpret and diagnose the properties of data structures with their memory representations and time complexity analysis. (1)

2)To use linear data structures like stacks, queues with their applications. (2)

3)To implement operations like searching, insertion, deletion, traversing mechanism etc. on various data structures with the help of dynamic storage representation. (3)

4)To demonstrate the use of binary tree traversals and to perform various operations on Non-linear data structures. (5)

5) To analyze the Graph data structure and to solve the applications of Graph data structures.(4)

6) To design the appropriate data structure by applying various hashing Techniques.(3)

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		2		2				2				2		
CO2	2		3		2		2		2							
CO3	2	3	3			2										
CO4		2			3				2							2
CO5	2	3	2				2	2		2		3		2		2
CO6	2		3	2				2			3		3		3	

CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
val	1	2	3	5	4	3

Future Courses Mapping: Following courses can be learned after successful completion of this course: Design and Analysis of Algorithms, Operating Systems, Compiler Design, Systems Programming, Data Science and similar courses.
Job Mapping:Data Structures and Algorithm is must necessary part of any programming job. Without Data structures it is not possible to be good in Competitive coding. All Industries always looks for a strong knowledge in Data structures. Without learning this course, one can't imagine a job in computer/IT related industries and research.

IT2202: Discrete Structures and Automata Theory

Course Prerequisites: Basic mathematics and programming

Course Objectives:

1. Formulate and solve counting problems, problems based on recurrence relations and probability theory
2. To study graph and tree based models to be applied in real life problems
3. To design suitable computational model/s for accepting a given language
4. To compare these models with respect to their power in recognizing different types of languages

Credits: 05 **Teaching Scheme Theory:** 03 Hours/Week

Lab: 02 Hours/Week

Tutorial: 01 Hours/Week

Course Relevance: This course lays a strong foundation for higher studies as well as research. For higher studies, there are different courses such as 'Program Analysis and Verification' which are based on the concepts of computation theory.

For Research scholars, it would help in understanding the type and class of problems, and to solve and prove certainty of the provided solution.

It would also help software developers in building the logic of programs, exploring its mathematical proofs, generating hypothetical scenarios, and designing various computing machines.

SECTION-1

Topics and Contents

Logic and Proofs: Propositional logic, applications of propositional logic, propositional equivalences, predicates and quantifiers, rules of inference, introduction to proofs: direct, contrapositive, contradiction, counter example, principle of mathematical induction.

Elementary Discrete Structures & Basic Counting: Elementary set theory, relations, functions, basic counting principles, permutations, combinations, Pigeon-Hole Principle, generalized pigeon-hole principle, Inclusion Exclusion Principle: Counting, Euler's phi function.

Recurrence relations: Recurrence relations, modelling using recurrence relations, Fibonacci numbers, solution of linear recurrence relations with constant coefficients (homogeneous and inhomogeneous).

Probability Theory: Discrete Probability, Conditional Probability, Bayes Theorem, Information and Mutual Information, Applications of Combinatorics and Discrete Probability.

Graph Theory: Graphs, different representations, properties of incidence and adjacency matrices, directed/undirected graphs, connected components, degree of a vertex, paths, cycles in graph, tree, bipartite graphs (graph with only odd cycles, 2-colorable graphs), Planar graphs, Eulerian path and Eulerian circuit, Hamiltonian circuit.

SECTION-1I

Topics and Contents

Finite Automata: Automaton as a model of computation, Alphabets, Strings, Languages, Finite Automata, Deterministic Finite Automata (DFA) - Formal Definition, State Minimization algorithm, Nondeterministic finite Automata (NFA), NFA with epsilon transition.

Regular Expression: Regular expression (RE) Definition, Applications, Kleene's Theorem: Equivalence of RE and DFA, Closure properties of Regular Languages, Myhill-Nerode theorem and its applications, Pumping Lemma for regular Languages.

Grammar: Grammar, definition, Context Free Grammars (CFG), Derivation, Languages of CFG, Constructing CFG, Closure and Decision properties of Context Free Languages (CFLs). Derivation trees, Ambiguity in CFGs, Removing ambiguity, CNF, GNF, Chomsky hierarchy, Applications of CFG.

Pushdown Automata: Pushdown Automata (PDA) definition, Languages, Acceptance by final state / empty stack, Deterministic and Non-deterministic PDAs, CFG to PDA construction, Equivalence of PDA and CFG, Pumping lemma for CFLs, Context Sensitive Languages, Context Sensitive Grammars, Linear Bounded Automata.

Turing Machine: Turing Machine (TM) definition, Instantaneous Description, Language acceptance, Robustness of TM, equivalence of TM variants; Universal Turing Machine, TM as enumerator, Recursive and Recursively Enumerable languages and their closure properties, Decidability and Undecidability.

List of Tutorials:

1. Applications of Bipartite graphs in biology and medicine
2. Applications of Probability theory in risk assessment and modeling
3. Hamiltonian graph vs Eulerian graph

4. Recursive and Recursively Enumerable Languages
5. Universal Turing Machine
6. Applications of DFA and NFA

List of Practical's: (Any Six)

1. Tower of Hanoi: Generate recurrence relation and solve.
2. Fibonacci numbers: Generate recurrence relation and solve.
3. Explore various set operations. Consider the universal set U: ={0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15}. Consider 2 sets A and B. Use the randomly generated sets to determine the following. A ∪ B , A ∩ B, A', A ∩ (B ∩ C), A − B , A' ∩ B , (A ∪ C) ∩ B
4. Problems based on Conditional Probability.
5. Exercises on conversion of Regular expression to DFA and vice versa
6. Problems on NFA to DFA conversion.
7. Numerical based on minimization and equivalence of Automata
8. Proof of Closure properties of Regular Languages
9. Problems on checking of Ambiguity of Grammar and Simplification of CFGs
10. Problems on Normal forms of CFGs: CNF and GNF
11. Problems based on PDA construction
12. Problems on Turing machine design

List of Course Seminar Topics:

1. Rings and its applications
2. Set Theory and its applications in Artificial Intelligence
3. Different Counting principles
4. Zero divisors and Integral domain
5. AVL-tree
6. Heap Tree
7. Web graph
8. DFA and NFA
9. Minimization of DFA
10. Myhill-Nerode Theorem
11. Context Free Grammar
12. Turing Machine

List of Course Group Discussion Topics:

1. Need of Graphs in real life applications
2. Applications of Set Theory
3. Applications of Euler's Theorem in counting remainders
4. Homogeneous Vs non-homogeneous recurrence relation
5. Pigeonhole principle and its applications
6. NFA vs DFA
7. Power of Automata and its applications
8. Need of Automata in Computer Science
9. Closure Properties of CFL
10. CFL and Non CFL and its applications
11. Power of Turing machine and Linear Bounded Automata

List of Course Projects:

1. Lexical Analyzer
2. Digital Logic design
3. Spell Checker
5. Parser
6. Word Processor Program
7. Text Editors
8. Switching circuit design
9. Game design POC MAN

List of Home Assignments:

Design:

1. Design of social network using graphs
2. Design of railway network using graph
3. Design of POC MAN Game
4. Design Switching Circuit
5. Digital Logic Design using DFA
6. Digital Logic Design using NFA
7. Design Multitape TM for Palindrome
8. Design PDA for String Copy
9. Design LBA for real world application
10. Design parser to recognize string

Case Study:

1. Discuss ways in which telephone numbering plan can be extended to accommodate the rapid demand for more telephone numbers. For each numbering plan, find how different telephone numbers can be formed
2. Investigate the properties of web graph, analyse web graphs by correlating the graph theoretic concepts with properties of web graph
3. Study any one real life application where DFA and NFA is used, study its merits and demerits
4. Study any one example of Turing machine with Multitape and its benefits
5. Study any one real life applications of PDA, discuss its advantages and limitations
6. Study all Automata and discuss their power
7. Study Membership Algorithm and discuss its applications
8. Study of Chomsky Hierarchy
9. Study of Pattern Matching Algorithm
10. Study of Myhill-Nerode Theorem
11. Pumping Lemma
12. Finite Automata in Markov Model

Blog

1. Proofs to differentiate direct, contrapositive, contradiction with suitable examples
2. Importance of discrete mathematics in real life. Write an article related to any four domains where discrete mathematics is dominantly used
3. How graph theory is used as a technology in recent trends? Graph theory and its applications (atleast 8)
4. Significance of Combinatorics and Discrete Probability in today's world
5. How search engines use graph concepts?
6. Automata Theory Limitations and Applications
7. Pumping Lemma
8. Kleene's star and Positive Closure
9. Regular Expression and its Closure Properties
10. PDA vs TM and its Advantages

Surveys

1. Recurrence relations for dynamic programming
2. Graphs in computer networks
3. Probability theory for weather forecasting
4. Game Theory: an application of probability
5. Graph theory for Machine learning problem
6. Pattern matching algorithm
7. Evolution of Computational Models
8. Applications of Computer Theory in real life
9. Applications where Automata Theory is Beneficial
10. Power of Turing Machine
11. Real life examples to find ambiguity in it and its elimination
12. Closure properties of Regular and Context Free Languages
13. Role of Non Determinism
14. Working of Parser
15. Evolution of Models of Computations

Suggest an assessment Scheme:

MSE, ESE, Lab, Course project, HA, Seminar, GD

Text Books:

1. *Kenneth Rosen , "Discrete Mathematics and its applications", 7th Edition, McGraw-Hill, ISBN 0–07–338309–0.*
2. *Alan Tucker ,"Applied Combinatorics" 6th Edition, Wiley Publishing company*
3. *C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", 4th Edition, McGraw-Hill*
4. *Hopcroft J, Motwani R, Ullman, Addison-Wesley, "Introduction to Automata Theory, Languages and Computation", Second Edition, ISBN 81-7808-347-7.*
5. *Michael Sipser, , "Introduction to Theory of Computation", Third Edition, Course Technology, ISBN-10: 053494728X.*

Reference Books:

1. *Peter J. Cameron, "Combinatorics: Topics, techniques, algorithms", Cambridge University Press*
2. *Reinhard Diestel ,"Graph Theory ",5th Edition, Springer Verlag Publishing Company*
3. *Douglas B. West ,"Introduction to Graph Theory", Prentice-Hall publishers*
5. *Edgar G. Goodaire, Michael M. Parmenter, "Discrete Mathematics with Graph Theory", 3rd Edition, Pearson Education*
6. *John C. Martin," Introduction to Languages and The Theory of Computation", Fourth Edition, McGraw Hill, ISBN 978-0-07-319146-1.*

Moocs Links and additional reading material:www.nptelvideos.in

Course Outcomes:

1. Students should be able to solve counting problems and problems based on recurrence relations
2. Students should be able to apply knowledge of Graph and Tree based models to solve real life problems
3. Students should be able to calculate discrete probabilities
4. Students should be able to design Finite Automata / Turing machine for given computational problems
5. Students should be able to correlate given computational model with its Language
6. Students should be able to analyse power of different computational models

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		2	3									2		
CO2	3	2	2			3	2		3			2		2		
CO3	2	3			3											
CO4			3	2					2		2				3	2
CO5	2	2			2	2		2		2	2		2			
CO6	2	3					3			2	3			3		3

CO Attainment Levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	2	3	3	3	4	4

Future Courses Mapping:

Adv. Data structures

Problem solving

Design and Analysis of Algorithms

Compiler Design

Machine Learning

Job Mapping:

Application developer, System software developer, Data science engineer, Machine learning architect

IT2266: Computer Network

Course Prerequisites: Fundamentals of Computer, C/C++ programming.

Course Objectives:
1. Understand the importance of Computer Network and its usage.
2. Study error control and flow control techniques.
3. Solve real-world problems in the context of today's internet (TCP/IP and UDP/IP).
4. Distinguish and relate various physical Medias, interfacing standards and adapters.
5. Implement mathematically and logically the working of computer protocols in abstract.

Credits: 5 **Teaching Scheme Theory:** 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:
A system of interconnected computers and computerized peripherals such as printers is called computer network. This interconnection among computers facilitates information sharing among them by using data communication. The main objective of computer network is to enable seamless exchange of data between any two points in the world. This course will explore common network services and protocols such as email, web services etc Networking is an ever growing domain in which there is a constant need of support. Networks are becoming progressively more and more convoluted as the technology is advancing and flourishing.

Section 1
Introduction:Introduction to computer network, LAN, MAN, WAN, PAN, Ad-hoc Networks,Network Architectures- Client-Server, Peer To Peer, Network Topologies- Bus, ring, tree, star, mesh,hybrid. Communication Models- OSI Model, TCP/IP Model, Design issues for layers. Physical Layer:Transmission media- Guided media, unguided media. Transmission Modes- Simplex, Half-Duplex and Full-Duplex. Network Devices- Hub, Repeater, Bridge, Switch, Router, Gateways and Brouter. Line Coding Schemes- Unipolar, Polar and Bipolar. Modulation- Narrowband signal, spread spectrum signal, FHSS, DSSS. Data Link Layer:Logical Link Layer- Services to Network Layer, Framing, Error Control and FlowControl. Framing in LLC- framing challenges, types of framing. Error Control in LLC- error detection, error correction, Parity Bits, Hamming Codes (11/12-bits) and CRC. Flow Control Protocols- Unrestricted Simplex, Stop and Wait, Sliding Window Protocol. WAN Connectivity- PPPand HDLC. Medium Access Control: Channel Allocation-Static and Dynamic, Multiple Access Protocols- Pureand Slotted ALOHA, CSMA, WDMA, IEEE 802.3 Standards and Frame Formats, CSMA/CD, FastEthernet, Gigabit Ethernet, IEEE 802.11a/b/g/n and IEEE 802.15 and IEEE 802.16 Standards, Frameformats, CSMA/CA.
Section 2

Network Layer: Switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, Subnetting, NAT, CIDR, ICMP, Routing Protocols- Distance Vector, Link State, Path Vector, Routing inInternet- RIP,OSPF, BGP, Congestion control and QoS, MPLS, Mobile IP, Routing in MANETAODV,DSR.

Transport Layer: Services, Berkley Sockets, Addressing, Connection establishment, Connectionrelease, Flow control and buffering, Multiplexing, TCP, TCP Timer management, TCP CongestionControl, Real Time Transport protocol (RTP), Stream Control Transmission Protocol (SCTP),Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless.

Application Layer: Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email:SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple
Network Management Protocol (SNMP).

List of Tutorials: (Any Three)

1. Identification of various networks components
2. Establishing LAN
3. Installation of network device drivers
4. Use/installation of proxy server
5. Configuration of network devices in CISCO packet tracer (Windows/Linux)
6. Implement communication between various network devices using CISCO packet tracer (Windows/Linux)
7. Network traffic monitoring using Wireshark/Ethereal (Windows/Linux)

List of Practical's: (Any Six)

1. Study and implement various networking commands on terminal.
2. Use Socket programming to create Client and Server to send Hello message.
3. Write a program for error detection and correction for 7/8 bits ASCII codes using HammingCodes or CRC. Demonstrate the packets captured traces using Wireshark Packet AnalyzerTool for peer-to-peermode. (50% students will perform Hamming Code and others willperform CRC)
4. Write a program to simulate Go back N and Selective Repeat Modes of Sliding WindowProtocol in peer-to-peer mode
5. Write a program to find class and type of a given IP address.
6. Write a program to demonstrate subnetting and find the subnet masks.
7. Write a program using TCP socket for wired network for following: a. Say Hello to Eachother (For all students) b. File transfer (For all students) c. Calculator (Arithmetic) (50%students) d. Calculator (Trigonometry) (50% students)
8. Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Videoone file each) between two machines.
9. Write a program to implement: a. Network Routing: Shortest path routing, AODV. b.Analysis of congestion control (TCP and UDP).
10. Write a program to analyse following packet formats captured through Wireshark for wirednetworks. 1.Ethernet 2. IP 3.TCP 4. UDP

List of Course Projects:

1. Write a program using TCP sockets for wired networks to implement a. Peer to Peer Chat b.Multi User Chat Demonstrate the packets captured traces using Wireshark Packet AnalyzerTool for peer-to-peer mode.
2. Implementation of shortest path protocol
3. Implementation of string encryption and decryption
4. Implementation of character stuffing and destuffing
5. Execution and analysis of Network commands
6. To find out details of network from IP addressing scheme using 'C' code
7. Implement real time Internet route optimization.
8. Implement Broadcast Server System.
9. Implement a real time voting System.
10. Real time packet capture and analysis for malwares in wireless networks.

List of Course Seminar Topics:

1. Asynchronous Transfer Mode
2. Need Of Multiplexing for Signal Modulation
3. TDM with PAM a case study
4. Noise signal
5. Basic Network Protocols
6. Manchester Vs Differential Manchester coding technique
7. Amplitude Shift Keying: Working and Applications
8. Nyquist Sampling Theorem
9. CDMA
10. Line coding Techniques with example

List of Course Group Discussion Topics:

1. TCP/IP Model
2. Mobile IP
3. Congestion Control and QoS
4. Wireless Technology for Short range and long range
5. Application Protocols and its security
6. IP Protocols
7. Data Communication Issues in IP Networks and Solutions to it
8. Congestion control in hybrid networks
9. Issues in Real time Audio and video transmission protocol.
10. IPV6

List of Home Assignments:

Design:

1. Enumerate the challenges in Line coding. Draw the line code for the sequence 010011110using Polar NRZ-L and NRZ-1 schemes.
2. 2.Design the procedure to configure TCP/IP network layer services.
3. Simulation of Routing Protocols using NS2
4. Simulation of FTP based Protocols using CISCO packet Tracer/ NS2
5. Simulation of Congestion Control Protocols Using NS2

Case Study:

1. Amplitude and Frequency Modulation Technique
2. Digital to Analog and Analog to Digital converters
3. Study of Various VPNs
4. IoT Solutions to Current Network Requirement
5. Unix Solutions for Broadcast System

Blog:

1. Communication Protocol
2. Emerging Trends in Computer Networks
3. Use of IOT in Networks
4. Cloud based Network Solutions for real world problems
5. Recent Trends in Computer Security

Surveys:

1. Survey of wireless Technologies
2. Survey of Congestion control methodologies
3. Survey of Bluetooth Technology
4. Survey of Virtual Private Networks
5. Survey of ADHOC Networks

Assessment Scheme:

1. MSE
2. ESE
3. LAB
4. VIVA
5. PPT/GD
6. HA
7.CVV

Text Books:

1. James F. Kurose, and Keith W. Ross," A Top-Down Approacht," 4th edition, Publisher: Addison-Wesley ISBN: 0-321-49770-8
2. Behrouz A. Forouzan ,"Data Communication and Networking", 4th edition, Tata McGraw Hill
3. Andrew S. Tanenbaum, "Computer Networks" ,5th Edition, Pearson Education

Reference Books:

1. Kurose, Ross,"Computer Networking a Top Down Approach Featuring the Internet", Pearson; 6th edition (March 5, 2012), ISBN-10: 0132856204
2. Holger Karl and Andreas Willig,"Protocols and Architectures for Wireless Sensor Network", Wiley, ISBN: 0-470-09510-5
3. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall, 2004

Moocs Links and additional reading material:

1. www.nptelvideos.in
2. https://www.my-mooc.com/en/categorie/computer-networking
3. www.udemy.com

COURSE OUTCOMES

1. Select network architecture, topology and essential components to design computer networks.
2. Estimate reliability issues based on error control, flow control and pipelining by using bandwidth, latency, throughput and efficiency.
3. Design mechanisms to demonstrate server channel allocation in wired and wireless computer networks
4. Analyze data flow between peer to peer in an IP network using Application, Transport and Network Layer Protocols
5. Demonstrate sustainable engineering practice indicating the scientific purpose and utility of communication frameworks and standards.
6. Develop Client-Server architectures and prototypes by the means of correct standards, protocols and technologies

CO-PO MAP

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3							1			2		3	
CO2	3	2		3	2								2			
CO3	2	2	3				2				2				3	
CO4	2	2		3			2					2		3		
CO5	2				3	3		2	2							
CO6			3		2	3			2						3	3

CO-ATTAINMENT LEVELS

CO1-2
CO2-3
CO3-4
CO4-4
CO5-4
CO6-5

FUTURE COURSE
NETWORK SECURITY CYBER SECURITY CLOUD COMPUTING BLOCKCHAIN

IT2203: Database Management Systems and Data Mining

Course Prerequisites: Data structure, Computer Programming

Course Objectives:

1. To understand fundamental concepts and principles of data bases ,database management system, including the architecture, design and functionality.
2. To learn data modeling concepts (E-R and Class diagrams) used in database development.
3. To normalize the databases up to a given normal form and query the database usingSQL/PLSQL
4. To learn classification fundamentals and applications.
5. To understand clustering of data and analysis
6. To do association analysis/mining from a given data set

Credits: 5 **Teaching Scheme Theory:** 3Hours/Week
Tutorial: 1 Hour/week
Lab: 2Hours/Week

Course Relevance: This course widely applicable in all software industries to manage and mine data

SECTION-I
Topics and Contents **Database fundamentals: -**Database and Need for DBMS, Characteristics of DBMS, Database Users, 3-tier architecture of DBMS, Data Models, Views of data-schemas and instances, Data Independence, Conventional data models & systems **ER modeling:** Entities, Relationships, Representation of entities, attributes, relationship, attributes, relationship sets, Generalization, aggregation, Structure of relational Database and different types of keys, Expressing M:N relation. **Relational data model**- basic concepts, constraints, and Relational database language - relational algebra, Codd's rules, **SQL and PL/SQL:-** Data definition Language in SQL ,Views and queries in SQL .Specifying constraints and indexes in SQL, PL/SQL basic programs-function, procedure

SECTION-II

Topics and Contents

Normalization- need of normalization, ER to Relational, Functional dependency, Inference Rules for Functional Dependencies ,Closure of functional dependencies, Normal forms 1NF, 2NF, 3NF and Checking of lossless join , dependency preserving decomposition

Transaction Processing- Concept of transaction, ACID properties, states of transaction, serializibility-conflict and view, Concurrency control - Locking techniques, Time stamp ordering

Data mining:

Basic concepts, introduction to pattern, pattern class, definitions of classification and clustering

Classification:

Basic concepts and techniques, decision tree classifier, nearest neighbor and K-NN classifier, over fitting and under fitting, concept of outliers.

Clustering:

Basic concepts and algorithms, c-means clustering, types of clustering, evaluation of clustering, confusion matrix

Association analysis:

Basic concepts, market basket analysis, support, confidence and association rule mining

List of Tutorials:

1.Data Visualization
2. Distances and Projections
3. Singular Value Decomposition
4. Principal Component Analysis
5. Optimization
6. Normal & Binomial Distribution
7. Hypothesis Testing
8. ANOVA test
9. Linear Regression
10. Logistic Regression
11. Nearest Neighbor Classification

12. Decision Trees based classification
13. Naive Bayes classification
14. Clustering
15. Evaluation of model performance
16. Bagging & Boosting approaches

List of Practicals: (Any Six - Any 3 out of 1 to 5 and any 3 out of 6 to 10)

1. Create tables using create table command, define table level and column level constraints, Commands for table management (DDL)- Alter table , Drop table, DML -commands -Insert , Update, Delete records and truncate
2. Select command with operators like arithmetic, comparison, logical Query Expression operators. Ordering the records with order by ,Grouping the records using group by clause , Aggregate functions: Avg, max, min, sum, count and etc
3. Use of set operations : Union, Union all, intersect, minus and join concept: Simple, equi, non equi, self, outer join and Sub queries.
4. Creation and use of DB objects like Sequence, Synonym, View: create, update, drop, Index
5. Create and execute basic programs based on PL / SQL- function and procedure.
6. Implementation of K-NN classifier for fisher iris data set and performance evaluation
7. Implementation of c-means clustering for a given data set and performance evaluation
8. Implementation of finding association rules mining from a given data set
9. Implementation of Decision tree classifier for fisher iris data set and performance evaluation.
10. Using nearest neighbor classifier for a given data set

Any other assignments suggested by the instructor

List of Projects:

From any one of the sub-domain

1. DBMS- Design a backend for a real DBMS application.

Project: Design and develop an application based on Database management system eg. School management system, Inventory management system. Each student will opt for the different system to be designed and implemented using SQL and PL/SQL. Across the batch similar topics can be allowed with prior permission of the teacher.

2. Use of classification, clustering and association mining for real data sets.

Use any data set from UCI repository or kaggle for classification/clustering or hybrid classification clustering

List of Course Seminar Topics:

1. Cloud databases .
2. Codd's Rules and their uses
3. Techniques of cluster analysis
4. Fast clustering techniques
5. Fuzzy classifiers
6. Parallel databases
7. Distributed databases
8. Modern concurrency control protocols
9. Embedded SQL- need and
10. Trigger and Cursors in Oracle
11. NoSQL- MongoDB
12. Algorithm of association rule mining
13. Neural network classifiers
14. SVM classifier
15. Some other topics decided by instructor

List of Course Group Discussion Topics:

1. Concurrency and recovery mechanism in DBMS
2. Security mechanism in DBMS
3. Avoiding over fitting and under fitting in classifiers
4. Fuzzy clustering technique
5. Database backup and recovery
6. Types of data considered for data mining
7. Features of MongoDB
8. Linear regression for prediction
9. Drawbacks of K-NN classifier
10. Comparison of SQL and No Sql
11. Introduction to MongoDB
12. Random forest classifier
13. Logistic regression for classification
14. Some other topics decided by instructor

List of Home Assignments:

Design:

1.Design a Database system for a School
2.Design a Database system for a Gym
3.Design a Database system for a shop
4.Design a Database system for a Hotel

5. Design a system for handwritten character classification using K-NN classifier
6. Design a clustering approach to reason about handwritten character shapes
7. Design a system to find association rules from a given data set

Some other topics decided by instructor

Case Study:

1. A priory algorithm for association mining with a real example
2. IBM's DB2
3. MySQL
4. ARTool for association rule mining (https://www.cs.umb.edu/~laur/ARtool/)
5. MongoDB
6. Classification in IoT
7. Clustering in visual pattern analysis
8. Document classification
9. Some other topics decided by instructor

Blog

1. Hybrid classification and clustering approach
2. Future of databases
3. Types of Concurrency control protocols and their comparison
4. Future of Data mining
5. Fast classification methods for higher dimensional data
6. Multiple databases a new trend
7. Big data management
8. Fast clustering approaches for higher dimensional data
9. Big data storage and processing
10. Some other topics decided by instructor

Surveys

1. Database migration tools
2. Development of fuzzy clustering
3. Development in classification approaches
4. Embedded SQL
5. New SQL developmental phases
6. Data sampling techniques
7. Methods of dimensionality reduction of data sets
8. Big data storage

Some other topics decided by instructor

Suggest an assessment Scheme:

MSE PPT Presentation ESE GD Viva Lab assignments +Course Project

Text Books:

1. *A. Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts, 6th editiion, McGraw Hill, 2010 ISBN 0-07-352332-1*
2. *RamezElmasri, Shamkant B. Navath, Fundamentals of Database System; 6th Edition;Pearson*
3. *Koch, George, Oracle: The Complete Reference, Tata McGraw Hill Publication, 2006, ISBN 0 – 07 – 063414 – 9*
4. *Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to data mining, Pearson, 2nd Edition, 2019*

Reference Books:

1. *Jeffrey D. Ullman and Jennifer Widom `A First Course in Database Systems , Prentice Hall, Second Edition, 2002.*
2. *Raghu Ramakrishnan, Johannes Gehrke; Database Management Systems, 3rd Edition ; McGraw Hill Education*
3. *RamezElmasri and Shamkant B. Navathe. 2015. Fundamentals of Database Systems (7th. ed.). Pearson.*
4. *Martin Gruber, Understanding SQL, BPB publication,2003*
5. *Scott Urman, Oracle 9 I PL/SQL Programming, Oracle Press,2005*
6. *Ivan Bayross, SQL, PL/SQL The Programming Language Of Oracle, BPB Publication, 2006, ISBN: 8176560723*
7. *Jiawei Han, Micheline Kamber, Jian pei, Data mining- concepts and techniques, Morgan Kaufman, 2011*

Moocs Links and additional reading material:

1. https://www.db-book.com/db6/
2. https://www.lucidchart.com/pages/examples/er-diagram-tool
3. https://hanj.cs.illinois.edu/bk3/bk3_slidesindex.htm

Course Outcomes:

The student will be able to –

1. Design data models as per data requirements of an organization
2. Synthesize a relational data model up to a suitable normal form
3. Develop a database system using relational queries and PL/SQL objects
4. Apply indexing techniques and query optimization strategies
5. Understand importance of classification and clustering techniques
6. Adapt to association rule mining from data sets

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3			2		2							3	
CO2		2	2		3							2			2	
CO3			3		2	2		2	2						3	
CO4	3	2		3									3			2
CO5	2	2		2						2	2		2			
CO6	2	2					2							2		

CO attainment levels

CO1-2
CO2-2
CO3-3
CO4-3
CO5-4
CO5-4
CO6-4

Future Courses Mapping:

Data warehouse and Data mining, Advanced DBMS, Data Science, Web enabled databases, Parallel databases, NoSQL DB, New SQL DB, Database System Administration, Database Performance Tuning, Big data mining, Parallel data mining

Job Mapping:

Database programmer, DB system Administrator, Database Designer, Database Application Designer- Front end and Back end, DB -Query optimization, SQL and Pl/SQL developer, Embedded SQL Developer, BI analyst, Data Modelers, ETL Analyst

IT2253: Software Development Project-II

Course Prerequisites: C, C++, Java, Android and Web Technologies

Course Objectives:

1. To enhance problem solving skills by independent learning
2. To emphasize learning activities that are long-term, interdisciplinary and student-centric.
3. To engage students in rich and authentic learning experiences.
4. To provide every student the opportunity to get involved individually to learn professionalism
5. To inculcate research culture and attitudes towards learning among the students.
6. To improve employability skills of students

Credits: 3 **Teaching Scheme Lab:** 6 Hours/Week

Course Relevance: Software Project Development comes under the category of Project Based Learning (PBL). For better learning experience, along with traditional classroom teaching and laboratory work-based learning, project based learning has been introduced with an objective to motivate students to learn how to solve a problem. Students may work on problems innovatively in different domains like social, technical, cultural and scientific.

Teacher's Role :

- Teacher will act as the facilitator and mentor.
- To utilize the principles of problem solving, critical thinking and metacognitive skills of the students.
- To make the individual aware of time management.
- To Help students to solve technical problems
- To assess and evaluate student performance by monitoring regularly on a weekly basis.

Recommended Guidelines :

1. SDP is a Project Based Learning. PBL is learning through activity. One of the faculty can be appointed as coordinator for SDP.

2. Following are the recommended guidelines that will work as an initiator and facilitator in the process of completion of SDP.

3. In the first week of commencement of semester let the coordinator create awareness about SDP (what, why, and how) among the students. Convey students expected outcomes, assessment process and evaluation criteria.

4. Assign mentor batch wise.

5. Provide guidelines for title identification (Problem can be some real life situation that needs technology solutions. This situation can be identified by meeting people around, visiting various industries, society, and institutes. The solution can be prototype, model, convertible solutions, survey and analysis, simulation, and similar).

6. Let students submit the problem identified in prescribed format (Title, Problem statement, domain, details of a problem undertaken, and what is need of solution to the problem)

7. Coordinator and Mentor can approve the problem statements based on feasibility and learning outcomes expected for second year engineering students.

8. Mentor is to monitor progress of the task during phases of project work. Broadly phases may include- literature survey, requirements gathering, preparing a solution, designing solution, Implementing and testing the solution.

9. Weekly monitoring and continuous assessment record is to be maintained by mentors.

10. Get the IEEE paper format as a report submitted at the end of semester.

11. In semester evaluation will be done by a mentor along with internal faculty as a jury and at the end of semester will be evaluated by industry experts.

Sample Software Project Statement based on Java ,C,C++, Android, Web technologies

1. QR Code bases contactless ordering
2. ATM Simulator
3. Drivers Booking Website
4. Document Scanner app
5. Campus canteen management system
6. movie ticket booking system
7. Covid-19 Live Statistical Analysis

...not limited to.....Faculty and students are free to include other area which meets the society requirements at large

Course Outcomes:

The student will be able to –

1. Find the real-life problem from societal need point of view

2. Compare different approaches and select the most feasible one.

3. Analyze and synthesize the identified problem from technical viewpoint

4. Design and develop an optimal and reliable solution to meet objectives

5. Validate the solution based on the criteria specified

6. Inculcate long life learning and research attitude among the students

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2		3		3								2		2
CO2	2			3	2									2		
CO3		3					2		2	2						

CO4			3					2		1	2				3	
CO5		2		2				2					3			
CO6	2											3				3

CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	4	2	4	5	1	3

Job Mapping: Software Engineer, Web Developer, Android Developer

IT2254: Engineering Design and Innovation

Course Prerequisites: Problem Based Learning

Course Objectives:

1. To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problems.

2. To Evaluate alternative approaches, and justify the use of selected tools and methods,

3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.

4. To engage students in rich and authentic learning experiences.

5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

6.To develop an ecosystem to promote entrepreneurship and research culture among the students.

Credits: 4 **Teaching Scheme Theory:** 1 Hour/Week

Lab: 6 Hours/Week

Course Relevance: Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Along with course based projects, curriculum can be enriched with semester long Engineering Design and Development courses, in which students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. To gain the necessary skills to tackle such projects ,students can select relevant online courses and acquire skills from numerous sources under guidance of faculty and enrich their knowledge in the project domain, thereby achieving project centric learning. Modern world sustained and advanced through the successful completion of projects. In short, if students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. Project based learning will also redefine the role of teacher as mentor in the learning process. The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom’s Taxonomy.

SECTION-I

SECTION-1

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. For all courses of ED, laboratory course contents of "Trends in Engineering Technology" are designed as a ladder to extend connectivity of software technologies to solve real world problems using an interdisciplinary approach. The ladder in the form of gradual steps can be seen as below:

Industry Communication Standards, Single Board Computers and IoT, Computational Biology (Biomedical and Bioinformatics), Robotics and Drone, Industry 4.0 (Artificial Intelligence, Human Computer Interfacing, 5G and IoT, Cloud Computing, Big Data and Cyber Security etc).

Suggest an assessment Scheme:

MSE and ESE

Text Books:

1. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE).ISBN:978-0-9935254-6-9; 2017

2. Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.

3.Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert RobartCapraro, Mary Margaret Capraro

Reference Books:

1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based

learning in engineering. Rotterdam: Sense Publishers. 2007.

2. Project management core textbook, second edition, Indian Edition , by Gopalan.

3. The Art of Agile Development. By James Shore & Shane Warden.

Course Outcomes:
The student will be able to –

1. Identify the projects relevant societal needs
2. Map the technologies learned with the project needs
3. Apply the technological knowledge to design various feasible solution
4. Select best possible possible solution solution to solve a the problem
5. Develop/Fabricate a working model of proposed solution
6. Testing and validate product performance

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2			3				2	2			3		
CO2				3	2	2		2							2	
CO3	2		3		3			2	2				3			
CO4		2				3										
CO5			3				2		2						2	3
CO6		2			3				2	3				2		

CO attainment levels
CO1-2
CO2-2
CO3-3
CO4-3
CO5-4
CO5-4
CO6-4

Future Courses Mapping: Major Project
Job Mapping: Software Engineer, Software Developer, IT Engineer

(Applicable w.e.f.AY21-22)

TY IT Module- V (B21Pattern)

Subject head	Course code	Course name	Contact hours per week			Credits
			Theory	Lab	Tut	
S1	IT3217	DBMS and Data Mining	3	2	1	5
S2	IT3203	Image Processing and Computer Vision	3	2	1	5
S3	IT3209	Software Design and Methodologies	3	2	1	5
S4	IT3219	Discrete Structure and Automata Theory	3	2	-	4
S5	IT3213	Engineering Design And Innovation - V	1	6	-	4
S6	IT3218	Artificial Intelligence	3	2	1	5
		Total				**28**
						Total Credits: 28

TY IT Module-VI (B21Pattern)

Subject head	Course code	Course name	Contact hours per week			Credits
			Theory	Lab	Tut	
S1	IT3207	Web Technology and cloud computing	3	2	1	5
S2	IT3215	Design and Analysis of Algorithms	3	2	1	5
S3	IT3216	Machine learning and Deep learning	3	2	1	5
S4	IT3202	System Programming	3	2	-	4
S5	IT3211	Engineering Design And Innovation-VI	1	6	-	4
S6	IT3220	Project based on Honor course(AI)	3	2	1	5
		Total Credits				**28**

FF No.: 654

IT3217: DBMS and Data Mining

Course Prerequisites: Data structure, computer programming

Course Objectives:

1. To understand fundamental concepts and principles of databases ,database management system, including the architecture, design and functionality.
2. To learn data modeling concepts (E-R and Class diagrams) used in database development.
3. To normalize the databases up to a given normal form and query the database using SQL/PLSQL
4. To learn classification fundamentals and applications.
5. To understand clustering of data and analysis
6. To do association analysis/mining from a given data set

Credits: 5 **Teaching Scheme Theory:** 3 Hours/Week

Tutorial: 1Hours/Week

Lab: 2 Hours/Week

Course Relevance: This course widely applicable in all software industries to manage data

SECTION1:
Database fundamentals:- Database and Need for DBMS, Characteristics of DBMS, DatabaseUsers, 3-tier architecture of DBMS, Data Models, Views of data-schemas and instances, Data Independence, Data abstraction,Conventional data models & systems ER modeling: Entities, Relationships, Representation of entities, attributes, relationship, attributes, relationship sets, Generalization, aggregation, Structure of relational Database and different types of keys, Expressing M:N relation. Relational data model- basic concepts, constraints, and Relational database language - relational algebra, Codd's rules, SQL and PL/SQL:- Data definition Language in SQL ,Views and queries in SQL .Specifying constraints and indexes in SQL, PL/SQL basic programs-function, procedure.
SECTION2:

Normalization- need of normalization, ER to Relational, Functional dependency, Inference Rules for Functional Dependencies ,Closure of functional dependencies, Normal forms 1NF, 2NF, 3NF and Checking of lossless join , dependency preserving decomposition

Transaction Processing- Concept of transaction, ACID properties, states of transaction, serializibility-conflict and view, Concurrency control - Locking techniques, Time stamp ordering

Data mining:

Basic concepts, introduction to pattern, pattern class, definitions of classification and clustering

Classification:

Basic concepts and techniques, decision tree classifier, nearest neighbor and K-NN classifier, over fitting and under fitting, concept of outliers.

Clustering:

Basic concepts and algorithms, c-means clustering, types of clustering, evaluation of clustering, confusion matrix

Association analysis:

Basic concepts, market basket analysis, support, confidence and association rule mining

List of Practical: (Any Six - Any 3 out of 1 to 5 and any 3 out of 6 to 10)

1. Create tables using create table command, define table level and column level constraints, Commands for table management (DDL)- Alter table , Drop table, DML -commands -Insert , Update, Delete records and truncate
2. Select command with operators like arithmetic, comparison, logical Query Expression operators. Ordering the records with order by ,Grouping the records using group by clause , Aggregate functions: Avg, max, min, sum, count and etc
3. Use of set operations : Union, Union all, intersect, minus and join concept: Simple, equi, non equi, self, outer join and Sub queries.
4. Creation and use of DB objects like Sequence, Synonym, View: create, update, drop, Index .
5. Create and execute basic programs based on PL / SQL- function and procedure.
6. Implementation of K-NN classifier for fisher iris data set and performance evaluation
7. Implementation of c-means clustering for a given data set and performance evaluation
8. Implementation of finding association rules mining from a given data set
9. Implementation of Decision tree classifier for fisher iris data set and performance evaluation
10. Using nearest neighbor classifier for a given data set
11. Any other assignments suggested by the instructor

List of Projects:

From any one of the sub-domain

1. DBMS- Design a backend for a real DBMS application.

2. Use of classification, clustering and association mining for real data sets.

Project: Design and develop an application based on Database management system eg. School management system, Inventory management system. Each student will opt for the different system to be designed and implemented using SQL and PL/SQL. Across the batch similar topics can be allowed with prior permission of the teacher.

List of Course Seminar Topics:

1. Cloud databases
2. Codd's Rules and their uses
3. Techniques of cluster analysis
4. Fast clustering techniques
5. Fuzzy classifiers
6. Parallel databases
7. Distributed databases
8. Modern concurrency control protocols
9. Embedded SQL- need and
10. Trigger and Cursors in Oracle
11. NoSQL- MongoDB
12. Algorithm of association rule mining
13. Neural network classifiers
14. SVM classifier
15. Some other topics decided by instructor

List of Course Group Discussion Topics:

1. Concurrency and recovery mechanism in DBMS
2. Security mechanism in DBMS
3. Avoiding over fitting and under fitting in classifiers
4. Fuzzy clustering technique
5. Database backup and recovery
6. Types of data considered for data mining
7. Features of MongoDB
8. Linear regression for prediction
9. Drawbacks of K-NN classifier
10. Comparison of SQL and No Sql
11. Introduction to MongoDB
12. Random forest classifier
13. Logistic regression for classification
14. Some other topics decided by instructor

List of Home Assignments:

Design:

1.Design a Database system for a School
2.Design a Database system for a Gym
3.Design a Database system for a shop
4.Design a Database system for a Hotel
5.Design a system for handwritten character classification using K-NN classifier
6. Design a clustering approach to reason about handwritten character shapes
7. Design a system to find association rules from a given data set
8. Some other topics decided by instructor

Case Study:
1. A priory algorithm for association mining with a real example
2. IBM's DB2
3. MySQL
4. ARTool for association rule mining (https://www.cs.umb.edu/~laur/ARtool/)
5. MongoDB
6. Classification in IoT
7. Clustering in visual pattern analysis
8. Document classification
9. Some other topics decided by instructor

Blog
1. Hybrid classification and clustering approach
2. Future of databases
3. Types of Concurrency control protocols and their comparison
4. Future of Data mining
5. Fast classification methods for higher dimensional data
6. Multiple databases a new trend
7. Big data management
8. Fast clustering approaches for higher dimensional data
9. Big data storage and processing
10. Some other topics decided by instructor

Surveys
1. Database migration tools
2. Development of fuzzy clustering
3. Development in classification approaches
4. Embedded SQL
5. New SQL developmental phases
6. Data sampling techniques
7. Methods of dimensionality reduction of data sets
8. Big data storage

9. Some other topics decided by instructor

Suggest an assessment Scheme:

MSE	PPT Presentation	ESE	GD	Viva	Lab assignments +Course Project
10	10	10	10	20	40

Text Books:

1. A. Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts, 6th editiion, McGraw Hill, 2010, ISBN 0-07-352332-1

2. RamezElmasri, Shamans B. Navath, Fundamentals of Database System; 6th Edition ;Pearson

3. Koch, George, Oracle: The Complete Reference, Tata McGraw Hill Publication, 2006, ISBN 0 – 07 – 063414 – 9

4. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to data mining, Pearson, 2nd Edition, 2019

Reference Books:

1. Jeffrey D. Ullman and Jennifer Widom `A First Course in Database Systems , Prentice Hall, Second Edition, 2002.
2. Raghu Ramakrishnan, Johannes Gehrke; Database Management Systems, 3rd Edition ; McGraw Hill Education
3. RamezElmasri and Shamkant B. Navathe. 2015. Fundamentals of Database Systems (7th. ed.). Pearson.
4. Martin Gruber, Understanding SQL, BPB publication,2003
5. Scott Urman, Oracle 9 I PL/SQL Programming, Oracle Press,2005
6. Ivan Bayross, SQL, PL/SQL The Programming Language Of Oracle, BPB Publication, 2006, ISBN: 8176560723
7. Jiawei Han, Micheline Kamber, Jian pei, Data mining- concepts and techniques, Morgan Kaufman, 2011

Moocs Links and additional reading material:

1. https://www.db-book.com/db6/
2. https://www.lucidchart.com/pages/examples/er-diagram-tool
3. https://hanj.cs.illinois.edu/bk3/bk3_slidesindex.htm

Course Outcomes:

The student will be able to –

1. Design data models as per data requirements of an organization
2. Synthesize a relational data model up to a suitable normal form
3. Develop a database system using relational queries and PL/SQL objects
4. Apply indexing techniques and query optimization strategies
5. Understand importance of classification and clustering techniques
6. Adapt to association rule mining from data sets

CO PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3			2		2							3	
CO2		2	2		3							2			2	
CO3			3		2	2		2	2						3	
CO4	3	2		3									3			2
CO5	2	2		2						2	2		2			
CO6	2	2					2							2		

CO attainment levels

CO1-2, CO2- 2, CO3-3, CO4-3, CO5-4, CO5-4, CO6-4

Future Courses Mapping:

Data warehouse and Data mining, Advanced DBMS, Data Science, Web enabled databases, Parallel databases, NoSQL DB, New SQL DB, Database System Administration, Database Performance Tuning, Big data mining, Parallel data mining

Job Mapping:

Database programmer, DB system Administrator, Database Designer, Database Application Designer- Front end and Back end, DB -Query optimization, SQL and Pl/SQL developer, Embedded SQL Developer, BI analyst, Data Modelers, ETL Analyst

FF No. : 654

IT3203: Image Processing and Computer Vision

Course Prerequisites: Knowledge of Linear Algebra, Different types of Signals

Course Objectives:
1. To learn Image Processing fundamentals.
2. To study Image preprocessing methods.
3. To understand image lossless and lossy compression techniques.
4. To introduce the major ideas, methods, and techniques of computer vision and pattern recognition.
5. To acquaint with Image segmentation and shape representation.
6. To explore object recognition and its application

Credits: 5

Teaching Scheme
Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance: Image processing and computer vision are of fundamental importance to anyfield in which images must be enhanced, manipulated, and analyzed. They play a key role inremote sensing, medical imaging, inspection, surveillance, autonomous vehicle guidance, andmore. Students of this course will benefit from the direct visual realization of mathematicalabstractions and concepts, and learn how to implement efficient algorithms to perform these tasks.

SECTION-I
Introduction: Elements of image processing system, Scenes and Images, Vector Algebra, Human Visual System, color vision color model: RGB, HVS, YUV, CMYK, YCbCr. Spatial domain techniques { Image Negative, Contrast stretching, gray level slicing, bit plane slicing, histogram and histogram equalization, local enhancement technique, image subtraction and image average. Image Statistical and Geometrical properties. Image Smoothening: low-pass spatial filters, median filtering. Image Sharpening: high-pass spatial filter, derivative filter. Introduction to Image compression and its need: Coding redundancy, classification of compression techniques (Lossy and lossless- JPEG, RLE, Huffman). One-two dimensional Discrete Fourier Transform (DFT). Cosine, affine transforms. Sub band coding, multi resolution expansions, Wavelet Transform in one dimensions; Wavelet transforms in two dimensions.
SECTION-II
Human Vision System, Computer Vision System, Camera Geometry Fundamentals, Camera Calibration. Construction of 3D Model from images. Image Segmentation techniques: Image Segmentation: Edge Based approaches to segmentation, Gradient using Masks, LOG, DOG, Canny, Edge Linking, Line detectors (Hough Transform), Corners – Harris, Region Growing, Region Splitting. Object recognition: Object Recognition, Feature Detectors, Supervised and Unsupervised Machine Learning for Image Classification, Principal Component Analysis, Singular Value Decomposition Shape priors for recognition, Stereo Vision.

List of Tutorials: (Any Three)

1) Implement Image preprocessing and Edge detection
2) Image Arithmetic Operations
3) Pseudo colouring operation of a given image using Intensity slicing technique and Gray to Colour transform
4) Image quality Enhancement by using following techniques- Logarithmic transformation, Histogram Equalization, Gray level slicing with andwithout background, Inverse transformation.
5) Image Compression
6) Implement Segmentation methods
7) Implement camera calibration methods
8) Determine depth map from Stereo pair
9) Construct 3D model from defocus image
10) Construct 3D model from Images
11) Implement object detection and tracking from video
12) Face detection and Recognition
13) Object detection from dynamic Background for Surveillance
14) Content based video retrieval
15) Construct 3D model from single image

List of Practicals: (Any Six)

1) A. Write matlab code to display following binary images
Square, Triangle, Circle

B. Write matlab code to perform following operations on images Flip Image along horizontal and vertical direction, Enhance quality of a given image bychanging brightness of image, Image negation operation, Change contrast of a given Image.

2) Study of different file formats e.g. BMP, TIFF and extraction of attributes of BMP.

3) Write matlab code to find following statistical properties of an image- Mean, Median, Variance, Standard deviation, Covariance.

4) Read an Image and Perform singular value decomposition. Retain only k largest Singular values and reconstruct the image. Also Compute the Compression ratio

5) Write matlab code to enhance image quality by using following techniques-Low pass and weighted low pass filter, Median filter, Laplacian mask.

6) Write matlab code for edge detection using Sobel, Prewitt and Roberts operators.

7) Write C-language code to find out Huffman code for the following word - COMMITTEE.

8) Write matlab code to design encoder and decoder by using Arithmetic coding for the following word MUMMY. (Probabilities of symbols M-0.4, U-0.2, X-0.3,Y- 0.1).

9) Write matlab code to find out Fourier spectrum, phase angle and power spectrum of binary image and gray scale image.

10) Develop an algorithm for pre-processing of an input image for geometric transformation of image.

11) Develop an algorithm for pre-processing of an input image for enhancement of image.

12) Develop an algorithm for feature extraction of an input image using point detector

13) Develop an algorithm for segmentation of an input image

14) Develop an algorithm for recognition of an object from input image

15) Develop an algorithm for motion estimation from a given video sequence.

16) Design an algorithm for SVM classifier

17) Design an algorithm for adaboost classifier

18) Line detection using Hough transform

19) To design and develop optical flow algorithm for Motion Estimation

List of Projects:

1. Lossless and Lossy Compression Techniques
2. Pseudo Colour Image Processing Model
3. Image and Video Enhancement models
4. Human Motion Detection
5. Object Detection Model
6. Face Recognition Model
7. Dynamic Texture Synthesis
8. Image and Video Editing
9. Develop an application for a vision-based security system during day/night time. The system should trigger an audio- visual alarm upon unauthorized entry.

10. Develop motion estimation/ tracking system to recognize object of interest related to one of the following applications. (Automobile tracking/ face tracking/ human tracking).
11. Develop motion estimation/ tracking system to recognize object of interest related to one of the following applications. (Space vehicle tracking/ solar energy tracking/ crowdpattern tracking).

List of Course Seminar Topics:

1. Linear Algebra used for Image Processing
2. Image File format-TIFF
3. Color Model
4. Pseudo Colour Image Processing
5. Image Enhancement-Spatial Domain
6. Image Smoothening
7. Image Enhancement-Frequency Domain
8. Image Sharpening
9. Image Segmentation
10. Watershed Transformation
11. 3-D model
12. Face Detection
13. Object Recognition

List of Course Group Discussion Topics:

1. Lossy Compression Techniques
2. Loss less Compression Techniques
3. Fourier Transform
4. Set Partitioning in Hierarchical Trees-SPIHT Wavelet Transform
5. Image Understanding-Pattern Recognition Models
6. Object Recognitions
7. 3-D models and its applications
8. Wavelet Transform
9. Face detection models etc.

List of Home Assignments:

Design:

1. Human Motion Detection
2. Object Detection Model
3. Face Recognition Model
4. Dynamic Texture Synthesis
5. Image and Video Editing
6. Design 3-D models
7. Face Detection Models
8. Develop an application for a vision-based security system during day/night time. The system should trigger an audio- visual alarm upon unauthorized entry.

9. Develop motion estimation/ tracking system to recognize object of interest related to one of the following applications. (Automobile tracking/ face tracking/ human tracking).
10. Develop motion estimation/ tracking system to recognize object of interest related to oneof the following applications. (Space vehicle tracking/ solar energy tracking/ crowdpattern tracking)

Case Study:
1. Image Processing for Smart City
2. Computer Vision for AR AVR
3. Research Areas in Image Processing & Computer Vision
4. Image Processing for Swastha Bharat
5. Image Processing in IoT
6. Computer Vision in Health Analytics
7. Computer Vision in wearable computing

Blog:
1. Computer Vision for Data Science
2. Image Processing for Smart Agriculture
3. Image Processing in Medical Field
4. Usage of AI for Computer Vision
5. Job Opportunities in Image Processing and Computer Vision
6. Usage of Image Processing in Computer Vision, Machine Learning, Deep Learning, and AI

Surveys:
1. Steganography and Cryptography
2. Image Processing for Educations
3. Dynamic Texture Synthesis
4. Classifications and Recognitions
5. Image & Video Compression
6. Drone based Surveillance
7. Video Editing
8. Human Motion/Object tracking and detections
9. Image Processing using High-Performance Computing-Computational
10. Complexity/Time Complexity and Execution time
11. Recent Trends in Image and Video Processing

Suggest an assessment Scheme:

1. MSE
2. ESE
3. LAB + Course Project
4. GD
5. PPT
6. VIVA

Course Outcomes:
The student will be able to-
1. Apply lossless and Lossy compression techniques for image compression.
2. Explore pre-processing algorithms to acquire images.

3. Use various image transforms to analyze and modify the image.
4. Extract features from Images and do analysis of Images.
5. Apply supervised and unsupervised machine learning for image classification.
6. Make use of Computer Vision algorithms to solve real-world problems.

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		3	2			2					2			
CO2			3		2				2	2					3	2
CO3	2	3				3						2				
CO4		3	2	2			2							2	2	
CO5	2				2				2							
CO6				3		2					2	2			3	3

CO Attainment Level:
CO1-1
CO2 -2
CO3-2
CO4-3
CO5-3
CO6-4

Text Books:

1. Rafael Gonzalez & Richard Woods, "Digital Image Processing," 3rd Edition, Pearsonpublications, ISBN 0132345633.
2. S. Jayaraman, S Esakkirajan, & T Veerakumar, "Digital Image Processing," Tata McGrawHill Education, ISBN(13) 9780070144798.
3. Anil K. Jain, "Fundamentals of Digital Image Processing," 5th Edition, PHI publication,ISBN 13: 9780133361650.
4. Richard Szeliski, "Computer Vision: Algorithms and Applications (CVAA)", Springer,2010.
5. E. R. Davies, "Computer & Machine Vision," 4th Edition, Academic Press, 2012.
6. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

Reference Books:

1. Pratt, "Digital Image Processing," Wiley Publication, 3rd Edition, ISBN 0-471-37407-5.
2. K.R. Castleman, "Digital Image Processing," 3rd Edition, Prentice Hall: Upper SaddleRiver, NJ, 3, ISBN 0-13-211467 -4.
3. K. D. Soman and K. I. Ramchandran, "Insight into wavelets - From theory to practice," 2nd Edition PHI, 2005.

4. D. Forsyth and J. Ponce, "Computer Vision - A modern approach," Prentice Hall
5. E. Trucco and A. Verri, "Introductory Techniques for 3D Computer Vision," Publisher:Prentice Hall.
6. D. H. Ballard, C. M. Brown, "Computer Vision", Prentice-Hall, Englewood Cliffs, 1982

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IT3209: Software Design and Methodologies

Course Prerequisites: Mastery of programming in a high-level, object-oriented language, Familiarity with data structures and algorithms.

Course Objectives:

1. Understanding object-oriented analysis and design.
2. Learn different software process models and principles and practices
3. Practicing UML to model OO systems
4. Familiarity with current models and standards for design.
5. Exposure to organizational issues in software design.
6. An ability to analyze and evaluate problems and draw on the theoretical and technical knowledge to develop solutions and systems

Credits: 4

Teaching Scheme

Theory: 3Hours/Week

Lab: 2Hours/Week

Course Relevance: Software Architecture

SECTION-I

Overview of Software Engineering: Software Process Framework, Process Patterns, Personal and Team Process Models, Process Models: Code-and-Fix, Waterfall Model, Incremental Models, Evolutionary Models, Iterative Development, The Unified Process, Agile process, Extreme Programming, Clean room Methodology, CMMI, Impact of Processes and Outcomes, Process Selection and applicability, Software Engineering Principles and Practices, The importance of modeling.

UML Building blocks: Things, relationships and diagrams, Architectural views: use case, design, implementation, process and deployment, Levels of detail: visualization, specification and construction, Object properties: Abstraction, encapsulation, Modularity, Hierarchy.

Requirements Engineering: RE Tasks, Requirement Elicitation Techniques, Software Requirements: Functional, Non-Functional, Domain, Requirements Characteristics and Characterization, Requirement qualities, Requirement Specification, Requirement Traceability, System Analysis Model Generation, Requirement Prioritization, Context Models, Behavioral Models, Data Models, Object Models, Structured Methods, Use Case Diagrams, Sequence Diagrams, State Chart Diagrams, Activity Diagrams, Design quality, Design Concepts.

The Design Model: Introduction to Pattern-Based Software Design, Architecture styles, Reference Architectures Architectural Design: Software Architecture, Data Design and Architectural Design, Design of Software Objects, Features and Methods, Cohesion and Coupling between Objects, Coupling and Visibility, Interfaces, Interfaces with Ball and Socket Notation, Templates, Analysis model vs. design model classes, Categorizing classes: entity, boundary and control , Modeling associations and collections,Component and deployment diagrams.

SECTION-II

Software Architecture Vs Software Design:Design process and Design quality, Design concepts, the design model, pattern based software design,Software Design Approaches, Structured Analysis, Structured Design. Software Architecture Relationships to Other Disciplines, Foundations of Software Architecture, Software architecture in the context of the overall software life cycle ,Role of Software Architect, Architectural Styles, Architectural Frameworks, Designing, Describing, and Using Software Architecture, Global Analysis, Conceptual Architecture View, Module Architecture View, Execution Architecture View, Code Architecture View. Introduction to software Patterns: Architectural Patterns, Design Patterns and Idioms.Architectural Patterns: Blackboard, Pipe and filter, Design Patterns proposed by GoF:Creational Patterns, Structural Patterns, and Behavioral Patterns.

List of Tutorials:(Any Three)

1) Goals of software engineering
2) Software process models, life cycle models
3) Process improvement, Capability Maturity Model
4) Unified Modeling Language (UML)
5) Design patterns
6) Frameworks, software product lines
7) Software architecture
8) Software measurements and metrics
9) Software estimation methods
10) Static and dynamic analysis
11)Version control, configuration management
12) Software quality, verification and validation, software testing

List of Practicals: (Any Six - Any 3 out of 1 to 5 and any 3 out of 6 to 10)

1. To study modeling methodologies and identify their applicability to various categories of projects 2. To understand Requirement Elicitation Techniques and recognize types of requirement while preparing System Requirement Specification.
3. To study MDD / MDA and identify the importance of Model Transformation.
4. To study types of MOF and metamodel concepts for various diagrams in UML 2.0.
5. To identify System Scope, Actors, Use Cases, Use Case structuring for a given problem and perform Use Case narration in template form with normal/alternate flows.
6. To identify Entity, Control, Boundary objects and trace object interactions for scenarios from use cases.

7. To identify object states, transitions, entry-exit points, concurrency, action parallelism and

prepare a state chart diagram for given object scenario.
8. To prepare detailed Activity diagram with notational compliance to UML 2.0 indicating clear use of pins, fork-join, synchronization, datastores.
9. To prepare Class diagram for a defined problem with relationships, associations, hierarchies, interfaces, roles and multiplicity indicators.
10) To prepare Component and Deployment diagram for a defined problem.

List of Projects:

1. ERP system
2. Hospital Management
3. Railway Reservation
4. Stock market management
5. Parking automation
6. Library Management
7. Online shopping
8. Content management

List of Course Seminar Topics:

1. CMMI
2. Process Models
3. Agile Methodology
4. Modelling using UML
5. Analysis and Design in OO systems
6. Requirement Engineering
7. Principles and Practices of good Software Design
8. Collaborative software development
9. Component diagram
10. Deployment diagram

List of Course Group Discussion Topics:

1. Traditional Vs Agile
2. Phases of SDLC.Which is more important?
3. UML modeling
4. Analysis Vs Design
5. Design Patterns
6. Design Vs Architecture
7. Architecture style
8. Design Vs Framework
9. Framework Vs Architecture
10. Archetype patterns

List of Home Assignments:

Design:

1.Requirement Engg steps
2.Analysis modeling
3.design modeling
4.Architechtural styles
5.design patterns

Case Study:

1.Imaging Software architecture
2.Banking Software architecture
3.ERP Software architecture
4.Online Shopping Software architecture
5.AI Software architecture

Blog:

1.Software Engg Do's and Don'ts
2.Which Process Model?
3.Scrum
4.Devops
5.Data ops

Surveys:

1.Software Design
2.Software Methodologies
3.Software Architectures
4.Design Patterns
5.Architechtural Patterns

Suggest an assessment Scheme:

MSE PPT Presentation ESE GD Viva Lab assignments +Course Project

Text Books:

1. Roger S Pressman ,"Software Engineering: A practitioner's Approach", 6 th edition. McGraw Hill International Edition, 2005
2. Craig Larman ,"Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design", Addison-Wesley, 1998.

Reference Books:

1. Pankaj Jalote ,"Software Engineering, A Precise Approach", Wiley India, 2010.
2. Waman S Jawadekar, "Software Engineering : A Primer", Tata McGraw-Hill, 2008
3. Rajib Mall ,"Fundamentals of Software Engineering", PHI, 2005
4. Deepak Jain, "Software Engineering, Principles and Practices", Oxford University Press.
5. Diner Bjorner ,"Software Engineering1: Abstraction and modeling", Springer International edition, 2006

Moocs Links and additional reading material:

www.nptelvideos.in

Course Outcomes:

The student will be able to –

1. Summarize capabilities and impact of Software Development Process Models and justify process maturity through application of Software Engineering principles and practices focusing tailored processes that best fit the technical and market demands of a modern software project.
2. Discriminate competing and feasible system requirements indicating correct real world problem scope and prepare stepwise system conceptual model using stakeholder analysis and requirement validation.
3. Formulate system specifications by analyzing User-level tasks and compose software artifacts using agile principles, practices and Scrum framework.
4. Propose and demonstrate realistic solutions supported by well-formed documentation with application of agile roles, sprint management, and agile architecture focusing project backlogs and velocity monitoring.
5. Conform to Configuration Management principles and demonstrate cohesive teamwork skills avoiding classic mistakes and emphasizing on software safety adhering to relevant standards.
6. Analyze the target system properties and recommend solution alternatives by practicing project planning, scheduling, estimation and risk management activities.

CO-PO map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3			3	2							3			
CO2	2	3		2		2		2			2			3		
CO3	2	2		3	2										3	
CO4		3	3		3	2		2								
CO5	2	2							2					3		
CO6							2	2			3	2			3	3

CO attainment levels

CO1	CO2	CO3	CO4	CO5	CO6
2	2	3	4	5	3

Future Courses Mapping: Project Management, Software Architecture
Job Mapping: Software Engineer, Project Manager, Software Architect

IT3219: Discrete Structures and Automata Theory

Course Prerequisites: Basic mathematics and programming

Course Objectives:

1. Formulate and solve counting problems, problems based on recurrence relations and probability theory
2. To study graph and tree based models to be applied in real life problems
3. To design suitable computational model/s for accepting a given language
4. To compare these models with respect to their power in recognizing different types of languages

Credits: 04 **Teaching Scheme Theory:** 03 Hours/Week

Lab: 02 Hours/Week

Course Relevance: This course lays a strong foundation for higher studies as well as research. For higher studies, there are different courses such as 'Program Analysis and Verification' which are based on the concepts of computation theory.

For Research scholars, it would help in understanding the type and class of problems, and to solve and prove certainty of the provided solution.

It would also help software developers in building the logic of programs, exploring its mathematical proofs, generating hypothetical scenarios, and designing various computing machines.

SECTION-1

Topics and Contents

Logic and Proofs: Propositional logic, applications of propositional logic, propositional equivalences, predicates and quantifiers, rules of inference, introduction to proofs: direct, contrapositive, contradiction, counter example, principle of mathematical induction.

Elementary Discrete Structures & Basic Counting: Elementary set theory, relations, functions, basic counting principles, permutations, combinations, Pigeon-Hole Principle, generalized pigeon-hole principle, Inclusion Exclusion Principle: Counting, Euler's phi function.

Recurrence relations: Recurrence relations, modelling using recurrence relations, Fibonacci numbers, solution of linear recurrence relations with constant coefficients (homogeneous and inhomogeneous).

Probability Theory: Discrete Probability, Conditional Probability, Bayes Theorem, Information and Mutual Information, Applications of Combinatorics and Discrete Probability.

Graph Theory: Graphs, different representations, properties of incidence and adjacency matrices, directed/undirected graphs, connected components, degree of a vertex, paths, cycles in graph, tree, bipartite graphs (graph with only odd cycles, 2-colorable graphs), Planar graphs, Eulerian path andEulerian circuit, Hamiltonian circuit.

SECTION-1I

Topics and Contents

Finite Automata: Automaton as a model of computation, Alphabets, Strings, Languages, Finite Automata, Deterministic Finite Automata (DFA) - Formal Definition, State Minimization algorithm, Nondeterministic finite Automata (NFA), NFA with epsilon transition.

Regular Expression: Regular expression (RE) Definition, Applications, Kleene's Theorem: Equivalence of RE and DFA, Closure properties of Regular Languages, Myhill-Nerode theorem and its applications, Pumping Lemma for regular Languages.

Grammar: Grammar, definition, Context Free Grammars (CFG), Derivation, Languages of CFG, Constructing CFG, Closure and Decision properties of Context Free Languages (CFLs). Derivation trees, Ambiguity in CFGs, Removing ambiguity, CNF, GNF, Chomsky hierarchy, Applications of CFG.

Pushdown Automata: Pushdown Automata (PDA) definition, Languages, Acceptance by final state / empty stack, Deterministic and Non-deterministic PDAs, CFG to PDA construction, Equivalence of PDA and CFG, Pumping lemma for CFLs, Context Sensitive Languages, Context Sensitive Grammars, Linear Bounded Automata.

Turing Machine: Turing Machine (TM) definition, Instantaneous Description, Language acceptance, Robustness of TM, equivalence of TM variants; Universal Turing Machine, TM as enumerator, Recursive and Recursively Enumerable languages and their closure properties, Decidability and Undecidability.

List of Tutorials: NA

List of Practical's: (Any Six)

1. Tower of Hanoi: Generate recurrence relation and solve.
2. Fibonacci numbers: Generate recurrence relation and solve.
3. Explore various set operations. Consider the universal set U: ={0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15}. Consider 2 sets A and B. Use the randomly generated sets to determine the following. A ∪ B , A ∩ B, A', A ∩ (B ∩ C), A − B , A' ∩ B , (A ∪ C) ∩ B
4. Problems based on Conditional Probability.
5. Exercises on conversion of Regular expression to DFA and vice versa
6. Problems on NFA to DFA conversion.
7. Numerical based on minimization and equivalence of Automata
8. Proof of Closure properties of Regular Languages
9. Problems on checking of Ambiguity of Grammar and Simplification of CFGs
10. Problems on Normal forms of CFGs: CNF and GNF
11. Problems based on PDA construction
12. Problems on Turing machine design

List of Course Seminar Topics:

1. Set Theory and its applications in Artificial Intelligence
2. Different Counting principles
3. Applications of Bipartite graphs in biology and medicine
4. Applications of Probability theory in risk assessment and modeling
5. Hamiltonian graph vs Eulerian graph
6. Zero divisors and Integral domain
7. DFA and NFA
8. Regular Expressions
9. Minimization of DFA
10. Myhill-Nerode Theorem
11. Context Free Grammar
12. Turing Machine
13. Pushdown Automata
14. Recursive and Recursively Enumerable Languages
15. Universal Turing Machine
16. Applications of DFA and NFA

List of Course Group Discussion Topics:

1. Need of Graphs in real life applications
2. Applications of Set Theory
3. Applications of Euler's Theorem in counting remainders
4. Homogeneous Vs non-homogeneous recurrence relation
5. Pigeonhole principle and its applications
6. NFA vs DFA
7. Power of Automata
8. Need of Automata in Computer Science
9. Ambiguity in Grammar
10. Mealy vs Moore Machine
11. CNF vs GNF
12. CFL and Non CFL and its applications
13. Power of Turing machine and Linear Bounded Automata
14. Closure Properties of CFL
15. Applications of Automata

List of Home Assignments:

Design:

1. Design of social network using graphs
2. Design of railway network using graph
3. Design of POC MAN Game
4. Design Switching Circuit
5. Digital Logic Design using DFA
6. Digital Logic Design using NFA
7. Design Multitape TM for Palindrome
8. Design PDA for String Copy
9. Design LBA for real world application
10. Design parser to recognize string

Blog

1. Proofs to differentiate direct, contrapositive, contradiction with suitable examples
2. Importance of discrete mathematics in real life. Write an article related to any four domains where discrete mathematics is dominantly used
3. How graph theory is used as a technology in recent trends? Graph theory and its applications (at least 8)
4. Significance of Combinatorics and Discrete Probability in today's world
5. How search engines use graph concepts?
6. Automata Theory Limitations and Applications
7. Pumping Lemma
8. Kleene's star and Positive Closure
9. Regular Expression and its Closure Properties
10. PDA vs TM and its Advantages

Surveys

1.Recurrence relations for dynamic programming

2. Graphs in computer networks

3. Probability theory for weather forecasting

4. Game Theory: an application of probability

5. Graph theory for Machine learning problem

6. Pattern matching algorithm

7. Evolution of Computational Models

8. Applications of Computer Theory in real life

9. Applications where Automata Theory is Beneficial

10. Power of Turing Machine

11. Real life examples to find ambiguity in it and its elimination

12. Closure properties of Regular and Context Free Languages

13. Role of Non Determinism

14. Working of Parser

15. Evolution of Models of Computations

List of Course Projects:

1. Lexical Analyzer

2. Digital Logic design

3. Spell Checker

4. Parser

5. Word Processor Program

6. Text Editors

7. Switching circuit design

8. Game design POC MAN

Suggest an assessment Scheme:

MSE, ESE, Lab, Course project, HA, Seminar, GD

Text Books:

1. *Kenneth Rosen , "Discrete Mathematics and its applications", 7th Edition, McGraw-Hill, ISBN 0–07–338309–0.*
2. *Alan Tucker ,"Applied Combinatorics", 6th Edition, Wiley Publishing company.*
3. *C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", 4th Edition, McGraw-Hill*
4. *Hopcroft J, Motwani R, Ullman, Addison-Wesley, "Introduction to Automata Theory, Languages and Computation", Second Edition, ISBN 81-7808-347-7.*
5. *Michael Sipser, , "Introduction to Theory of Computation", Third Edition, Course Technology, ISBN-10: 053494728X.*

Reference Books:

1. *Peter J. Cameron, "Combinatorics: Topics, techniques, algorithms", Cambridge University Press*
2. *Reinhard Diestel , "Graph Theory", 5th Edition, Springer Verlag Publishing Company*
3. *Douglas B. West ,"Introduction to Graph Theory", Prentice-Hall publishers*
4. *Edgar G. Goodaire, Michael M. Parmenter, "Discrete Mathematics with Graph Theory", 3rd Edition, Pearson Education*
5. *John C. Martin," Introduction to Languages and The Theory of Computation", Fourth Edition, McGraw Hill, ISBN 978-0-07-319146-1.*

Moocs Links and additional reading material:www.nptelvideos.in

Course Outcomes:

1. Students should be able to solve counting problems and problems based on recurrence relations
2. Students should be able to apply knowledge of Graph and Tree based models to solve real life problems
3. Students should be able to calculate discrete probabilities
4. Students should be able to design Finite Automata / Turing machine for given computational problems
5. Students should be able to correlate given computational model with its Language
6. Students should be able to analyse power of different computational models

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		2	3									2		
CO2	3	2	2			3	2		3			2		2		
CO3	2	3			3											
CO4			3	2					2		2				3	2
CO5	2	2			2	2		2		2	2		2			
CO6	2	3					3			2	3			3		3

CO Attainment Levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	2	3	3	3	4	4

Future Courses Mapping:

Adv. Data structures

Problem solving

Design and Analysis of Algorithms

Compiler Design

Machine Learning

Job Mapping:

Application developer, System software developer, Data science engineer, Machine learning architect

IT3218: Artificial Intelligence

Course Prerequisites: Data structures, Computer programming Course Objectives:

To make students

1. Familiar with basic principles of AI
2. Capable of using heuristic searches
3. Aware of knowledge-based systems
4. Able to use fuzzy logic and neural networks
5. Learn various applications domains AI

Credits: 5 **Teaching Scheme Theory:** 3 Hours/Week

Tut: 1 Hours/Week

Lab: 2 Hours/Week

Course Relevance: This course is highly applied in many scientific and engineering disciplines

SECTION-I

Fundamentals of Artificial Intelligence

Introduction, A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation

Uninformed Search Strategies

Formulation of real world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensor-less problems, Contingency problems.

Informed Search Strategies

Generate& test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence

SECTION-II

Knowledge Representation

Knowledge based agents, Wumpus world. Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. Basics of PROLOG: Representation, Structure, Backtracking. Expert System: Case study of Expert System in PROLOG

Introduction to Planning and ANN

Blocks world, STRIPS, Implementation using goal stack, Introduction to Neural networks:basic, comparison of human brain and machine, biological neuron, general neuron model, activation functions, Perceptron learning rule, applications and advantages of neural networks. Brief introduction to single layer and multiplayer networks.

Uncertainty

Non Monotonic Reasoning, Logics for Non Monotonic Reasoning, Justification based Truth Maintenance Systems, Semantic Nets, Statistical Reasoning, Fuzzy logic: fuzzy set definition and types, membership function, designing a fuzzy set for a given application. Probability and Bayes' theorem, Bayesian Networks.

List of Tutorials: (Any Three)

1. Heuristic function design for Tic-Tac-Toe
2. Heuristic function design for 8-puzzle / or given problem
3. Trace of A* algorithm for 8-puzzle
4. Trace of AO* algorithm for a given problem
5. Conversion to clause form
6. Resolution in predicate logic
7. Resolution in propositional logic
8. Using inference rules in predicate logic
9. Design of fuzzy sets for a given application
10. Perceptron learning for 2 class classification

List of Practicals: (Any Six)

1. Implement Non-AI and AI Techniques
2. Implement any one Technique from the following:
    1. Best First Search & A* algorithm
    2. AO* algorithm
    3. Hill Climbing
3. Implement Perceptron learning algorithm
4. Implement a real life application in Prolog.
5. Expert System in Prolog-new application

6. Implement any two Player game using min-max search algorithm.
7. Design a fuzzy set for shape matching of handwritten character
8. Conducting Turing test of an online chat robot

List of Projects: (Any project within following domain)

1. Pattern recognition –Classification, Clustering, hybrid-classification clustering
2. Prediction using -Regression –Linear or nonlinear
3. Game playing- single player/2-player/multi-player
4. Use of Knowledge based system for generating inferences
5. Deep Learning
6. Neural network training and using for a real application
7. Use of fuzzy sets for human like reasoning
8. Use of any ML algorithm for solving real world problem

List of Course Seminar Topics:

1. Fuzzy sets theory- Operations on sets
2. Deep Learning
3. Non-monotonic Logic and real applications
4. Neural network training for real applications
5. Predicate Logic for reasoning
6. Expert system design and development
7. PROLOG and LISP comparison
8. Heuristic Search Techniques
9. Game playing - A specific game and its method
10. ML Algorithms for predictions

List of Course Group Discussion Topics:

1. Semantic Networks
2. Fuzzy set design for real application
3. Neural network training and testing
4. Classification, Clustering and hybrid approaches to pattern recognition
5. Blocks world Domain- STRIPS
6. Predicate logic inference rules
7. Resolution in predicate logic
8. Perceptron Learning rule
9. R-category perceptron learning algorithm and application design
10. Bays theorem and classifier

List of Home Assignments:

Design:

1. Heuristic function design for a specific search application
2. Knowledge base design for a small expert system for real application
3. Design of fuzzy sets for a given application
4. Designing Neural network architecture for pattern recognition
5. Design of a reasoning system for the shape matching of objects
6. Any other topic mutually decided by students-instructor

Case Study:

1. PROLOG expert system
2. Alexa
3. Google Assistant
4. Page ranking algorithm
5. Emotion detection
6. Any other topic mutually decided by students-instructor

Blog:

1. Future of AI
2. Deep Learning Architectures
3. AI in healthcare
4. AI in finance
5. Neural network classification
6. Any other topic mutually decided by students-instructor

Surveys:

1. HCR algorithms
2. Face recognition
3. Thumb print recognition
4. Image captioning
5. Data sampling techniques
6. Any other topic mutually decided by students-instructor

Suggest an assessment Scheme:

1. MSE-10

2. PPT-10

3. ESE-10

4.GD-10

5. VA-20

6. Lab Assignment and Course Project -40

Text Books:

1. *Elaine Rich and Kevin Knight," Artificial Intelligence", 2nd Ed., Tata McGraw Hill, 1991*
2. *Stuart Russell & Peter Norvig, "Artificial Intelligence : A Modern Approach", 2nd Ed, Pearson Education, 2003*

Reference Books:

1. *Ivan Bratko, "Prolog Programming For Artificial Intelligence", 2nd Ed. Addison Wesley, 1986.*
2. *Eugene, Charniak, Drew Mcdermott, "Introduction to Artificial Intelligence", Addison Wesley, 1985*
3. *Dan W Patterson, "Introduction to AI and Expert Systems", PHI, 1990*
4. *Nils J. Nilsson, "Principles of Artificial Intelligence", 1st Ed., Morgan Kaufmann,1982*
5. *Carl Townsend, "Introduction to turbo Prolog", Paperback, 1987*
6. *Jacek M. Zurada, "Introduction to artificial neural systems", Jaico Publication, 1994*

Moocs Links and additional reading material:

1. http://www.eecs.qmul.ac.uk/~mmh/AINotes/AINotes4.pdf
2. https://www.slideshare.net/JismyKJose/conceptual-dependency-70129647
3. https://web.archive.org/web/20150813153834/http://www.cs.berkeley.edu/~zadeh/papers/Fuzzy%20Sets-Information%20and%20Control-1965.pdf
4. https://www.youtube.com/watch?v=aircAruvnKk
5. https://www.youtube.com/watch?v=IHZwWFHWa-w
6. Others suggested by instructor

Course Outcomes:

Upon completion of the course, graduates will be able to -

1. Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents capable of problem formulation.
2. Evaluation of different uninformed search algorithms on well formulated problemsalong with stating valid conclusions that the evaluation supports.
3. Design and Analysis of informed search algorithms on well formulated problems.
4. Formulate and solve given problems using Propositional and First order logic.
5. Apply planning and neural network learning for solving AI problems
6. Apply reasoning for non-monotonic AI problems.

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3						2				2		2		
CO2		2	2	3			2				1		2			
CO3	2		3		3	2		2						2	3	3
CO4	2	3								2						
CO5	2								2				3		2	
CO6				2	2	3						2	1			

CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	2	3	3	4	5	3

Future Courses Mapping: Fyzzy Logic and soft computing, Artificial Neural networks, Pattern Recognition, Knowledge based systems, Intelligent Searching, Natural Language Processing and etc.

Job Mapping: Knowledge Engineer in Expert system, AI Engineer, Developer -AI applications, Architect AI solutions and etc

IT3213: Engineering Design and Innovation- V

Course Prerequisites: Problem Based Learning

Course Objectives:

1. To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problems.

2. To Evaluate alternative approaches, and justify the use of selected tools and methods

3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.

4. To engage students in rich and authentic learning experiences.

5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

6.To develop an ecosystem to promote entrepreneurship and research culture among the students.

Credits: 4 **Teaching Scheme Theory:** 1 Hours/Week

Lab: 6 Hours/Week

Course Relevance: Project Centric Learning (PCL) is a powerful tool for students to work inareas of their choice and strengths. Along with course based projects, curriculum can be enrichedwith semester long Engineering Design and Development courses, in which students can solvesocially relevant problems using various technologies from relevant disciplines. The varioussocially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City,Smart Energy and Swaccha Bharat Abhiyan. To gain the necessary skills to tackle such projects,students can select relevant online courses and acquire skills from numerous sources underguidance of faculty and enrich their knowledge in the project domain, thereby achieving projectcentric learning. Modern world sustained and advanced through the successful completion ofprojects. In short, if students are prepared for success in life, we need to prepare them for aproject-based world. It is a style of active learning and inquiry-based learning. Project basedlearning will also redefine the role of teacher as mentor in the learning process. The PCL modelfocuses the student on a big open-ended question, challenge, or problem to research and respondto and/or solve. It brings students not only to know, understand and remember rather it takesthem to analyze, design and apply categories of Bloom's Taxonomy.

SECTION-I

SECTION-1

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students;rather they are free to explore

their creativity beyond the guideline mentioned herewith. For all courses of ED, laboratory course contents of "Trends in Engineering Technology" are designed as a ladder to extend connectivity of software technologies to solve real world problems using an interdisciplinary approach. The ladder in the form of gradual steps can be seen as below:
Industry Communication Standards, Single Board Computers and IoT, Computational Biology(Biomedical and Bioinformatics), Robotics and Drone, Industry 4.0 (Artificial Intelligence,Human Computer Interfacing, 5G and IoT, Cloud Computing, Big Data and Cyber Securityetc).

Suggest an assessment Scheme:
MSE and ESE

Text Books: (As per IEEE format)

1. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE).
ISBN:978-0-9935254-6-9; 2017
2. Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert RobartCapraro, Mary Margaret Capraro

Reference Books: (As per IEEE format)

1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based
learning in engineering. Rotterdam: Sense Publishers. 2007.
2. Project management core textbook, second edition, Indian Edition , by Gopalan.
3. The Art of Agile Development. By James Shore & Shane Warden.
Moocs Links and additional reading material: www.nptelvideos.in

Course Outcomes:

On completion of the course, learner will be able to–
CO1: Identify the real life problem from societal need point of view
CO2: Choose and compare alternative approaches to select most feasible one
CO3: Analyze and synthesize the identified problem from technological perspective
CO4: Design the reliable and scalable solution to meet challenges
CO5: Evaluate the solution based on the criteria specified
CO6: Inculcate long life learning attitude towards the societal problems

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2			3				2	2			3		
CO2				3	2	2		2							2	
CO3	2		3		3			2	2				3			
CO4		2				3										
CO5			3				2		2						2	3
CO6		2			3				2	3				2		

IT3207:Web Technology and Cloud Computing

Course Prerequisites: Computer Programming, Database Management Systems, Computer Network

Course Objectives:

1. To learn the fundamentals of HTML and CSS.
2. To obtain knowledge of client-side technologies in web development.
3. To acquire skills of server-side technologies in web development.
4. To study fundamental concepts of Cloud Computing.
5. To understand the implementation of virtualization in Cloud Computing.
6. To learn security management in Cloud Computing.

Credits: 5 **Teaching Scheme Theory:** 3Hours/Week

Tut: 1Hours/Week

Lab: 2 Hours/Week

Course Relevance: Web development is the work involved in developing a website for the Internet or an intranet . Web development can range from developing a simple single static page of plain text to complex web-based internet applications (web apps), electronic businesses, and social network services. Cloud Computing is the on-demand solution for storing and retrieving data globally. cloud computing has become a very integral part of the entire infrastructure of theIT industry.

SECTION-1

Introduction: Internet and WWW, web site planning and design issues, HTML: Introduction, Html elements:heading,paragraph,line break,color,font,links,frames,lists,tables,images, forms, Difference between HTML and HTML5.

CSS: Introduction to Style Sheet, Need, Inserting CSS in an HTML page, CSS selectors

Client Side Technologies: JavaScript: Overview of JavaScript, Data types, Control Structures, Arrays, Functions and Scopes, Objects in JS, DOM: DOM levels, DOM Objects and their properties and methods, Manipulating DOM, JQuery: Introduction to JQuery, Loading JQuery, Selecting elements, changing styles, creating elements, appending elements, removing elements, handling events.

Server Side Technologies: Introduction to PHP, features, sample code, PHP syntax, control structures, functions, arrays, string manipulation, form handling, include and require statements,

file handling, Error Handling and Reporting ,Introduction to Object-oriented PHP, Using GET, POST, SESSION and COOKIE variables, MySQL with PHP: built-in database functions, connecting to a MySQL, selecting a database, building and sending query to database engine, retrieving, updating and inserting data

SECTION-1I

Cloud Computing: Introduction, Definition, Characteristics, Components, Cloud Service Models: SaaS, PaaS, IaaS, Cloud provider, benefits and limitations, Cloud computing vs. Cluster computing vs. Grid computing. Infrastructure as a Service (IaaS): Virtualization Technology: Different approaches to virtualization, Cloud file-systems: GFS and HDFS, BigTable, Features and comparisons among GFS, HDFS etc. Map-Reduce: Parallel computing, The map-Reduce model, Example/Application of Map-reduce, PaaS: Introduction to PaaS - What is PaaS, Service Oriented Architecture (SOA). SaaS: Introduction to SaaS, Web services, Web 2.0, Web OS, Service Management in Cloud Computing:Service Level Agreements(SLAs) , Cloud Security:Infrastructure Security - Network level security, Host level security, Application level security. Risk in Cloud computing,cloud security services.

List of Tutorials: (Any Three)

1) Learn various HTML tags

2) Use of CSS tags in web page designing

3) Understand use of Javascript objects in web page designing

4) Configuration and Installation of PHP

5) Web based application development using AJAX framework

6) Setup and configure cloud environment

7) Study of IBM cloud

8) Deploy and manage cloud environment

9) Study of performing Data, ML task in cloud

10) Study of cloud security tools

List of Practicals: (Any Six)

1) Design a web page to demonstrate the use of different HTML tags and use of inline, internal and external CSS.

2) Design a HTML form for student registration and perform validation using JavaScript.

3) Design a web page demonstrating various effects using jQuery.

4) Write a PHP program to create a simple calculator that can accept two numbers and perform operations like add, subtract, multiplication and divide.

5) Write a PHP Script to perform file handling operations like creating, reading, copying,

moving, deleting, updating and uploading.

6) Design a dynamic web application using PHP and MYSQL as back-end for student data with insert, delete, view and update operation.

7) Implement application using NoSQL for cloud

8) Implement application using Map-Reduce for cloud

9) Implement SaaS application and host it on Cloud Platform

10) Create a local repository using git on a Linux instance running in EC2

11) Create an Amazon Virtual Private Cloud (Amazon VPC)

12) Install and configure google app engine

List of Projects:

1. Student Registration System

2. Tours and Travel System

3. Canteen Food Ordering and Management System.

4. Online personal counseling

5. Online recruitment System

6. Farming Assistant Web Service

7. Cloud based Attendance system

8. University campus online automation using Cloud

9. Cloud based student information chatbot

10. E-learning platform using cloud computing

List of Course Seminar Topics:

1. EJB

2. Bootstrap

3. Spring Framework

4. Joomla

5. Progressive Web Apps

6. Servlet

7.Object Oriented PHP

8. Client side technology

9. Server side technology

10. Web Technology frameworks

List of Course Group Discussion Topics:

1. Cloud Service Models

2. Cloud computing vs. Cluster computing vs. Grid computing

3. Virtualization

4. Cloud file-systems

5. Cloud data stores

6. Databases on Cloud

7. Map-Reduce model for Cloud

8. Data security and Storage for Cloud

9. Application security for Cloud
10. Commercial and business risk and opportunities in Cloud

List of Home Assignments:

Design:

1. Design, Develop and Deploy social web applications using Bootstrap.
2. Design, Develop and Deploy web applications using CMS.
3. Design, Develop and Deploy web application for department/college
4. Design Local Train ticketing system using Cloud
5. Design online Book-store system using Cloud

Case Study:

1. Secure file storage in Cloud
2. AWS
3. e-Bug tracking in Cloud
4. Rural Banking using Cloud
5. Wordpress
6. Angular JS

Blog:

1. Recent web development trends
2. Databases for web developers
3. Web services
4. Private Vs Public Cloud
5. Storage and Energy efficient Cloud computing
6. Openstack Vs Cloudstack

Surveys:

1. Comparison of web services
2. Frameworks for web development
3. Scripting languages for Web Designing.
4. Public cloud security
5. Cloud based Improved file handling

Suggest an assessment Scheme:

1.Home Assignment

2.MSE/ESE

3.CVV

4.Seminar

5.Group Discussion

6.LAB-Course Assignment and Project Evaluation

Text Books:

1.Thomas A. Powell; "Complete reference HTML"; 4th edition, Tata McGraw-Hill Publications

2. Black book; "Web Technologies:HTML,JS,PHP,Java,JSP,ASP.NET,XML and AJAX" ; Dreamtech Press, 2016.

3.Dave Mercer, Allan Ken; "Beginning PHP 5"; Dreamtech Publications.

4. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, "Cloud Computing for Dummies", Wiley India.

5. Ronald Krutz and Russell Dean Vines, "Cloud Security", Wiley-India

Reference Books:

1. Jeremy McPeak& Paul Wilton; "Beginning JavaScript"; 5th Edition, Wrox Publication.

2. Robin Nixon; " Learning PHP, MySQL, JavaScript, CSS and HTML 5";4th Edition,'Reilly publication.

3. Barrie Sosinsky, "Cloud Computing Bible", Wiley India

4. Antohy T Velte, et.al, "Cloud Computing : A Practical Approach", McGraw Hill.

5. McGraw Hill, "Cloud Computing", Que Publishing.

Moocs Links and additional reading material:

1. www.nptelvideos.in
2. https://www.udemy.com
3. https://learn.saylor.org
4. https://www.coursera.org
5. https://swayam.gov.in
6. https://www.w3schools.com

Course Outcomes:

The student will be able to –

1) Design reliable, efficient, scalable front end view of web pages using HTML5, CSS with Bootstrap framework.

2) Perform client side web page validation.

3) Deliver realistic and extensible lightweight web application using PHP

4) Illustrate the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud.

5) Develop solution for a given business case using Map-Reduce model, resource virtualization and deploy on cloud

6) Understand risk management and security in cloud computing

CO PO Map:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		3							3	3				3	
CO2	2				3							2				
CO3	2	2			2				3							
CO4	3	2											3			
CO5	3	2				3	3	3	3			2				3
CO6	2	3		3	2								2	3		

CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	1	3	3	2	4	3

Future Courses Mapping: Advance web technology

Job Mapping: Web developer, Front end developer, Back end developer, Full stack developer, cloud architect, cloud developer,cloud engineer

IT3215:Design and Analysis of Algorithms

Course Prerequisites: Basic programming Skills, Data structures, Discrete Structures.

Course Objectives:

1. To understand asymptotic notations and apply suitable mathematical techniques to find asymptotic time and space complexities of algorithms.
2. To provide students with foundations to deal with a variety of computational problems using different design strategies.
3. To select appropriate algorithm design strategies to solve real world problems.
4. To understand notions of NP-hardness and NP-completeness and their relationship with the intractability of decision problems.
5. To understand randomized, approximation algorithms for given computational problems.

Credits:5 **Teaching Scheme Theory:**3 Hours/Week

Tut: 1 Hour/Week

Lab:2 Hours/Week

Course Relevance: This is an important course for Information Technology Engineering. It develops algorithmic thinking capability of students. Designing algorithms using suitable paradigms and analyzing the algorithms for computational problems has a high relevance in all domains of IT (equally in Industry as well as research). Once the student gains expertise in Algorithm design and in general gains the ability of Algorithmic thinking, it facilitates systematic study of any other domain (in IT or otherwise) which demands logical thinking. This course is also relevant for students who want to pursue research careers in theory of computing, computational complexity theory, and advanced algorithmic research.

SECTION-1

Basic introduction to time and space complexity analysis: Asymptotic notations (Big Oh, small oh, Big Omega, Theta notations). Best case, average case, and worst-case time and space complexity of algorithms. Using Recurrence relations and Mathematical Induction to get asymptotic bounds on time complexity. Master’s theorem and applications. Proving correctness of algorithms.

Divide and Conquer: General strategy, Binary search and applications, Analyzing Quick sort, Merge sort, Counting Inversions, finding a majority element, Josephus problem using recurrence, Efficient algorithms for Integer arithmetic (Euclid's algorithm, Karatsuba's algorithm for integer multiplication, fast exponentiation).

Greedy strategy: General strategy, Analysis and correctness proof of minimum spanning tree and shortest path algorithms, fractional knapsack problem, Huffman coding,conflict free scheduling.

Dynamic Programming: General strategy, Principle of Optimality, simple dynamic programming-based algorithms to compute Fibonacci numbers, binomial coefficients, Matrix Chain multiplication, Optimal binary search tree (OBST) construction, Coin change problem, 0-1 Knapsack, Traveling Salesperson Problem, Bellman Ford shortest path algorithm, longest increasing subsequence problem, Largest independent set for trees.

SECTION-II

Backtracking strategy: General strategy, n-queen problem, backtracking strategy for some NP Complete problems (e.g., graph coloring, subset sum problem)

Branch and Bound strategy: Control abstraction for LIFO, Least Cost Search and FIFO branch and bound, 0-1 knapsack problem using LC branch and bound

Computational Complexity classes: Complexity classes P, NP, NP complete, NP Hard and their interrelation, Notion of polynomial time reduction, Cook-Levin theorem and implication to P versus NP question, Satisfiability Problem,NP-hardness of halting problem, NP-Complete problems (some selected examples).

Introduction to Randomized and Approximation algorithms: Introduction to randomness in computation, Las-Vegas and Monte-Carlo algorithms, Abundance of witnesses/solutions and application of randomization, randomized quick sort, Introduction to Approximation algorithms for NP-optimization problems (like Vertex Cover).

List of Tutorials: (Any Three)

1. Divide and conquer strategy and its applications
2. Asymptotic notations
3. Greedy Algorithms Vs. Dynamic Programming strategy
4. Backtracking vs Branch and bound
5. Comparison of P Vs NP problems
6. Applications of randomized algorithms
7. Applications of Approximation algorithms
8. Reducing NP problems to Integer Linear Programming

List of Practical: (Any Six)

1. Assignment based on some simple coding problems on numbers, graphs, matrices
2. Assignment based on analysis of quick sort (deterministic and randomized variant)
3. Assignment based on Divide and Conquer strategy (e.g. majority element search, finding kth rank element in an array)
4. Assignment based on Divide and Conquer strategy (e.g. efficient algorithm for Josephus problem using recurrence relations, fast modular exponentiation)
5. Assignment based on Dynamic Programming strategy (e.g. Matrix chain multiplication, Longest increasing subsequence)
6. Assignment based on Dynamic Programming strategy (e,g, All pair shortest path, Traveling Sales Person problem)
7. Assignment based on Greedy strategy (e.g. Huffman encoding, fractional knapsack problem)
8. Assignment based on Backtracking (e.g. graph coloring, n-queen problem)
9. Assignment based on Las-Vegas and Monte-Carlo algorithm for majority element search
10. Assignment based on factor-2 approximation algorithm for metric-TSP

List of Projects:

1.Applications of A* algorithm in gaming

2. Pac-Man game

3. Creation / Solution of Maze (comparing the backtracking-based solution and Dijkstra's algorithm)

4. Different exact and approximation algorithms for Travelling-Sales-Person Problem

5. Knight tour algorithms

6. Network flow optimization and maximum matching

7. AI for different games such as minesweeper, shooting games, Hex, connect-4, sokobanetc

8. SUDOKU solver

9. Algorithms for factoring large integers

10. Randomized algorithms for primality testing (Miller-Rabin, Solovay-Strassen)

11. Slider puzzle game

List of Course Seminar Topics:

1. Complexity classes

2. Space complexity

3. Divide and Conquer Vs Dynamic Programming

4. Greedy strategy Vs Backtracking strategy

5. Dynamic Programming Vs Greedy

6. Computational Complexity

7. Comparison of P Vs NP problems

8. Compression Techniques

9. Approximation algorithms

10. Pseudorandom number generators

List of Home Assignments:

Design:

1. Divide and Conquer strategy for real world problem solving
2. Dynamic Programming strategy for real world problem solving
3. Problems on Randomized Algorithms
4. Problems on Approximation Algorithms
5. Problems on NP completeness

Case Study:

1. Encoding techniques
2. Network flow optimization algorithms
3. Approximation algorithms for TSP
4. Sorting techniques
5. AKS primality test

Blog:

1. How to decide suitability of Approximation Algorithms
2. When do Randomized Algorithms perform best
3. Applications of Computational Geometry Algorithms
4. Role of number-theoretic algorithms in cryptography
5. Performance analysis of Graph Theoretic Algorithms

Surveys:

1. Primality Testing Algorithms
2. Integer Factoring Algorithms
3. Shortest Path Algorithms
4. Algorithms for finding Minimum Weight Spanning Tree
5. SAT solvers

Suggest an assessment Scheme:

1. Home Assignment
2. MSE & ESE
3. Seminar
4. LAB-Course Assignment and Project Evaluation

Text Books:

1. *Cormen, Leiserson, Rivest and Stein "Introduction to Algorithms", 3rd edition, 2009. ISBN 81-203-2141-3, PHI*
2. *Horowitz and Sahani, Fundamentals of computer Algorithms, Galgotia, ISBN 81-7371-612-9*
3. *Jon Kleinberg, Eva Tardos "Algorithm Design", 1st edition, 2005. ISBN 978-81-317-0310-6, Pearson*

4.Dasgupta, Papadimitriu, Vazirani "Algorithms", 1st edition (September 13, 2006), ISBN-10:9780073523408, ISBN-13: 978-0073523408, McGraw-Hill Education

Reference Books:

1. *Anany Levitin, "Introduction to the Design & Analysis of Algorithm", Pearson, ISBN 81- 7758-835-4.*
2. *Gilles Brassard, Paul Bratle, Fundamentals of Algorithms, Pearson, ISBN 978-81-317-1244-3.*
3. *Motwani, Raghavan "Randomized Algorithms", 1st edition (August 25, 1995), ISBN-10:0521474655, ISBN-13: 978-0521474658, Cambridge University Press*

4.Vazirani, "Approximation Algorithms", ISBN-10: 3642084699, ISBN-13: 978-3642084690,Springer (December 8, 2010)

Moocs Links and additional reading material:

1. https://nptel.ac.in
2. https://www.udemy.com

3. https://www.coursera.org

4. https://www.geeksforgeeks.org

Course Outcome:

The student will be able –

1. To formulate computational problems mathematically.
2. To apply appropriate algorithmic paradigm to design efficient algorithms for computational problems.
3. To apply suitable mathematical techniques to analyze asymptotic complexity of the algorithm for a complex computational problem.
4. To understand the significance of NP--completeness of some decision problems and its relationship with intractability of the decision problems.
5. To understand significance of randomness, approximability in computation and design randomized and approximation algorithms for suitable problems.
6. To incorporate appropriate data structures, algorithmic paradigms to craft innovative scientific solutions for complex computing problems.

CO-PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3							3							
CO2	1		3	2		3	1							2		3
CO3	3			3	3				3			3	2			3
CO4		3		3						2				3		
CO5	2		3												2	
CO6	3	3			3								2			

CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	1	3	2	3	4	4

Future Courses Mapping: Advanced Algorithms, Computational Geometry, Algorithmic Number Theory, Algorithmic Graph Theory, Motion planning and Robotics

Job Mapping: Algorithm design is an essential component of any job based on programming.All Industries in IT Engineering always look for a strong knowledge in Algorithm design andData structures for positions like Developer, Architect, Principal Engineer, Backend leadengineer, Full stack developers, Solution architect, Solution / Senior engineer, technical leadetc.

IT3216: Machine Learning and Deep Learning

Course Prerequisites: Linear Algebra, Statistics, Calculus, and Probability Basics

Course Objectives:

1. Understanding Human learning aspects.
2. Acquaintance with primitives in the learning process by computer.
3. Understanding the nature of problems solved with Machine Learning and Deep Learning.
4. To study different Machine learning algorithms.
5. To study different Deep learning algorithms.
6. To understand the application development process using ML and DL

Credits: 5 **Teaching Scheme Theory:** 3Hours/Week

Tut: 1Hours/Week

Lab: 2Hours/Week

Course Relevance: Machine Learning and Deep Learning are disruptive technologies. Powered by data science, machine learning and Deep Learning makes our lives easier. When properly trained, they can complete tasks more efficiently than a human. Understanding the possibilities and recent innovations of ML technology and Deep Learning are important for businesses so that they can plot a course for the most efficient ways of conducting their business. It is also important to stay up to date to maintain competitiveness in the industry.

SECTION-I

Topics and Contents

Topics and Contents

Introduction: What is Machine Learning, Examples of Machine Learning applications, Training versus Testing, Positive and Negative Class, Cross-validation, Mathematical models.

Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning.

Regression and Generalization: Regression: Linear and Logistic Regressions, Assessing performance of Regression – Error measures, Overfitting and Underfitting, Catalysts for Overfitting, Univariate Regression, Multivariate Linear Regression.

Classification: Binary and Multiclass Classification: Assessing Classification Performance, Handling more than two classes, Perceptron, Support Vector Machines (SVM), Soft Margin

SVM, KNN Algorithm, Naïve Bayes Classifier, Decision Tree and Random Forest.
Clustering: Distance Based Models: Distance based clustering algorithms - K-means and C-means, Hierarchical clustering, Association rules mining – Apriori Algorithm, Confidence and Support parameters.

SECTION-II

Topics and Contents

Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis.

Trends in Machine Learning: Ensemble Learning: Combining Multiple Models, Bagging, Randomization, Boosting, Stacking Reinforcement Learning: Exploration, Exploitation, Rewards, Penalties.

Deep Learning: Introduction to deep learning, Neural Network Basics , Batch Normalization, The Neuron, Expressing Linear Perceptron as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons. Shallow Neural Network and Deep Neural Networks. Attacking neural networks with Adversarial Examples and Generative Adversarial Networks, Practical aspects of deep learning, Optimization algorithms, Hyperparameters Tuning, Batch Normalization.

Deep Learning Strategy: A guide to convolution arithmetic for deep learning, Is the deconvolution layer the same as a convolutional layer?, Visualizing and Understanding Convolutional Networks, Deep Inside Convolutional Networks: Types of CNN, Visualizing Image Classification Models and Saliency Maps, Understanding Neural Networks Through Deep Visualization, Learning Deep Features for Discriminative Localization

List of Tutorials: (any six)

1. Feature Selection Techniques
2. Supervised Learning
3. Unsupervised Learning
4. Reinforcement Learning
5. Collaborative filtering
6. Q Learning
7. Item based Recommender system
8. Real time applications
9. Shallow Neural Networks
10. Key concepts on Deep Neural Networks
11. Practical aspects of deep learning ,Optimization Algorithms
12. Hyperparameter tuning, Batch Normalization, Programming Frameworks
13. Bird recognition in the city of Peacetopia (case study)
14. Autonomous driving (case study)
15. The basics of ConvNets
16. Deep convolutional models
17. Keras Tutorial
18. Detection Algorithms
19. Special Applications: Face Recognition & Neural Style Transfer
20. Natural Language Processing and Word Embeddings
21. Sequence Models and Attention Mechanism

List of Practicals: (Any Six)

1. Normalization
2. Detection
3. Optimization
4. Classification
5. Clustering
6. Regression Analysis
7. Collaborative filtering
8. Recommender systems

9.Planar data classification with a hidden layer

10. Building your Deep Neural Network: step by step
11. Deep Neural Network – Application
12. Initialization, Regularization, Gradient Checking, Optimization
13. Tensorflow
14. Convolutional Model: step by step,
15. Convolutional Model: application
16. Residual Networks
17. Car Detection with YOLO

18.Art Generation with Neural Style Transfer

19.Face Recognition

20.Dinosaur Land -- Character-level Language Modeling

21.Jazz improvisation with LSTM

22.Operations on Word Vectors – Debiasing

23. Trigger Word Detection

List of Projects:

1. chat bot
2. stock market prediction
3. sentiment analysis
4. Iris Flowers Classification Project.
5. Housing Prices Prediction Project.
6. MNIST Digit Classification Project.
7. Stock Price Prediction using Machine Learning.
8. Fake News Detection Project.
9. Bitcoin Price Predictor Project.
10. Uber Data Analysis Project.
11. Credit Card Fraud Detection Project.
12. Plant-Disease-Identification-usingCNN Speech-Separation
13. Analysing and predicting crypto currency prices
14. Handwritten character recognition system
15. Predicting Consumer Purchase intention using Twitter Data
16. MovieRecommender
17. How can you predict social influencers?
18. Text Simplification
19. Facial Expression analysis
20. Object Detection

List of Course Seminar Topics:

1. Validation
2. Naive Bayes Algorithm
3. Machine And Privacy
4. Limitations of ML
5. Ensemble Learning
6. Dimensionality reduction algorithms
7. Comparison of Machine Learning algorithms
8. Feature Extraction In Machine Learning
9. Reinforcement Learning
10. Probabilistic Model
11. Dropout: a simple way to prevent neural networks from overfitting,
12. Deep Residual Learning for Image Recognition
13. Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate ShiftLarge-Scale
14. Video Classification with Convolutional Neural NetworksGenerative adversarial nets
15. High-Speed Tracking with Kernelized Correlation Filters
16. Do we need hundreds of classifiers to solve real world classification problems
17. Scalable Nearest Neighbor Algorithms for High Dimensional Data
18. A survey on concept drift adaptation
19. Simultaneous Detection and Segmentation

List of Course Group Discussion Topics:

1. Supervised Vs Unsupervised
2. Univariate Vs Multivariate analysis
3. Accuracy measuring methods
4. Bias Vs Variance Tradeoff
5. Data Reduction Vs Dimensionality reduction
6. Continuos Vs Discrete variables

7.Feature Extraction Vs Automatic Feature detection

8. RNN Vs LSTM
9. Sentence Classification using Convolutional Neural Networks
10. Dog-breed Classifier
11. Generate TVScripts
12. Generate Faces
13. Factoid Question Answering

14..Neural Summarization

15. Dialogue Generation withLSTMs

List of Home Assignments:

Design:

1. Propensity to Foreclose:Predicting propensity of the customer to foreclose their loans. The objective is to retain the customer for the maximum tenure.
2. Portfolio & Price Prediction for Intra-day trades:Price movement prediction using a masked set of features - This involves predicting short-term to mid-term price movements using a combination of multiple features.

3. Smart Building Energy Management System using Machine Learning

4. Quick analysis of quality of cereals, oilseeds and pulses using ML

5. Video Library Management System using Machine Learning

6. Building a Recurrent Neural Network

7. Character level Dinosaur Name generation

8. Music Generation

9. Operations on Word vectors

10. Neural Machine translation with attention

Case Study:

1. Product Recommendation: Given a purchase history for a customer and a large inventory of products, identify those products in which that customer will be interested and likely to purchase. A model of this decision process would allow a program to make recommendations to a customer and motivate product purchases. Amazon has this capability. Also think of Facebook, GooglePlus and LinkedIn that recommend users to connect with you after you sign-up.

2. Medical Diagnosis: Given the symptoms exhibited in a patient and a database of anonymized patient records, predict whether the patient is likely to have an illness. A model of this decision problem could be used by a program to provide decision support to medical professionals.

3. Stock Trading: Given the current and past price movements for a stock, determine whether the stock should be bought, held or sold. A model of this decision problem could provide decision support to financial analysts.

4. Customer Segmentation: Given the pattern of behaviour by a user during a trial period and the past behaviors of all users, identify those users that will convert to the paid version of the product and those that will not. A model of this decision problem would allow a program to trigger customer interventions to persuade the customer to covert early or better engage in the trial.

5. Shape Detection: Given a user hand drawing a shape on a touch screen and a database of known shapes, determine which shape the user was trying to draw. A model of this decision would allow a program to show the platonic version of that shape the user drew to make crisp diagrams. The Instaviz iPhone app does this.

6. AlexNet

7. VGG

8. Inception

9. ResNet

10. YOLO

Blog

1. Focusing Too Much on Algorithms and Theories.
2. Mastering ALL of ML.
3. Having Algorithms Become Obsolete as Soon as Data Grows.
4. Getting Bad Predictions to Come Together With Biases.
5. Making the Wrong Assumptions.
6. Receiving Bad Recommendations.
7. Having Bad Data Convert to Bad Results.
8. Open AI
9. ComputerVision
10. Google Brain
11. Deep Learning and Natural Language Processing
12. Multi-task Learning and Transfer Learning

Surveys

1. Concept learning

2. reinforcement learning

3. semi supervised learning

4. deep learning
5. transfer learning
6. Deep Neural Networks in Speech and Vision Systems
7. GANs
8. Deep Learning for big data
9. Deep Learning for NLP
10. Transfer Learning

Suggest an assessment Scheme:

MSEPPT Presentation ESE GD Tut Viva Lab assignments.+Course Project

Text Books:

1. *T. Mitchell, " Machine Learning", McGraw-Hill, 1997.*
2. *Anup Kumar Srivastava, Soft Computing, Alpha Science International limited. 2009.*
3. *Deep Learning with Python by François Chollet, Manning Publications Co, ISBN: 9781617294433*
4. *Deep Learning - A Practical Approach by Rajiv Chopra, Khana Publications, ISBN: 9789386173416*

Reference Books:

1. EthemAlpaydin, "Introduction to Machine Learning", MIT press, 2004.
2. Jacek M. Zurada, "Introduction to Artificial neural System", JAICO publishing house,2002,.
3. Deep Learning by Ian Goodfellow and YoshuaBengio and Aaron CourvillePublished by An MIT Press book

Moocs Links and additional reading material:

www.nptelvideos.in

Course Outcomes:

1. Explore Different Machine Learning Techniques.
2. Evaluate Regression and Classifier Algorithms.
3. Use different Clustering Algorithms to different objects.
4. Acquaint with Trends in Machine Learning
5. Analyse Deep Neural Network.
6. Understand functionality of all layers in a convolutional neural network and Recurrent Neural Networks.

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2			3								3			
CO2	3	3			2									3		
CO3	2				3								2			
CO4	3	3		2		2	2	2	2	2		3				3
CO5	3			3											2	
CO6	2		3										2			

Future Courses Mapping:

MS in Machine Learning, MS in Deep learning

Job Mapping: ML Engineer, Data Scientist, DL Engineer

IT3202: System Programming

Course Prerequisites: Data structures, programming in C/C++/Java

Course Objectives:

1. To introduce students the concepts and principles of system programming and to enable them to understand the duties and scope of a system programmer.
2. To provide students the knowledge about both theoretical and practical aspects of system programming, teaching them the methods and techniques for designing and implementing system-level programs.
3. To train students in developing skills for writing system software with the aid of sophisticated OS services, programming languages and utility tools.
4. To train students in developing skills for writing compiler from scratch
5. To understand encoding-decoding of instruction set for a new machine.

Credits: 5 **Teaching Scheme Theory:** 3 Hours/Week

Tut: 1 Hours/Week

Lab: 2 Hours/Week

Course Relevance: This course is helpful in designing different system softwares like operating systems, compilers and device drivers etc.

SECTION-1
Introduction: software types, software hierarchy, components of system software, machine structure, interfaces, address space, levels of system software, recent trends in software development. Language processors: Programming languages and language processors, fundamentals of language processing, life cycle of a source program, language processing activities, data structures for language processing: search data structures, allocation data structures. Macroprocessor: Introduction, macro definition and call, macro expansion, nested macro calls, design of macro processor, design issues of macro processors, two-pass macro processors, one-pass macro processors. Assembler: Elements of assembly language programming, design of the assembler, assembler design criteria, types of assemblers, two-pass assemblers, one-pass assemblers, assembler algorithms, multi-pass assemblers, variants of assemblers design of two

pass assembler, machine dependent and machine independent assembler features. Allocation, relocation, linker v/s loader.

Linkers and Loaders: relocation and linking concepts, static and dynamic linker, subroutine linkages, Linking of Overlay Structured Programs, dynamic linking libraries, MSDOS linker. Loaders: Introduction to Loader, Sequential and Direct Loaders, loader Schemes compile and go loader, general loader scheme, absolute loader, relocating loader, dynamic linking loader.

SECTION-II

Systems Programming for Linux as Open Source OS: Essential concepts of linux system programming, APIs and ABIs, standards, program segments/sections, the elf format, linking and loading, linux dynamic libraries (shared objects), dynamic linking,API compatibility, dynamically linked libraries.

Advanced system programming concepts: Operating system interfaces, stack smashing. Multitasking and paging, address translation, memory protection, comparison with windows.

Compilers: Introduction to Compiler phases, Introduction to cross compiler, Features of machine dependent and independent compilers, types of compilers.

Interpreters: Compiler Vs. Interpreter, phases and working. Debuggers: Types of errors, debugging procedures,classification of debuggers, dynamic/interactive Debugger. Lexical Analyzer, Specification and Recognition of Tokens, LEX, Expressing Syntax, Top-Down Parsing, Predictive Parsers. Bottom-Up Parsing, LR Parsers: constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, YACC. Encoding and decoding schemes for the X-86 processor. Device Driver: Types of drivers, driver history, driver issues, kernel level device drivers, virtual device drivers (VxD), device driver stack buses and physical devices, static device drivers, dynamic device drivers, PnP, device namespace, and named devices. TSR: types, structure, details of TSR loading, examples, writing TSRs.

List of Tutorials: (Any Three)

1) File handling basics

2) Debugging concepts

3) logic development for implementing assignments

4) Booting process and system files

5) Inbuilt drivers structure of Linux

6) Study of Linkers

7) Study of Loaders

8) Different DLL

9) Paging

10)Segmentation

List of Practicals: (Any Six)

1)Design and implementation of an Editor: Design of a Line or Screen Editor using C Language.
2)Simulation of linkers.

3)Simulation of loaders.

4)Understanding the design for DLL on Linux shared library.

5)Use of different debugger tools.

6)Printer controller in device drivers.

7)Write a TSR program in 8086 ALP to implement Real Time Clock (RTC). Read the Real Time from CMOS chip by suitable INT and FUNCTION and display the RTC at the bottom right corner on the screen. Access the video RAM directly in your routine.
8)Write a TSR program in 8086 ALP to implement Screen Saver. Screen Saver should get activated if the keyboard is idle for 7 seconds. Access the video RAM directly in your routine.
9)Write a TSR program in 8086 ALP to handle the "Divide by zero" interrupt. Test your program with a small code, which causes the divide by zero interrupt.
10)Write a TSR program in 'C' that would change the color of the screen every 10 seconds.

List of Projects:

1. Design Macroprocessor
2. Design One pass Assembler
3. Design Two pass Assembler
4. Design direct linking loader

5. Mouse driver for Linux
6. USB driver for Linux
7. Keyboard driver for Linux
8. Implement a Lexical Analyzer using LEX for a subset of C.
9. Design and implementation of DLL on Linux shared library
10. Design a device driver on Linux system

List of Course Seminar Topics:

1. Macro processor design
2. Assembler design
3. machine dependent and machine independent assembler features
4. linker v/s loader
5. Structured Programs
6. MSDOS linker
7. dynamic linking loader.
8. dynamic linking libraries
9. static and dynamic linker with subroutine linkages
10. Linux linking schemes

List of Course Group Discussion Topics:

1. Windows Vs Linux OS
2. Application Programming Vs System Programming
3. Carrers in Application Programming Vs System Programming
4. API Vs ABI
5. Single pass Vs multipass strategy
6. Compiler Vs Interpret

List of Home Assignments:

Design:

1. Design and implementation of 2 Pass Macroprocessor.
2. Design and implementation of 2 Pass Assembler.
3. Simulation of linker & loader.
4. Implement a Lexical Analyzer using LEX for a subset of C.
5. Design and implementation of DLL on Linux shared library.
6. Design a device driver on Linux system.

Case Study:

1. Linux OS system architecture
2. Windows OS system architecture
3. Android OS system architecture
4. MAC OS system architecture
5. New trends in linker and loaders

Blog:

1. PASS-I Assembler
2. PASS-II Assembler
3. Macro expansion Algorithm
4. Macro Definition Algorithm
5. Machine Language Instruction Generation from Assembly Language Instruction
6. Language Processor Pass

7. Procedure vs Problem Oriented Languages
8. Macro Expansion and Macro definition
9. Linux File System
10. Device Drivers
11. Dynamic Link Library
12. BIOS
13. DOS
14. LINKER
15. LOADER

Surveys:

1. Display drivers
2. Network drivers
3. Printer drivers
4. New trends in device drivers design
5. Driver adaptability

Suggest an assessment Scheme:

1. Home Assignment
2. MSE & ESE
3. Quiz
4. Seminar
5. Group Discussion
6. LAB-Course Assignment and Project Evaluation

Text Books:

1. D M Dhamdhere, "Systems Programming & Operating Systems", Tata McGraw Hill Publications, ISBN – 0074635794

2. John J Donovan, "Systems Programming", ISBN - 0070176035

Reference Books:

1. Robert Love, "Linux System Programming", O'Reilly, ISBN 978-0-596-00958-8

Moocs Links and additional reading material:

1. www.nptelvideos.in

Course Outcomes:

The student will be able to –

1. Discriminate among different System software and their functionalities.
2. Design language translators like Macroprocessor and Assembler.
3. Develop approaches and methods for implementing linker and loader.
4. Identify and interpret the different phases of a compiler and their functioning.
5. Design a well-structured system to ensure the syntactic and semantic correctness of a program.
6. Interpret the methods and techniques about instructions Encoding and Decoding for implementing system-level programs and Device Drivers.

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3								1						
CO2	3		3		3				3	3	3				2	
CO3	3		3			3		2								3
CO4	3	2		3												
CO5	1		3				3	3	3	3	3	3			3	
CO6	2				2								3	3		

CO attainment level:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	1	2	3	4	5	2

Future Courses Mapping: Linux system programming
Job Mapping: System Programming, System Engineer, Opportunities in companies like Nvidia

IT3211: Engineering Design and Innovation-VI

Course Prerequisites: Problem Based Learning

Course Objectives:

1. To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problems.

2. To Evaluate alternative approaches, and justify the use of selected tools and methods,

3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.

4. To engage students in rich and authentic learning experiences.

5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

6.To develop an ecosystem to promote entrepreneurship and research culture among the students.

Credits: 4 **Teaching Scheme Theory:** 1 Hours/Week

Lab: 6 Hours/Week

Course Relevance: Project Centric Learning (PCL) is a powerful tool for students to work inareas of their choice and strengths. Along with course based projects, curriculum can be enrichedwith semester long Engineering Design and Development courses, in which students can solvesocially relevant problems using various technologies from relevant disciplines. The varioussocially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City,Smart Energy and Swaccha Bharat Abhiyan. To gain the necessary skills to tackle such projects,students can select relevant online courses and acquire skills from numerous sources underguidance of faculty and enrich their knowledge in the project domain, thereby achieving projectcentric learning. Modern world sustained and advanced through the successful completion ofprojects. In short, if students are prepared for success in life, we need to prepare them for aproject-based world. It is a style of active learning and inquiry-based learning. Project basedlearning will also redefine the role of teacher as mentor in the learning process. The PCL modelfocuses the student on a big open-ended question, challenge, or problem to research and respondto and/or solve. It brings students not only to know, understand and remember rather it takesthem to analyze, design and apply categories of Bloom’s Taxonomy.

SECTION-I

Topics and Contents

Preamble - The content and process mentioned below is the guideline document for thefaculties and students to start with. It is not to limit the flexibility of faculty and students;rather they are free to explore their creativity beyond the guideline mentioned herewith. For allcourses of ED, laboratory course contents of "Trends in Engineering Technology" aredesigned as a ladder to extend connectivity of software technologies to solve real wordproblem using interdisciplinary approach. The ladder in the form of gradual steps can be seenas below:

Industry Communication Standards, Single Board Computers and IoT, Computational Biology(Biomedical and Bioinformatics), Robotics and Drone, Industry 4.0 (Artificial Intelligence,Human Computer Interfacing, 5G and IoT, Cloud Computing, Big Data and Cyber Securityetc).

Group Structure:

· There should be team/group of 4-5 students.

· A supervisor/mentor teacher assigned to individual groups.

· It is useful to group students of different abilities and nationalities together.

Selection of Project/Problem:

· Students must focus to initiate the task/idea .The idea inception and consideration shallbe from following areas as a real world problem:

Health Care, Agriculture, Defense, Education, Smart City, Smart Energy, Swaccha BharatAbhiyan, Environment, Women Safety.

This is the sample list to start with. Faculty and students are free to include other areawhich meets the society requirements at large.

The model begins with the identifying of a problem, often growing out of a question or"wondering". This formulated problem then stands as the starting point for learning.

Students design and analyze the problem/project within an articulated disciplinary subjectframe/domain.

· A problem can be theoretical, practical, social, technical, symbolic, cultural, and/orscientific and grows out of students' wondering within different disciplines and professionalenvironments. A chosen problem has to be exemplary. The problem may involve aninterdisciplinary approach in both the analysis and solving phases.

· By exemplarity, a problem needs to refer back to a particular practical, scientific,social and/or technical domain. The problem should stand as one specific example ormanifestation of more general learning outcomes related to knowledge and/or modes ofinquiry.

Teacher's Role in PCL :

· Teacher is not the source of solutions rather he will they act as the facilitator and mentor.

· To utilize the principles of problems solving, critical thinking and metacognitive skills ofthe students.

· To aware the group about time management.

· Commitment to devote the time to solve student's technical problems and interested inhelping students to empower them better.

Student's Role in PCL:

· Students must have ability to initiate the task/idea .they should not be mere imitators.

· They must learn to think.

· Students working in PCL must be responsible for their own learning.

· Students must quickly learn how to manage their own learning, Instead of passivelyreceiving instruction.

· Students in PCL are actively constructing their knowledge and understanding of thesituation in groups.

· Students in PCL are expected to work in groups.

· They have to develop interpersonal and group process skills, such as effective listening orcoping creatively with conflicts.

Developing Inquiry Skills:

· Students in PCL are expected to develop critical thinking abilities by constantly relating:

What they read to do? What they want to do with that information?

· They need to analyze information presented within the context of finding answers.

· Modeling is required so that the students can observe and build a conceptual model of therequired processes.

· Use following mechanism to maintain the track of moving towards the solution.

· How effective is …….? How strong is the evidence for ……? How clear is ……?

· What are the justifications for thinking? Why is the method chosen?

· What is the evidence given to justify the solution?

Literature Survey – To avoid reinvention of wheel:

· It is integral part of self- directed learning

· Identify the information needed to solve a given problem or issue

· Be able to locate the needed information

· Use the information to solve the given problem effectively.

· Skills required by students in information literacy include:

· How to prepare the search? How to carry out the research

· Sorting and assessing of information in general

Use of Research Methodology: - investigation, collaboration, comprehension, application,analysis, synthesize and evaluation

Focus on following skills while working in a team to reach to solution:

· Collaborative learning

· Interpersonal Skills

· Resources Evaluation

· Metacognitive Skills

Reflection Skills

SECTION-II

EDI Sample Case Studies : -

1) Design of bioinformatics library using CPython for Next-generation Sequencingprocessing and analysis

2) Design of bioinformatics library using CPython for Next-generation Sequencingprocessing and analysis for SAM and BAM processing and analysis

3) Design of bioinformatics library using CPython for Next-generation Sequencing processingand analysis for Gnome NGS processing and analysis

4) Design of bioinformatics library using CPython for Next-generation Sequencingprocessing and analysis for population genetics simulation

5) Design of bioinformatics library using CPython for Next-generation Sequencingprocessing and analysis for proteomics processing and analysis

...not limited to.....Faculty and students are free to include other area which meets thesociety requirements at large.

Suggest an assessment Scheme:

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degreeassessment and check if it covers all aspects of Bloom's Taxonomy.

Higher levels of the Booms Taxonomy - analyze, apply, evaluate and create.

Suggest an assessment Scheme:
MSE Review(50 Marks) and ESE Review(100 Marks) with Jury and Weekly meetings with the project guide

Text Books:

1. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE).ISBN:978-0-9935254-6-9; 2017

2. Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.

3.Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert RobartCapraro, Mary Margaret Capraro

Reference Books:

1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based

learning in engineering. Rotterdam: Sense Publishers. 2007.

2. Project management core textbook, second edition, Indian Edition , by Gopalan.

3. The Art of Agile Development. By James Shore & Shane Warden.

Moocs Links and additional reading material:

1. www.nptelvideos.in

Course Outcomes:
The student will be able to –

1. Identify the projects relevant societal needs
2. Map the technologies learned with the project needs
3. Apply the technological knowledge to design various feasible solution
4. Select best possible possible solution solution to solve the problem
5. Develop/Fabricate a working model of proposed solution
6. Testing and validate product performance

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2			3				2	2			3		
CO2				3	2	2		2							2	
CO3	2		3		3			2	2				3			
CO4		2				3										
CO5			3				2		2						2	3
CO6		2			3				2	3				2		

CO attainment levels
CO1-2
CO2-2
CO3-3
CO4-3
CO5-4
CO5-4
CO6-4

Future Courses Mapping:

Major Project

Job Mapping:

Software Engineer, Software Developer, IT Engineer

IT3220:Project Based on Honor (AI)

Following are the indicative project list mentioning broad areas. Students can do projects in one of the following, a combination of multiple topics or areas which is not mentioned here in consultation with the instructor.

Important Note:- Since this course is a 5 credit course, students are expected to write their own code in the host language and don't use the library functions available for their core work.

Credit: 05

Fuzzy systems or use of fuzzy logic to solve real world problems

1. ANN- feedforward or feedback architecture
2. CNN- for visual object recognition
3. Fuzzy neural networks for pattern recognition
4. Fault detection and diagnosis system
5. Expert system using PROLOG for diagnosis
6. Prediction and forecasting
7. Deep learning architectures for solving real application
8. Pattern classification using statistical, fuzzy or neural classifiers
9. Pattern clustering for real applications
10. GPU based AI project with GPU parallel implementation
11. CPU based AI project with parallel processing using multiple cores
12. Any research oriented work to update basic method in AI
13. Stock market analysis and prediction
14. Multivariate Linear regression and analysis

Course Outcomes:
Identify the projects relevant societal needs. (1)
Map the technologies learned with the project needs (2)
Apply the technological knowledge to design various feasible solution (3)
Select best possible solution to solve the problem (4)
Develop/Fabricate a working model of proposed solution (5)
Testing and validate solution performance (5)
CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2			3				2	2			3		
CO2				3	2	2		2							2	
CO3	2		3		3			2	2				3			
CO4		2				3										
CO5			3				2		2						2	3
CO6		2			3				2	3				2		

Structure Module VII

Course code	Course name	Total number of Contact hours				Credits
		Theory	Lab	Tut	Total Hrs	
MD4206	OE1: Financial Management and Costing	2	-	-	2	2
IT4210	OE2: Machine Learning	2	-	-	2	2
IT4211	OE2:Natural Language Processing					
IT4212	OE2:Advanced Communication Engineering					
IT4216	OE3 : Data management , Protection and Governance	2	-	-	2	2
IT4213	OE3:Deep Learning					
IT4214	OE3:Cloud Computing					
IT4215	Distributed Computing	2	-	-	2	2
IT4205	Major Project	-	20	-	20	10
	Total	**8**	**20**	**-**	**20**	**18**

Structure Module VIII

Subject	BTech Sem1/Sem2 (Internship Module)	Theory	Lab	Tut	Credits
IT4251	Industry Internship	-	40	-	16
OR					
IT4252	International Internship	-	40	-	16
OR					
IT4253	Research Internship	-	40	-	16
OR					
IT4254	Project Internship	-	40	-	16
					Total Credits-16

FF No. : 654

MD4206: Financial Management and Costing

Course Prerequisites:
Basic concepts of cost, profit, loss, debit and credit.

Course Objectives:

Students will be able to:
1. Understand, analyze and interpret financial statements
2. Understand and concept of financial accounting for analysis of financial statements of a business.
3. Develop an ability of decision making about investments.

Credits: 2 **Teaching Scheme Theory: 2** Hours/Week

Course Relevance: Basic knowledge of Finance for working in a industry

SECTION-1

1. Financial Statement Analysis- Nature and Scope of Finance Function; Financial goal profit vs. wealth, Maximization; Scope and Functions of Financial Management, Financial Planning and Forecasting. Budgets & Budgetary Control: Types of Budget, Preparation of Budgets: Operational & Financial Budgets, Financing and Dividend decisions. Types of accounts, bookkeeping, Profit and Loss Account and Balance Sheet, Cash Flow Statement

2. Capital Budgeting and ratio Analysis -Ratio Analysis Classification, Ratio Analysis and its limitations. Types of Ratios, Activity Turnover, Profitability, Liquidity, etc., B: Common Size Statement, Index Statement, Capital Budgeting - Nature of Investment decisions; Investment evaluation criteria - Non-DCF & DCF Techniques, PBP, Discounted PBP, PI, ARR, Annual Worth

3. Working Capital Management - Meaning, significance and types of working capital; calculating operating cycle period and estimation of working capital requirements; sources of working capital, NPV and IRR comparison; Capital rationing. Various committee reports on bank finance; Dimensions of working capital management.

SECTION-1I

4. Introduction to concept of Cost and Overheads - Cost, Cost Centre, Cost Unit, Elements of Cost: Material Cost. Different methods of pricing of issue of materials Labour Cost: Direct & Indirect cost, Different methods, Direct Expenses: Constituents and Significance, Prime Cost, Classification: Production, Office & Administration, Selling & Distribution. Treatment of Overheads: Collection ,Primary and Secondary Distribution and Absorption of Overheads Machine, Labour hour rate, Under/Over Absorption of Overheads, Preparation of Cost Sheet

5. Costing Methods - Job Costing, Unit Costing, Contract Costing, Process Costing, Activity Based Costing Simple numerical on various methods of costing to enable ascertains cost of product. Standard costing: Concept, Standard Cost, Standard costing. Calculation of Variance Numerical on calculation of variances, Variance – Variance Analysis

6. Marginal Costing and Break Even Analysis - Fixed & Variable (Marginal) Cost, Marginal Cost. Applications of Marginal Costing in Decision-making: Product Mix, Profit Planning, Make or Buy Decisions. Limiting Factor, Cost Volume Profit Analysis, Concept of Break-Even, P/V Ratio and Margin of Safety

List of Tutorials: (Any Three)

1.Capital financing
2.Working capital finance
3.Preparation of Journal entries, Ledgers
4.Profit and Loss Account and Balance Sheet
5.Ratio Analysis
6.Investment decisions
7.Product Costing
9.Service Costing.
10.Process Costing

List of Practicals: (Any Six)

1. Case study on sources of capital and working capital
2. Case study on assessment of working capital
3. Studying and understanding Financial Statements - Profit and Loss
4. Studying and understanding Financial Statements - Balance sheet
5. Studying and understanding various financial ratios used in practice
6. Studying and understanding various financial ratios for decision making
7. Case study on Analysis of published results of an organisation – Manufacturing
8. Case study on Analysis of published results of an organisation – Service industry
9. Prepare a cost sheet to estimate the cost of any product10. Prepare a cost sheet any process
11. Case study on use Marginal Costing to determine Break Even Point and profitability
12. Case study on use Marginal Costing to determine profitability

List of Projects:

1.Budgeting including sources of capital financing
2.Budgeting including sources of working capital finance
3.Preparation of Journal entries, Ledgers
4.Preparation Profit and Loss Account and Balance Sheet
5.Preparation of Balance Sheet
6.Ratio Analysis based on real life data from project on Profit and loss and Balance sheet
7.Compare Analysis of published results of organisations to enable investment decision
8.Apply Product Costing to estimate cost of any process used in practice
9.Apply Service Costing to estimate cost of any process used in practice
10.Apply Process Costing to estimate cost of any process used in practice
11.Apply Standard Costing to estimate cost of any process used in practice
12.Apply Marginal Costing to determine Break Even Point and profitability

List of Course Seminar Topics:

1.Sources of Capital Financing
2.Working Capital Management
3.Profit and Loss Account
4.Balance Sheet
5.Turnover and Ratios
6.Taxation
7.Product Costing
8.Service Costing
9.Process Costing
10.Investment Decisions

List of Course Group Discussion Topics:

1. Sources of Capital Financing - Bank or Investors.
2. Working Capital Management - Which is better - Less or More?
3. Profit and Loss Account
4. Balance Sheet - Effect on share prices.
5. Turnover and Ratios - which should be focused on?
6. Taxation - Fair or Unfair in India
7. Product Costing - does it drive Profits or Markets?
8. Service Costing - Quality or Cost?
9. Process Costing - Automation or Manual Labour?
10. Investment Decisions - Guts or Statistics?

List of Home Assignments:

Design:

1. Design a cost estimate for running a Shoe Company.
2. Design a cost estimate for running a Fabrication Shop.
3. Design a cost estimate for running an Online Book Company.
4. Design a cost estimate for running a Grocery Company.
5. Design a cost estimate for running a Data Science Company.

Case Studies :

1. Ratio Analysis based on real life data from project on Profit and loss and Balance sheet in any one sector Company (KPO/BPO, Manufacturing, Pharma,....
2. Compare Analysis of published results of organisations to enable investment decision
3. Apply Product Costing to estimate cost of any process used in any one sector Company (KPO/BPO, Manufacturing, Pharma,....
4. Apply Service Costing to estimate cost of any process used in any one sector Company (KPO/BPO, Manufacturing, Pharma,....
5. Apply Process Costing to estimate cost of any process used in any one sector Company (KPO/BPO, Manufacturing, Pharma,....

Blog

1. Taxation
2. Product Costing
3. Service Costing
4. Process Costing
5. Investment Decisions

Surveys

1. Interest Rates
2. Domestic Investment Decisions
3. Industrial Investment Decisions
4. Government Schemes
5. Suggestions about taxation.

Text Books:

1. Prasanna Chandra, Financial Management – Theory and Practi
ce, Edition 8, 2011, Tata McGraw Hill Education,
2. B. K. Bhar, Cost Accounting– Methods and Problems, Academi
c Publishers,1980
3. M.Y. Khan and P K Jain, Financial Management: Text, Proble
ms and Cases, Tata McGraw Hill Education
4. Amitabha Mukherjee and Mohammed Hani, Modern Accountancy, Edition 2, 2002, Tata McGraw Hill Education

Reference Books:

1. Paresh P. Shah, Financial Management, Reprint No. 2 2011, Biztantra, New Delhi,
2. S. N. Maheshwari, Introduction to Accountancy, Edition 11, 2013, Vikas Publishing House
3. M. Y. Khan, P. K. Jain, Management Accounting –Text, Problems, Cases, Edition No. Tata McGraw Hill Publishers, 2013

Course Outcomes:

1.Understand and analyze financial statements and budgeting, interpret accounting ratios
2.Understand the concepts of Capital Budgeting and Working Capital management
3.Understand the mechanics of financial accounting for preparation of financial statements to ascertain the performance and financial position of a business
4.Classify, apply different types of costs and overheads to ascertain costs of a product/ process
5.Apply costing methods as per the suitability for various production processes and services.
6.Develop decision making of optimum product mix, profit planning, make or buy decisions

CO PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1		3		2	2						3		1			
CO 2											3	2		1		
CO 3																
CO 4									2	2	3					1
CO 5											2					
CO 6			3						2	2		2			3	

Job Mapping:

Better growth opportunities for higher Management positions.

IT4210: Machine Learning

Course Objectives:

1. Understanding Human learning aspects.
2. Acquaintance with primitives in the learning process by computer.
3. Understanding the nature of problems solved with Machine Learning.
4. To study different supervised learning algorithms.
5. To study different unsupervised learning algorithms.
6. To understand the application development process using ML

Credits: 2 **Teaching Scheme:-Theory: 2 Hours / Week**

Prerequisite-Linear Algebra, Statistics, Probability, Calculus, and Programming Languages

Course Relevance-Machine Learning is the applicable science of making computers work without being explicitly programmed. It is mainly an application of Artificial Intelligence (AI) that allows systems to learn and improve from experience, without any human intervention or assistance. Machine Learning keeps on innovating every aspect of the business and has been shaping up the futures even more powerfully now.Machine learning is the fuel we need to power robots, alongside AI.With ML, we can power programs that can be easily updated and modified to adapt to new environments and tasks- to get things done quickly and efficiently.Machine learning skills help you expand avenues in your career.

Section 1:
Introduction: What is Machine Learning, Examples of Machine Learning applications in various domains, Introduction to Data Science, Training versus Testing, Positive and Negative Class, Cross-validation.Framework of ML Model development. **Types of Learning**: Supervised, Unsupervised and Semi-Supervised Learning. **Regression and Generalization:**Regression: Linear and Logistic Regressions, Assessing performance of Regression – Error measures, Overfitting and Underfitting, Catalysts for Overfitting, Univariate Regression, Multivariate Linear Regression. **Classification:**Binary and Multiclass Classification: Handling more than two classes, Multiclass Classification-One vs One, One vs Rest Linear Models: Perceptron, KNN, Decision Tree, and Random Forest, Assessing Classification Performance.
Section2:

Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis and Singular Value Decomposition.

Logic Based and AlgebraicModels: Support Vector Machines (SVM), Distance Based Models: Distance based clustering algorithms - K-means and C-means, Hierarchical clustering, Association rules mining – Apriori Algorithm, Confidence and Support parameters.

Probabilistic Models: Conditional Probability, Joint Probability, Probability Density Function, Normal Distribution and its Geometric Interpretation, Naïve Bayes Classifier, Discriminative Learning with Maximum Likelihood. Probabilistic Models with Hidden variables: Expectation-Maximization methods.

Trends in Machine Learning: Ensemble Learning: Combining Multiple Models, Bagging, Randomization, Boosting, Stacking Reinforcement Learning.

Introduction to Deep Learning: The Neuron, Expressing Linear Perceptron as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons, reinforcement learning.

Text Books

1. T. Mitchell, ― Machine Learning‖, McGraw-Hill, 1997.
2. Anup Kumar Srivastava, Soft Computing, Alpha Science International limited. 2009.

Reference Books

1. EthemAlpaydin, "Introduction to Machine Learning", MIT press, 2004.
2. Jacek M. Zurada, ―Introduction to Artificial neural System‖, JAICO publishing house,2002.

Course Outcomes:

The student will be able to –

1. Understand Different Machine Learning Techniques (1)
2. Evaluate Regression Algorithms (2)
3. Apply different Classifiers to Classify different objects (3)
4. Explore Different Clustering Algorithms(4)
5. Acquaint with Trends in Machine Learning(4)
6. Analyze research based problems using Machine Learning Techniques (5)

CO-PO Mapping

CO	ProgrammeOutcomes												ProgramSpecificOutcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO 4
CO 1	2				2	2							2			
CO 2		2		2							2		2			
CO 3	3	3			2		2				2		2			
CO 4	2		2		3				1	1					3	
CO 5		2	2				2	2			2			2		
CO 6	2	2		2		2						2				3

CO Attainment Level: CO1-1 CO2 -2 CO3-3 CO4-4 CO5-4 CO6-5
Future Courses Mapping: *MS in Machine Learning, MS in Deep learning*
Job Mapping: *ML Engineer, DL Engineer, Data Scientist*

IT4211: Natural Language Processing

Course Prerequisites:

1. Probability and statistics.
2. Linear Algebra
3. Python programming language

Course Objectives:

1. Learn fundamentals of Text processing
2. Understand the different Language Models
3. Implement POS tagging
4. Implement Text classification
5. Implement sentiment analysis
6. Implement Machine translation

Credits: 2 **Teaching Scheme Theory: 2 Hours/Week**

Course Relevance:

Natural Language Processing is a branch of artificial intelligence that deals with the interaction between computers and humans using the natural language. The common applications of NLP involves, Google translator, Word Processors such as Microsoft, Interactive Voice Response, Personal assistant applications.

SECTION-I
Text Processing: Basics, Empirical Laws, Spelling Correction: Edit Distance, N-Gram Language Models, Basic Smoothing, POS Tagging, Hidden Markov Models for POS Tagging, Viterbi Decoding for HMM and Parameter Learning, Maximum Entropy Models.
SECTION-II
Maximum Entropy Models, Name entity recognition, Syntax, Dependency Grammars and Parsing, Semantic, text classification, sentiment analysis, Machine Translation, Question Answering.
List of Course Seminar Topics: 1. SemEval-2016 task 4: Sentiment analysis in Twitter 2. Modelling user attitudes using hierarchical sentiment-topic model

3. Multilingual dynamic topic model

4. Document-Level Text -classification Using Single-Layer Multisize Filters Convolutional Neural Network
5. Twitter Storytelling Generator Using Latent Dirichlet Allocation and Hidden Markov Model POS-TAG (Part-of-Speech Tagging)

7. Part-of-speech Tagging and Named Entity Recognition Using Improved Hidden Markov Model and Bloom Filter

8. Part of speech tagging for Twitter conversations using Conditional Random Fields model

9. A system for named entity recognition based on local grammars

10. A Maximum-Entropy Segmentation Model for Statistical Machine Translation

11. Mobile embodied conversational agent for task specific applications

List of Course Group Discussion Topics:

1 Smoothing Technique

2. N-gram models

3. POS tagging

4. Ambiguities in NLP 16

5. Challenges in NLP

6. Challenges in designing Language Translators

7. Challenges in designing text classification

8. Challenges in designing sentiment analysis

9. Challenges in designing Question and Answering system

10. Challenges in designing text summarization.

List of Home Assignments:

Design:

1. POS tagging using HMM

2. Build Chatbot

3. Summarization of customers reviews

4. Social media Information extraction

5. SMS spam classification

Case Study:

1. Hiring and recruitment

2. Advertising

3. Healthcare

4. Market intelligence

5. Sentiment analysis

Blog

1. Social media Information extraction

2. Name Prediction in Multiple Languages using Recurrent Neural Networks

3. Text Classification using Sentiment Analysis

4. Image Caption Generator

5. gender identification in Marathi names

Surveys

1. POS tagging techniques

2. SMS and email spam classification

3. Categorization of sport articles

4. machine translation Techniques

5. Name entity recognition methods

Suggest an assessment Scheme:

1. Seminar – 10 Marks

2. Group Discussion – 10 Marks

3. Home Assignment – 10 Marks

4. Course Viva – 20 Marks

5. MSE – 15 Marks

6. ESE – 15 Marks

7. Lab work –10 Marks

8. Course project -10 Marks

Text Books: (As per IEEE format)

1. Jurafsky & Martin "Speech and Language Processing" Prentice Hall, 2000

2. Akshar Bharati, Rajeev Sangal and Vineet Chaitanya: "Natural Language Processing: A Paninian Perspective", Prentice-Hall of India, New Delhi, 1995.

Reference Books: (As per IEEE format)

1. Steven Bird, Ewan Klein, and Edward Loper “Natural Language Processing with Python”, O’Reilly Media 2009.

Moocs Links and additional reading material:

1. https://nptel.ac.in/courses/106/105/106105158/

2. https://nptel.ac.in/courses/106/106/106106211/

Course Outcomes:

The student will be able to –

1. Have broad understanding of the field of natural language processing (Co Attainment Level - 3)

2. Get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics (Co Attainment level -3)

3. Apply mathematical models and algorithms in applications of NLP. (Co Attainment level - 4)

4. Design and implementation issues in various NLP applications such as information retrieval and information extraction (Co Attainment level - 4)

5 Demonstrate crucial ideas in linguistics (e.g., syntax, semantics, pragmatics), artificial intelligence (e.g., knowledge representation), and machine learning (e.g., deep learning) to natural language processing. (Co Attainment level - 4)

6. Identify one of the contemporary (sub) problems of natural language processing and 19 implement, in the form of a complete computer program as a possible solution to it. (Co Attainment level - 5)

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	1	1	1	1	1		2	3	1	1	1
CO2	3	2	2	2	2	2	1	1	1	1	1	2	2	2	2	2
CO3	3	3	2	3	2	2	1	1	2	2	1	2	2	2	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	2	2	3	3
CO5	3	3	3	3	3	2	2	2	2	2	2	2	2	2	3	2
CO6	3	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2

CO attainment levels

1. CO1 - Level 3
2. C02 - Level 3
3. CO3 - Level 4
4. CO4 - Level 4
5. CO5 - Level 4
6. CO6 - Level 5

Job Mapping:

Natural Language engineers, Data Scientist and Algorithm Architect with industries in domains Media & Entertainment, Healthcare and Finance.

IT4212: Advanced Communication Engineering

Course Prerequisites:

Communication Engineering, Digital Signal Processing, Wireless Communication

Course Objectives:

1. Analyze the path loss and shadowing effects in wireless communication.
2. Understand diversity techniques of communication.
3. Understand wireless channel modelling.
4. Analyze Orthogonal Frequency Division Multiplexing system.
5. Evaluate the performance of Multiple Input Multiple Output systems.
6. Simulate MIMO receivers

Credits:02 **Teaching Scheme Theory: 02 hours/Week**

Course Relevance:

Future generations of cellular communication require higher data rates and a more reliable transmission link. The transmission data rates can be increase by increasing transmission bandwidth and using higher transmitter power. Wireless communication channels suffer from various factors. Fading problem is the major impairment problem. To improve the performance of those fading channels, diversity techniques are used. Advanced Communication Engineering begins with wireless channel modelling. Also it covers Bit Error Rate performance in fading wireless channel. It covers deep fading issues in wireless communication. Also, it covers how to solve fading problems. It also covers advanced technologies like OFDM (Orthogonal Frequency Division Multiplexing) and MIMO (Multiple Input Multiple Output. An integral part of the course is MATLAB based computer assignments, which are designed to reinforce theoretical concepts.

SECTION-I
Wireless Communication and Diversity Path Loss and Shadowing, Wireless Channel Modelling, Bit Error Rate (BER) performance in Additive White Gaussian Noise (AWGN) communication channel-Analysis, Bit Error Rate (BER) performance in fading wireless channel, Deep fade phenomenon in wireless channels. Diversity in Wireless System Multiple antenna Wireless Systems, optimal receiver combining, Bit Error Rate (BER) performance with diversity, Types of diversity, Deep Fade Analysis with Diversity.
SECTION-II
Orthogonal Frequency Division Multiplexing Multicarrier modulation, Introduction to Orthogonal Frequency Division Multiplexing (OFDM), OFDM system model, IFFT/ FFT Transceiver Model, OFDM -BER and SNR performance, multiuser OFDM. Multiple Input Multiple Output (MIMO) Technology MIMO System model, MIMO- Zero-Forcing (ZF) and Minimum Mean Square Error (MMSE) Receivers, Singular Value Decomposition (SVD), MIMO channel capacity, Optimal water filling power allocation.
List of Course Seminar Topics: 1. Performance analysis of multiple-input multiple-output singular value decomposition 29 transceivers.

2. Modeling the Indoor MIMO Wireless Channel
3. Channel Modelling for 5G mobile Communication
4. Comparison of Indoor Geolocation methods in DSSS and OFDM Wireless Lan Systems
5. Analysis of MIMO system through Zero Forcing and MMSE detection scheme
6. SVD for Engine design of High Throughput MIMO OFDM system
7. Measured capacity gain using water filling in frequency selective MIMO Channels
8. MIMO channel capacity in Co-channel interference.
9. OFDM Channel estimation using Singular value decomposition
10. Increase in capacity of Multiuser OFDM system

List of Course Group Discussion Topics:

1. Fading Environment
2. Deep Fade Phenomenon in Wireless Communication
3. OFDM versus CDMA
4. Filtered -OFDM & OFDM modulation
5. OFDM vs MIMO-OFDM
6. OFDM for Optical Communication
7. MIMO -opportunities and challenges
8. MIMO Radar
9. Massive MIMO for next generation wireless systems
10. 5G - Spectrum, Deployment & Customer Trends

List of Home Assignments:

Design:

1. Design of OFDM for UWB environment
2. Design of 4G MIMO OFDM wireless system
3. OFDM for underwater Acoustic communication
4. Design LMSE algorithm for equalization
5. Design Zero forcing Algorithm

Case Study:

1. Role of digital communication in digital transformation
2. Digital Communication over fading channels
3. Network coding for wireless Mesh Networks
4. Capacity of wireless communication systems employing antenna arrays
5. MIMO OFDM

Blog

1. 5G and Industrial IoT

2. Equalization Techniques for MIMO

3. Diversity Techniques for 4G wireless Communication

4. Massive MIMO

5. Will 5G change the world?

Surveys

1. Diversity techniques in Wireless Communication

2. Space time coding scheme for MIMO 31

3. Survey on resource allocation techniques in OFDM (A) networks

4. Survey on Mobile WiMax

5. Performance Analysis in MIMO OFDM system

Suggest an assessment Scheme:

1. Seminar

2. Group Discussion

3. Home Assignment

4. Course Viva

5. MSE

6. ESE

Text Books: (As per IEEE format)

1. Principles of Modern wireless communication systems. Theory and practice , Aditya K. Jagannatham ,McGraw –Hill publication.

2. Wireless Communications-Andrea Goldsmith –Cambridge university press.

3.Wireless Communications- Principle and practice- Theodore S, Rappaport, Pearson.

4. Digital communications -Fundamentals and applications –Bernard Sklar, Prentice Hall

Reference Books: (As per IEEE format)

1. Baseband Receiver Design for wireless MIMO-OFDM communications, Tzi-Dar Chiueh, Pei-Yun Tsai, I-Wei Lai, Wiley-IEEE Press, 2012.

2.Theory and applications of OFDM and CDMA : Wideband Wireless COmmunications , Henrik Schulze, Christian Lueders, Wiley, 2005.

3. Radio Propagation and Adaptive Antennas for Wireless Communication Networks, Nathan Blaunstein, Christos G. Christodoulou, Wiley , 2014.

4. Fundamentals of Wireless Commu

Moocs Links and additional reading material:

www.nptelvideos.in

Advanced 3G, 4G Wireless Mobile Communications

https://nptel.ac.in/courses/117/104/117104099/#

Course Outcomes:

The student will be able to –

1) Calculate received power by system and keep required margin

2) Differentiate between diversity techniques

3) Understand channel modelling

4) Illustrate OFDM System

5) Discuss performance behavior of MIMO systems

6) Differentiate between ZF & MMSE receivers

CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1		2								1	1		
CO2	2	3	1		2							1	1	1		
CO3	3	2	1		2					1		2	1	1		
CO4	3	2	1	2	2					1		2	1	1		
CO5	2	2			2				1	1			1	2		
CO6	2	2			2				1	1			1	2		

CO attainment levels

Future Courses Mapping:

Mobile Communication

Job Mapping:

Students will have good opportunities in the communication industry as service engineers for operations and maintenance, network planning, software product developer, analytics engineer and so many.

IT4216: Data management, Protection and Governance

Course Prerequisites: Database Management System, Operating System

Course Objectives:

To facilitate the learner to –

1. Get acquainted with the high-level phases of data life cycle management.
2. Acquire knowledge about the various aspects of data storage, data availability, data protection.
3. Gain exposure to various solutions/reference architectures for various use-cases.
4. Understand the technical capabilities and business benefits of data protection.

Credits: 2 **Teaching Scheme Theory: 2... Hours/Week**

Course Relevance: Since technology trends such as Machine Learning , Data science and AI rely on data quality, and with the push of digital transformation initiatives across the globe, data management, governance and security is very much important.

SECTION-I

Data Storage, Availability and Security

Introduction to data life cycle management (DLM): - Goals of data life cycle management,Challenges involved: Volume of data source, Ubiquity of data locations, User demand for access;Stages of data life cycle - creation, storage, usage, archival, destruction;Risks involved without DLM, benefits, best practices.

Data storage and data availability :- Storage technology: Hard Disk Device (HDD), Solid State Devices (SSD), memory devices, Data access - block, files, object ; Data center End to End View – overview of complete stack including storage, network, host, cluster, applications, virtual machines, cloud storage ; Storage virtualization technologies - RAID level, storage pooling, storage provisioning ; Advance topics in storage virtualization – storage provisioning, thin provisioning; Cloud storage – S3, glacier, storage tiering; **High Availability**: Introduction to high availability, clustering, failover, parallel access

Data Threats and Data center security: - **Type of Threats:** Denial of Service (DoS), man in the middle attacks, Unintentional data loss,Repudiation,Malicious attacks to steal data;**Introduction to Ransomware**; **Understanding, Identification and Threat modelling tools**
;**Security:** Authorization and authentication - access control, Transport Layer
Security (TLS), key management, security in cloud, Design and architecture considerations for security

SECTION-II

Data Protection, Regulation and Governance

Introduction to data protection: - Introduction- Need for data protection,basic of back-up/restore;Snapshots for data protection, copy-data management (cloning, DevOps);De-duplication;Replication;Long Term Retention – LTR;Archival;Design considerations: System recovery, Solution architecture,Backup v/s Archival,media considerations and management (tapes, disks, cloud), challenges with new edge technology (cloud, containers)

Data regulation, compliance and governance: - Regulations requirements and Privacy Regulations: The Health Insurance Portability and Privacy Act of 1996 (HIPPA), PII (Personally Identifiable Information), General Data Protection Regulation (GDPR) ;Information Governance : Auditing, Legal Hold,Data classification and tagging (Natural Language Processing); India's Personal Data Protection bill

Applications uninterrupted: - Understand data management aspects of traditional and new edge applications;Reference architecture/best practices *(pick 2-3 case studies from below topics):* Transactional Databases (Oracle, MySQL, DB2), NoSQL Databases (MongoDB, Cassandra),Distributed applications (micro service architectures),Cloud applications – Platform as Service (PaaS), Software as Service (SaaS), Kubernetes,Multi-Tiered applications,ETL workloads,Data analytics (AI/ML)

List of Home Assignments:

Design:

1. Design data management aspects for cloud applications.
2. Design data management aspect for MongoDB/Cassandra.
3. Design data management aspect Distributed applications.
4. Design data life cycle management for any application.
5. Design data management for any Multi-Tiered application.

Case Study:

1. Consider different Transactional and NoSQL Data bases. Comparative study.
2. Compare various cloud applications based on Platform as service and Software as service.
3. Data Analytics based study for data management.

4. Study of Multi-Tiered Applications

5. Study data management in DevOps

Blog:

1. Comparative study of data protection schemes.

2. study of The Health Insurance Portability and Privacy Act of 1996 (HIPPA)

3. Need of data management, protection and governance

4. How Threat modelling tools are useful? Consider any application related to it.

5. Role of storage Technology for cloud storage.

Surveys:

1. Survey on data protection challenges with new edge technology like cloud
2. Survey on General Data Protection Regulation (GDPR)
3. Survey on Data classification and tagging in Natural Language Processing
4. Survey on Ransomware data security.
5. Survey on Kubernetes.

Suggest an assessment Scheme:

MSE, ESE, HA

Text Books: (As per IEEE format)

1. Robert Spalding, **'Storage Networks: The complete Reference'**.
2. Vic (J.R.) Winkler, **'Securing The Cloud: Cloud Computing Security Techniques and Tactics'**, Syngress/Elsevier - 978-1-59749-592-9

Reference Books: (As per IEEE format)

1. Martin Kleppmann, **'Designing Data-Intensive Applications'** , O'Reilly

Web References:

1. https://www.enterprisestorageforum.com/storage-hardware/storage-virtualization.html
2. https://searchstorage.techtarget.com/definition/data-life-cycle-management
3. https://www.hitechnectar.com/blogs/three-goals-data-lifecycle-management/
4. https://www.bmc.com/blogs/data-lifecycle-management/
5. https://www.dataworks.ie/5-stages-in-the-data-management-lifecycle-process/
6. https://medium.com/jagoanhosting/what-is-data-lifecycle-management-and-what-phaseswould- it-pass-through-94dbd207ff54
7. https://www.spirion.com/data-lifecycle-management/
8. https://www.bloomberg.com/professional/blog/7-phases-of-a-data-life-cycle/
9. https://www.datacore.com/storage-virtualization/
10. https://www.veritas.com/content/dam/Veritas/docs/solutionoverviews/
11. V0907_SB_InfoScale-Software-Defined-Infrastructure.pdf
12. https://www.veritas.com/solution/digital-compliance
13. https://www.veritas.com/solution/data-protection
14. https://www.veritas.com/gdpr

Course Outcome:

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

1. Understand the data management world, challenges and best practices.
2. Compare various concepts and technologies for enabling data storage and high availability.
3. Illustrate various types of data threats and approaches to ensure data center security.
4. Explain the various concepts related to data protection.
5. Outline different standards for compliance and governance of data.
6. Understand various approaches for designing data intensive enterprise

applications and industry standard solutions in data management.

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2				2		2	2			2	3			
CO2	3	3		2	2	2	1							3		
CO3	3	2	2	3	2										2	
CO4	2	2		3											3	
CO5	3	2		2	2	2	2	2				3	3			

CO6	**2**		**3**			**2**	**2**							**3**	**3**

CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Val						

Future Courses Mapping: Following courses can be learned after successful completion of this course: Cloud storage security, Data management in Distributed system, Data Analytics

Job Mapping: Manager- Master Data Governance, Data Analyst, Data Strategist, Solution and Data Governance Architect

IT4213: Deep Learning

Course Prerequisites: Linear algebra, probability theory and statistics, Digital signal processing, Computer vision

Course Objectives:

1. To present the mathematical, statistical and computational concepts for stable representations of high-dimensional data, such as images, text
2. To introduce NN and techniques to improve network performance
3. To introduce Convolutional networks
4. To introduce Sequential models of NN
5. To build deep nets with applications to solve real world problem

Credits: 2 **Teaching Scheme Theory: 2 Hours/Week**

Course Relevance: Deep learning is revolutionizing the technology and business world today. It is a subfield of machine learning concerned with algorithms to train computers to perform tasks by exposing neural networks to large amounts of data, its analysis and prediction. It is an incredibly powerful field with capacity to execute feature engineering on its own, uses multiple neural network layers to extract patterns from the data. Top applications of Deep learning involve, self-driving cars, natural language processing, robotics, finance, and healthcare.

Section-I
Topics and Contents Foundations of neural networks and deep learning, Logistic regression as a neural network, different activation function, logistic regression cost function, logistic regression gradient descent, vectorizing logistic regression, forward and backward propagation, Techniques to improve neural networks: regularization and optimizations, hyperparameter tuning, batch normalization, data augmentation, deep learning frameworks, Implementation of neural network for a case study.
Section-II
Convolutional Neural Networks, padding, strided convolution, pooling layers, convolutional implementation of sliding windows, Applications: object classification, object detection, face verification. ResNet, inception networks, bounding boxes, anchor boxes. Sequence modelling: recurrent nets, architecture, vanishing and exploding gradient problem, Applications & use cases.
List of Course Seminar Topics: 1. Deep learning for Stock Market Clustering 2. Application of Deep Networks in health care 3. Credit card fraud detection 4. Classification of skin cancer with deep neural networks 5. ALEXNET 6. VCGNET 7. Accelerating Deep Network Training by Reducing Internal Covariate Shift 8. Deep learning applications for predicting pharmacological properties of drugs

9. GAN (Generalised Adversial network)
10. Auto encoders
11. LSTM

List of Course Group Discussion Topics:

1. Recurrent or Recursive Networks for sequential Modelling?
2. Initializing network weights vs performance
3. Difficulty of training deep feedforward neural networks
4. Hyperparameter tuning: Is there a rule of thumb?
5. Problem of overfitting: How to handle?
6 Which cost function: Least squared error or binary cross entropy?
7. How to tackle with loss of corner information in CNN
8. Need of hundred classifiers to solve real world classification problem
9. Which optimization: Batch gradient descent of stochastic gradient descent
10. Activation functions: Comparison of trends
11. Remedy of problem of vanishing gradient and exploding gradient in RNN

List of Home Assignments:

Design:

1. Deep learning for library shelf books identification
2. Development of control system for fruit classification based on convolutional neural networks
3. Classifying movie review using deep learning
4. Sentiment analysis of the demonetization of economy 2016 India
5. Predicting Students Performance in Final Examination

Case Study:

1. Deep learning for security
2. Bag of tricks for efficient text classification
3. Convolutional Neural Networks for Visual Recognition
4. Deep Learning for Natural Language Processing
5. Scalable object detection using deep neural networks

Blog

1. Brain tumor segmentation with deep neural networks
2. Region-based convolutional networks for accurate object detection and segmentation
3. Human pose estimation via deep neural networks
4. Content Based Image Retrieval
5. Visual Perception with Deep Learning
6. Music genre classification system

Surveys:

1. Machine translation using deep learning - survey
2. Shaping future of radiology using deep learning
3. Training Recurrent Neural Networks
4. Text generation with LSTM
5. Deep learning applications in Biomedicine

Suggest an assessment Scheme:

1. Seminar – 10 Marks
2. Group Discussion – 10 Marks
3. Home Assignment – 10 Marks
4. Course Viva – 20 Marks
5. MSE – 25 Marks
6. ESE –25Marks

Text Books: (As per IEEE format)

1. Goodfellow, I., Bengio, Y., and Courville, A., Deeep Learning, MIT Press, 2016.
2. C., M., Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books: (As per IEEE format)

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Moocs Links and additional reading material:

www.nptelvideos.in 1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs11 2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs50

Course Outcomes:

Students will be able to

1) Demonstrate understanding of a logistic regression model, structured as a shallow Neural network
2) Build and train a deep Neural Network
3) Apply techniques to improve neural network performance
4) Demonstrate understanding of functionality of all layers in a convolutional neural network
5) Implement convolutional networks for image recognition/classification tasks
6) Demonstrate Understanding of Recurrent nets and their applications

CO PO Map

CO	Programme Outcomes	Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	4	3	3	2	4	1		1	1	1		2	1	1		
CO2	4	3	3	2	4	2		1	1	1		2	3	3		
CO3	4	3	3	3	4	2		1	1	1		2	3	3		
CO4	4	3	3	3	4	2		1	1	1		2	3	3		
CO5	4	4	3	3	4	2		1	1	1		2	3	3		
CO6	4	4	3	3	4	2		1	1	1		2	3	3		

CO attainment levels

Co1 -Level 3 Co2 - Level 3 Co3 - Level 5 Co4 - Level 4 Co5 - Level 5 Co6 - Level 4

Future Courses Mapping: Advanced course on Deep learning including Autoencoders and Boltzmann machines, Reinforcement Learning etc

Job Mapping: Deep learning engineer, Data Scientist and Algorithm Architect with industries in domains Healthcare, Industrials & Energy, Automobiles, Finance & Insurance, Human Resources, Agriculture, Cybersecurity, Ad & Marketing, Media and Entertainment, Government, Defence

IT4214: Cloud Computing

Course Prerequisites:

Operating Systems, Fundamentals of Computer Networks

Course Objectives:

1. To become familiar with Cloud Computing and its ecosystem
2. To learn basics of virtualization and its importance
3. To evaluate in-depth analysis of Cloud Computing capabilities
4. To give a technical overview of Cloud Programming and Services.
5. To understand security issues in cloud computing

Credits: 2 **Teaching Scheme Theory: 2 Hours/Week**

Course Relevance:

Cloud computing to enable transformation, business development and agility in an organization.

SECTION-I
Introduction to Cloud Computing: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Evolution of cloud computing Cloud Computing Architecture: Cloud versus traditional architecture, Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), , Public cloud, Private cloud, Hybrid cloud, Community cloud, Google Cloud architecture, The GCP Console, Understanding projects, Billing in GCP, Install and configure Cloud SDK, Use Cloud Shell, GCP APIs196 111 Infrastructure as a Service (IaaS): Introduction to IaaS, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM), Compute options in the cloud, Exploring IaaS with Compute Engine, Configuring elastic apps with autoscaling, Storage options in the cloud, Structured and unstructured storage in the cloud, unstructured storage using Cloud Storage, SQL managed services, Exploring Cloud SQL, Cloud Spanner as a managed service, NoSQL managed service options, Cloud Datastore, a NoSQL document store, Cloud Bigtable as a NoSQL option
SECTION-II
Platform as a Service (PaaS): Introduction to PaaS, Service Oriented Architecture (SOA). Cloud Platform and Management, Exploring PaaS with App Engine, Event driven programs with Cloud Functions, Containerizing and orchestrating apps with Google Kubernetes Engine Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS, Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing and accounting, Billing in GCP Cloud Security: Introduction to security in the cloud, the shared security model, Encryption options, Authentication and authorization with Cloud IAM, Identify Best Practices for Authorization using Cloud IAM. Cloud

Network : Introduction to networking in the cloud, Defining a Virtual Private Cloud, Public and private IP address basics, Google's network architecture, Routes and firewall rules in the cloud, Multiple VPC networks, Building hybrid clouds using VPNs, interconnecting, and direct peering, Different options for load balancing.

List of Course Seminar Topics:

1. Storage Cost Optimization On Cloud
2. Cloud Security And Cryptography
3. Infrastructure As A Code (IAC)
4. Cloud Computing In Healthcare
5. Serverless Architecture
6. Deployment Of Microservices In Kubernetes Engine
7. RPA Using AWS Cloud
8. Cloud Trends In Supporting Ubiquitous Computing
9. Mobile Cloud Computing
10. Modern Data Center Architecture

List of Course Group Discussion Topics:

1. Data Storage Security in Cloud
2. Cloud Services for SMB's
3. Monitoring Services Provided by GCP and AWS
4. Docker and Kubernetes
5. SaaS vs FaaS (Function as a service)
6. Hybrid Cloud
7. GCP Vs AWS Web Service Architecture
8. Cloud based security issues and threats
9. Authentication and identity 113
10. Future of Cloud-Based Smart Devices

List of Home Assignments:

Design:

1. Serverless Web App to order taxi rides using AWS lambda.
2. Deploying App on Kubernetes
3. Serverless web Application (GCP Cloud Functions)
4. Demonstration of EBS, Snapshot, Volumes
5. Single Node Cluster Implementation (Hadoop)

Case Study:

1. PayU Migration to AWS

2. Cloud object storage
3. Deployment and Configuration options in AWS
4. Deployment and Configuration options in Microsoft Azure
5. Deployment and Configuration options in GCP

Blog

1. Comparing design of various cloud computing platforms
2. AWS EKS and Google Cloud Functions
3. App Engine
4. Cloud Endpoints
5. Cloud Pub/Sub

Surveys

1. Disaster Recovery in Cloud Computing 114
2. Cloud Economics
3. Data archiving solutions
4. Salesforce
5. Dropbox

Suggest an assessment Scheme:

MSE, ESE, GD, Seminar, HA

Text Books: (As per IEEE format)

1. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, "Cloud Computing for Dummies", Wiley,India.
2. Ronald Krutz and Russell Dean Vines, "Cloud Security", Wiley-India
3. Gautam Shroff. "Enterprise Cloud Computing", Cambridge

Reference Books: (As per IEEE format)

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India
2. Antohy T Velte, et.al, "Cloud Computing : A Practical Approach", McGraw Hill.
3. Michael Miller, "Cloud Computing", Que Publishing. 115
4. Tim Malhar, S.Kumaraswammy, S.Latif, "Cloud Security & Privacy", SPD,O'REILLY
5. Scott Granneman, "Google Apps", Pearson

Moocs Links and additional reading material**:**

Course Outcome:

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

1) Describe the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing

2) Explain the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

3) Identify problems, and explain, analyze, and evaluate various cloud computing solutions.

4) Choose the appropriate technologies, algorithms, and approaches for the related issues.

5) Display new ideas and innovations in cloud computing. 116

6) Collaboratively research and write a paper on the state of the art (and open problems) in cloud computing

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3														
CO2			3													
CO3							2									
CO4										2						
CO5											1					
CO6																3

CO attainment levels:

CO1-1 CO2-2 CO3-3 CO4-5 CO5-4 CO6-3

Future Courses Mapping: After completing this course different certifications courses in cloud be taken such as AWS, Azure, Google cloud certifications. One can go for higher studies in specialization of cloud computing and allied subjects.

Job Mapping: Cloud Architect, Cloud Engineer, Cloud Administrator, Solutions Architect - Cloud Computing - AWS / Kubernetes, Cloud Computing Technical Consultant, Associate Cloud Computing Engineer, Cloud Computing Trainer

IT4215::Distributed Computing

Course Pre requisites: Operating System, Data Structures and Programming languages

Course Objectives:

1. To learn fundamentals of distributed systems.
2. To discuss different interprocess communication and clock synchronization approaches.
3. To gain knowledge of distributed transaction and distributed deadlock.
4. To understand Fault tolerance and Distributed Shared Memory.

Credits: 2 **Teaching Scheme Theory:** 2 Hours/Week

Course Relevance: This course focuses on key principles in designing and implementing distributed system concepts like inter process communication, clock synchronization, deadlock, transaction, fault tolerance and distributed shared memory.

SECTION-1
Introduction: Motivation, Examples,Design issues, Hardware and Software Concepts,Applications, Architectural Model,**Interprocess Communication:**Communication primitives, Message Oriented Communication, Stream Oriented Communication, RPC, Model, Transparencies in RPC, Implementation, Stub Generation, RPC Messages, Server Management, Call Semantics, Communication Protocols, Distributed Objects: Remote Method Invocation, Java RMI **Clock Synchronization**: Introduction, Logical Clocks, Scalar time, Vector time,Election Algorithm,Mutual Exclusion
SECTION-1I
Distributed Transaction: Transaction Model, Classification, Implementation, Concurrency Control: Serializability, 2 Phase Locking, Strict 2 PL, Distributed Commit: 2 Phase Commit, Recovery, **Distributed Deadlock:** Avoidance, Prevention, Detection and Recovery,**Fault Tolerance:**Introduction, Failure Models, Failure Masking by Redundancy, Process Resilience, Agreement in Faulty Systems: Two Army Problem, Byzantine Generals Problem, Reliable Client Server Communication, Reliable Group Communication,**Distributed Shared Memory:**Introduction, Advantages, Disadvantages, Architecture, Design and Implementation issues of DSM

List of Home Assignments:

Design:

1. Client-Server application using RMI
2. Client-Server application using socket programming
3. Distributed application using MapReduce under Hadoop
4. Distributed application using Mutual exclusion
5. Distributed Deadlock

Case Study:

1. GFS:Google file system
2. Hadoop
3. DCE RPC
4. Bigtable: A Distributed Storage System for Structured Data
5. HPC: High performance computing

Blog:

1.Consistency protocols in distributed system
2. Security in distributed system
3. Distributed programming models
4. Resource management in distributed system
5. Wireless distributed computing

Surveys:

1. Distributed file system
2. Distributed database system
3. Cloud computing vs Cluster computing vs Grid computing
4.Challenges and Benefits in designing distributed computing
5.Recent trends in distributed computing

Suggest an assessment Scheme:

1.Home Assignment: Design, Case study, Blog and Survey
2.MSE
3.ESE
4. CVV

Text Books: (As per IEEE format)

1. Andrew S. Tanenbaum & Maarten Van Steen; "Distributed Systems Principles and Paradigms";5th Edition, Prentice Hall India.
2.Pradeep K. Sinha; "Distributed Operating Systems Concepts and Design;1997, Prentice Hall India.

Reference Books: (As per IEEE format)

1. Ajay Kshemkalyani, Mukesh Singhal; "Distributed Computing: Principles, Algorithms, and Systems"; 2008, Cambridge University Press.
2. George Coulouris, Jean Dollimore & Tim Kindberg;"Distributed Systems – Concepts and Design"; 5th Edition, Addison-Wesley.
3. Mukesh Singhal, Niranjan G. Shivaratri; "Advanced Concepts In Operating Systems",2001, McGrawHill.
4. M. L. Liu ;"Distributed Computing: Principles and Applications";2004, Addison-Wesley.

Moocs Links and additional reading material:

1. https://.nptel.ac.in
2. https://www.udemy.com
3. https://www.coursera.org

Course Outcomes:

The student will be able to –

1. Identify the basic principles, design issues and architectural aspects of distributed systems.
2. Analyze the different techniques used for Communication in distributed system.
3. Compare the mechanisms used forClock synchronization, Mutual exclusion in distributed system.
4. Determine an optimal solution for Distributed Deadlock.
5. Apply important methods in distributed systems to support Fault tolerance.
6. Illustrate architecture and design issues of Distributed Shared Memory.

CO PO Map:

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3					2							2	3
CO2	2	2	3		2									3		
CO3	3	2			2				2	2				2		

CO4			2	2			2					4		2		
CO5	3	2					2						2			
CO6				3		2		2			2				2	

CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	2	3	3	4	3	3

Future Courses Mapping: Advanced Operating Systems, Parallel Computing, Cloud Computing

Job Mapping: Senior manager- Distributed storage system, Distributed software engineer, Distributed system automation tool maintenance

IT4205: Major Project

Credits: 10 **Teaching Scheme Lab:** 20 hours/week

Course Relevance:

This is a culmination of four years of learning into Practical. This course is essential for Graduate Engineers to practice the successful management of a software development project. The course emphasizes on project life cycle phases requirement engineering, system analysis and system design and gives them the exposure to research in any area of their interest. A further aim is for students to heighten personal awareness of the importance of developing strategies for themselves and It is a way of increasing the student's maturity and preparing him/her for their future career. The students carry out cutting edge projects with a flexibility to balance between research- and application-oriented work as per their interest. The program enables the students to find opportunities for higher studies in top ranking universities abroad, and to find jobs in dream companies .

The Motivation for this Major Project is

a. Synthesis of knowledge
b. To demonstrate the aptitude of applying the own knowledge to solve a specific problem.
c. To mature the knowledge.
d. Preparation for joining the working world.

The Project Work can lead to:

a. Novice algorithm development
b. Optimization of existing system/method
c. New state of the art application
d. Some incremental work in any existing field of their choice

Overview of the Course:

1. The Student Project Group is expected to make a survey of situation for identifying the requirements of selected Technological Problem. The Student Project Group will be monitored by Internal Guides and External Guides (if any).
2. The project requires the students to conceive, design, implement and operate a mechanism (the design problem). The mechanism may be entirely of the student's own design, or it may incorporate off-the-shelf parts. If the mechanism incorporates off-the-shelf parts, the students must perform appropriate analysis to show that the parts are suitable for their intended purpose in the mechanism.
3. The project must be open-ended – meaning that there is not a known correct answer to the design problem. Students are expected to apply their creativity (simply copying or re-creating something that already exists is not acceptable).
4. The project must have an experimental component. Students must conceive, design, implement and operate an appropriate experiment as part of the project. The experiment might be to collect data about some aspect of the design (i.e., to verify that the design will work as expected). Alternatively, the experiment could be to verify that the final mechanism performs as expected.
5. Upon receiving the approval, the Student Project Group will prepare a preliminary project report consisting Requirement Definition Document, Feasibility Study Document, System Requirement Specification, System Analysis Document, Preliminary System Design Document. All the

documents indicated will have a prescribed format.

6. The Project Work will be assessed jointly by a panel of examiners having more than Five Years experience. The Project Groups will deliver the presentation of the Project Work which will be assessed by the panel.
7. The Student Project Group needs to actively participate in the presentation. The panel of examiners will evaluate the candidate's performance based on presentation skills, questions based on the Project Work, understanding of the Project, analysis and design performed for the project.
8. The Student Project Groups are expected to work on the recommendations given by the panel of examiners. In no case any variation in Project Theme will be permitted.
9. The outcome of the project should be tangible in terms of paper publication/patent/SOP/prototype
10. The Project should justify the work worth 10 credits.

Assessment Scheme

Sr. No.	Content	Marks
1	Development of Prototype/ Model	20
2	Innovativeness and intellectual input	20
3	evaluation of literature review	10
4	Individual contribution	10
5	Usage of Modern Tool/ Technology and experimental competency	10
6	Presentation of the Project Work	10
7	Resultsand analysis	10
8	Quality Publication and Project Report	10

Note:

The student needs to identify a technological problem in the area of Computer Engineering or Information Technology of their choice like signal processing, computer vision, machine learning and artificial intelligence, control systems, game theory, and communication networksand address the problem by formulating a solution for the identified problem. The project work needs to be undertaken by a group of maximum FOUR and minimum of THREE students. The Project work will be jointly performed by the project team members.

The Project Group will prepare a synopsis of the project work which will be approved by the concerned faculty member. The project should not be a reengineering or reverse engineering project. In some cases, reverse engineering projects will be permissible based on the research component involved in it. The project work aims at solving a real world technical problem. Hence ample literature survey is required to be done by the students. Application-oriented projects will not be acceptable. Low-level custom User Interface development and its allied mapping with a particular technology will not be accepted.

Following is the list of recommended domains for Project Work:

signal processing, computer vision, machine learning and artificial intelligence, IoT, Block Chain, Image Processing, data Science etc.

Course Outcomes:

Upon completion of the course, graduates will be able to -

1. Model the Real World Problem
2. Identify the Design within Specification and Available Resources
3. Realize the Solution within Defined references
4. Defend his Design with Technical and Ethical reasoning
5. Adapt to changing Technological and Human resource advances
6. Use the gained knowledge for other Real-World Problems
7. Project will involve development of a compact solution to current problem/s in chosen field.

.CO-PO Map

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	3			3								3		
CO2	2			1	2										2	
CO3	3		3		2			3	1				3			
CO4	2	2				3										
CO5	3		3				3		3		3				3	3
CO6	3	2			2					3		3				

MODULE VII
IT4251: Industry Internship
Credit: 16

Course Relevance: Implementation of technical knowledge acquired during previous three years of Internship and to get acquainted with Industry culture.

SECTION-1

Get used to corporate culture

Realization of Internship as per problem statement

Design, Testing / Experimentation, Analysis / Validation

Documentation and Report Writing

Quality of Work

Performance in Question & Answers Session

Regular interaction with guide

SECTION-2

Problem Statement

Literature Review

Clarity about the objectives of Internship activity

Requirement Analysis, Internship Planning

Knowledge of domain, Latest technology, andmodern tools used /to be used

Neat project documentation

Suggest an assessment Scheme:

MSE review for 50 marks converted to 30

ESE review for 100 marks converted to 70

Course Outcomes:

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

CO1: Explore career alternatives prior to graduation.

CO2: Integrate theory and practice.
CO3: Develop work habits and attitudes necessary for job success.
CO4: Develop communication, interpersonal and other critical skills in the job interview process.
CO5: Acquire employment contacts leading directly to a full-time job following graduation from college.
CO6: Practice Project Management and learn team dynamics

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1					3										
CO2	2	2		2	3	2							3	3	2	2
CO3	3		2				3	3		2						
CO4	3		2					2	3	3						
CO5										3		2				
CO6											3	3				

IT4252: International Internship
Credit: 16

Course Relevance: Implementation of technical knowledge acquiredduring previous three years of Internship and to inculcate research culture.

SECTION-1

Realization of Internship as per problem statement

Design, Testing / Experimentation, Analysis / Validation

Documentation and Report Writing

Quality of Work

Performance in Question & Answers Session

Regular interaction with guide

SECTION-2

Problem Statement

Literature Review

Clarity about the objectives of Internship activity

Requirement Analysis, Internship Planning

Knowledge of domain, Latest technology, andmodern tools used /to be used

Research Paper should be published in Peer Reviewed Journal/Conference or Patent should be published.

Suggest an assessment Scheme:

MSE review for 50 marks converted to 30

ESE review for 100 marks converted to 70

Course Outcomes:

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

CO1: Explore career alternatives prior to graduation.

CO2: Integrate theory and practice.
CO3: Develop work habits and attitudes necessary for job success.
CO4: Develop communication, interpersonal and other critical skills in the job interview process.
CO5: Acquire employment contacts leading directly to a full-time job following graduation from college.
CO6: Practice Project Management and learn team dynamics

CO	**Programme Outcomes**												**Program Specific Outcomes**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1					3										
CO2	2	2		2	3	2							3	3	2	2
CO3	3		2				3	3		2						
CO4	3		2					2	3	3						
CO5										3		2				
CO6											3	3				

IT4253: Research Internship
Credit: 16

Course Relevance: Implementation of technical knowledge acquiredduring previous three years of Internship and to inculcate Industry culture.

SECTION-1

Realization of Internship as per problem statement

Design, Testing / Experimentation, Analysis / Validation

Documentation and Report Writing

Quality of Work

Performance in Question & Answers Session

Regular interaction with guide

SECTION-2

Problem Statement

Literature Review

Clarity about the objectives of Internship activity

Requirement Analysis, Internship Planning

Knowledge of domain, Latest technology, andmodern tools used /to be used

Suggest an assessment Scheme:

MSE review for 50 marks converted to 30

ESE review for 100 marks converted to 70

Course Outcomes:

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

CO1: Explore career alternatives prior to graduation.
CO2: Integrate theory and practice.
CO3: Develop work habits and attitudes necessary for job success.
CO4: Develop communication, interpersonal and other critical skills in the job interview process.

CO5: Acquire employment contacts leading directly to a full-time job following graduation from college.
CO6: Practice Project Management and learn team dynamics

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1					3										
CO2	2	2		2	3	2							3	3	2	2
CO3	3		2				3	3		2						
CO4	3		2					2	3	3						
CO5										3		2				
CO6											3	3				

IT4254: Project Internship
Credit: 16

Course Relevance: Implementation of technical knowledge acquired during previous three years of Internship and to get acquainted with Industry culture.

SECTION-1

Get used to corporate culture and get sponsorship from the company

Realization of Internship as per problem statement

Design, Testing / Experimentation, Analysis / Validation

Documentation and Report Writing

Quality of Work

Performance in Question & Answers Session

Regular interaction with guide

SECTION-2

Problem Statement

Literature Review

Clarity about the objectives of Internship activity

Requirement Analysis, Internship Planning

Knowledge of domain, Latest technology, and modern tools used /to be used

Neat project documentation

Suggest an assessment Scheme:

MSE review for 50 marks converted to 30

ESE review for 100 marks converted to 70

Course Outcomes:

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

CO1: Explore career alternatives prior to graduation.

CO2: Integrate theory and practice.
CO3: Develop work habits and attitudes necessary for job success.
CO4: Develop communication, interpersonal and other critical skills in the job interview process.
CO5: Acquire employment contacts leading directly to a full-time job following graduation from college.
CO6: Practice Project Management and learn team dynamics

CO	Programme Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1					3										
CO2	2	2		2	3	2							3	3	2	2
CO3	3		2				3	3		2						
CO4	3		2					2	3	3						
CO5										3		2				
CO6											3	3				