M.Tech-Computer Science and Engineering

M.Tech (R16) - Curriculum

CBCS - Choice Based Credit System

Department of Computer Science and Engineering
School of Computing

Department of Computer Science and Engineering

VISION

To produce intellectual graduates who could contribute significantly in the analysis, design, development, operation and maintenance of complex software systems for meeting the ever changing requirements and to compete globally towards professional excellence.

MISSION

The mission of Computer Science and Engineering Department is to

M1: Design curricula for imparting training in adapting newer computing methods and technologies for providing effective and efficient solutions to the existing / new problems.

M2: Inculcate in-depth knowledge of various courses by employing Information and Communication Technology (ICT) based pedagogy methods.

M3: Create a conducive research environment for making technological innovations by the faculty and students.

M4: Provide leadership skills and professional ethics thereby making a prolific career in academics and industry.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs for CSE)

PEO1: Equip with advanced technical knowledge and competency to solve computer science and engineering problems.

PEO2: Demonstrate the impact of cutting edge technologies for the development of optimized solutions and Software Products.

PEO3: Have effective communication, teamwork and leadership and exhibit managerial decisions based on high ethical and professional standards.

PEO4: Pursue research in the relevant fied of computer Science and Engineering and work in global, technological, societal and environmental issues.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to,

PO1: Independently carry out research / investigation and development work to solve practical problems.

PO2: Write and present a substantial technical report / document.

PO3: Demonstrate a degree of mastery in the area of Computer Science & Engineering.

PO4: Apply the advanced knowledge of computer science and engineering, professional and ethical principles to design and develop solutions for complex engineering problems**.**

PO5: Use of appropriate techniques, skills and modern engineering tools to formulate problems, propose algorithm and model efficient scalable systems.

PO6: Exhibit critical thinking, communication and leadership skills to manage projects in multidisciplinary environment with lifelong learning capabilities.

PROGRAM SPECIFIC OUTCOMES (PSO)

On successful completion of the program, the graduates will be able to,

PSO1: Apply the algorithmic principles for modeling and simulation of computing Problems.

PSO2: Design software systems, components, or processes using software engineering principles and practices to meet identified needs within economic, environmental and social constraints.

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Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology

Department of Computer Science and Engineering

M. Tech Computer Science and Engineering - CBCS VTUR16

S. No	Subject Code	CBCS R-16		L	T	P	C	Pg.No
		Foundation Course						
1	2160MA102	Probability and Statistics	FC	4	0	0	4	6
		Program Core						
2	2161CS209	Advanced Data Structures and Algorithms	PC	3	0	2	4	10
3	2161CS210	Modern Operating Systems	PC	3	0	2	4	13
4	2161CS217	Advanced Data Base Management Systems	PC	3	0	2	4	16
5	2161CS130	Parallel Computer Architecture	PC	3	0	0	3	20
6	2161CS211	Software Engineering Principles and Practices	PC	3	0	2	4	22
7	2161CS218	Advanced Computer Network	PC	3	0	2	4	25
8	2161CS129	Machine Learning Techniques	PC	3	0	0	3	31
9	2161CS140	Artificial Intelligence	PC	3	0	0	3	34
10	2161CS304	Machine Learning Techniques Laboratory	PC	0	0	2	1	37
		Total Credits					30	
		Program Specific Elective						
		Data Science						
1	2162CS201	Foundation of Data Science	PE	2	0	2	3	40
2	2162CS202	Big Data Analytics	PE	2	0	2	3	43
3	2162CS203	Data Visualization	PE	2	0	2	3	46
4	2162CS204	Modeling For Data Science	PE	2	0	2	3	49
5	2162CS205	Deep Learning	PE	2	0	2	3	53
		Artificial Intelligence						
6	2162CS206	Soft Computing	PE	2	0	2	3	55

7	2162CS207	Natural Language Processing	PE	2	0	2	3	58
8	2162CS208	Reinforcement Learning	PE	3	0	0	3	62
9	2162CS209	Computer Vision	PE	2	0	2	3	65
Security								
10	2162CS117	Cryptography and Network Security	PE	3	0	0	3	69
11	2162CS156	Cyber Forensics	PE	3	0	0	3	71
12	2162CS157	Ethical Hacking	PE	3	0	0	3	74
13	2162CS158	Internet of Things and Cloud Security	PE	3	0	0	3	
Independent Learning								
1	2163MG401	Research Methodology	Independent Learning				2	
2	2163CS402	ICT Tools	Independent Learning				2	
3	2163CS501	Research Seminar	Independent Learning (Anyone)				2	
4	2163CS801	Field Study						
5	2163CS802	Internship						
6	2163GE401	Business Communication and Technical Writing	Independent Learning				2	
Project Work								
1	2164CS601	Project Phase 1	Project Work				10	
2	2164CS701	Project Phase 2	Project Work				16	

L – Lecture; T – Tutorial; P – Practical; C – Credits

FOUNDATION COURSE

COURSE CODE	COURSE TITLE	L	T	P	C
2160MA102	Probability and Statistics	4	0	0	4

A.Preamble

To provide an in-depth knowledge about probability, sampling, Correlation and Random process

B.Prerequisite Courses

C.Course Objectives

Students undergoing this course are expected to

- Be familiar with the basic concepts of probability and random variables.
- Understand the basic concepts of sampling distribution.
- Develop the knowledge of testing of hypothesis for small and large samples which playsan important role in real life problems.
- Apply the Correlation and classifications of design of experiments for statistical quality control.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the basic concepts of probability	K2
CO2	Apply the basic concepts of different types of sampling	K3
CO3	Utilize the concepts of Hypothesis testing and Chi-square testing to solve simple problems	K3
CO4	Demonstrate the concepts of Correlation	K3
CO5	Develop the concepts of Random process to solve simple problems	K3
Knowledge Level (Based on revised Bloom's Taxonomy)		
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M			M			M	M
CO2	M			M			M	M
CO3	M			M			M	M
CO4	M			M			M	M
CO5	M			M			M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION   L-9 Hours

Axioms of probability - Conditional probability - Total probability - Baye's theorem - Random variable - Probability mass function - Probability density function – Properties – Moments - Moment generating function and their properties - Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Gamma and Weibull distribution and their properties.

UNIT 2 SAMPLING   L-9 Hours

Sampling: different types of sampling – Sampling distribution – Sampling distribution of Mean Point Estimation of parameters: general concepts of Estimation – Unbiased estimators – Variance of a point Estimator – Standard error – Method of point estimation (method of moments – method of maximum likelihood) – Statistical intervals for a single sample: confidence interval on the mean of a normal distribution with variance known – Confidence interval on the mean of a normal distribution with variance unknown – Confidence interval on the variance and standard deviation of a normal distribution

UNIT 3 TESTING OF HYPOTHESIS   L-9 Hours

Hypothesis testing: one sample and two sample tests for means and properties of large samples (z-test), one sample and two sample tests for means of small samples (t-test), F-test for two sample standard deviations – Chi-square test for single sample standard deviation – Chi-square tests for independence of attributes and goodness of fit.

UNIT 4 CORRELATION AND REGRESSION   L-9 Hours

Correlation – Scatter diagram – Karlpearson coefficient of correlation – calculation of the correlation coefficient for a bivariant frequency distribution – rank correlation – repeated rank – Regression – lines of regression – regression curves – regression coefficients – multiple and partial correlation – coefficient of partial correlation – generalization – multiple correlation.

UNIT 5 RANDOM PROCESSES   L-9 Hours

Classification – Stationary process – Markov Process – Poisson process – Discrete parameter – Markov chain – Chapman Kolmogorov equations – Limiting distributions.

Total : 45 Hours

F.Learning Resources (in IEEE Format)

i.Text Books:

1.Richard A. Johnson and C. B. Gupta, Probability and Statistics for Engineers, (7th Edn.), Pearson Education, Indian Impression – 2011 (Unit 1 to 5)

ii.Online References:

1.Course on "Probability and statistics" Dec 2021[online],Available: https://nptel.ac.in/courses/111/105/111105090

2.Course on "Probabilities and Statistics course ",Dec 2021[online], Available:https://stanford.edu/~shervine/teaching/cs-229/refresher-probabilities-statistics

PROGRAM CORE

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS209	**Advanced Data Structures and Algorithms**	**3**	**0**	**2**	**4**

A.Preamble

To provide an in-depth knowledge in problem solving techniques and data structures

B.Prerequisite Courses

C.Course Objectives

Students undergoing this course are expected to

- Develop skill in formulate, design and analyze algorithms for problem statements.
- Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Understand the necessary mathematical abstraction to solve problems.
- Comprehend and select algorithm design approaches in a problem specific manner.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand various concepts of trees structures, Hashing	K2
CO2	Apply the depth knowledge of Disjoint sets	K3
CO3	Illustrate some of the advanced algorithms in graphs	K2
CO4	Demonstrate the depth knowledge of NP completeness and string-matching algorithms.	K2
CO5	Make use of knowledge of Randomized Algorithms	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M						M	
CO2			H	M			M	
CO3	M		M	H			M	
CO4	M		H	M			M	
CO5	M	M	H	M			M	

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 ELEMENTARY DATA STRUCTURES   **L-9 Hours**

Probabilistic Analysis, Amortized Analysis, Competitive Analysis, Hash tables: Direct Addressing, Functions and tables, Open addressing, Perfect Hashing, Red-Black Trees, Splay Trees, Augmented Data Structures

UNIT 2 ADVANCED DATA STRUCTURES   **L-9 Hours**

B-trees, Fibonacci heaps, Van Emde Boas Trees, DataStructures for Disjoint Sets.

UNIT 3 GRAPHS & ALGORITHMS   **L-9 Hours**

Representation, Maximum Flow-Flow networks, The Ford-Fulkerson method , Maximum bipartite matching ,Push-relabel algorithms ,The relabel-to-front algorithm. .

UNIT 4 STRING MATCHING AND APPROXIMATION ALGORITHMS

L-9 Hours

String Matching Algorithms: Rabin-Karp, Knuth-Morris-Pratt, String Matching with finite automata-Approximation algorithms: Need of approximation, Introduction to P, NP, NP-Hard and NP-Complete; Vertex Cover problem, TSP, Set Cover, Subset sum Problem.

UNIT 5 RANDOMIZED ALGORITHMS   **L-9 Hours**

Introduction, Type of Randomized Algorithms, Min- Cut, 2- SAT; Game Theoretic Techniques, Random Walks.

F.Laboratory of Experiments

TASK 1	Create a hash table and perform open addressing for a set of values. **Tools: C/ C++/Python/Java**
TASK 2	For a given graph perform graph coloring. **Tools: C/ C++/Python/Java**
TASK 3	Create a Btree for a given set of values and perform insert and delete operations. **Tools: C/ C++/Python/Java**
TASK4	Perform two types of rotations in Red Black Tree. **Tools: C/ C++/Python/Java**
TASK5	Find out the Maximum flow and Minimum cut in a graph for any given number of nodes. **Tools: C/ C++/Python/Java**
TASK6	Implement string matching by Rabin-Karp Algorithm. **Tools: C/ C++/Python/Java**
TASK7	Implement string matching by Knuth-Morris-Pra Algorithm. **Tools: C/ C++/Python/Java**
TASK8	Solve TSP for a given graph. **Tools: C/ C++/Python/Java**

TASK9	Solve Set Cover Problem for given set of elements. **Tools: C/ C++/Python/Java**
TASK10	Write a program to solve subset sum. **Tools: C/ C++/Python/Java**

Total: 75 Hours

G.Learning Resources (in IEEE Format)
i.Text Books:

1. Thomas Coremen, "Introduction to Algorithms", Third edition, Prentice Hall of India – 2009. (Unit 1– 4).

2. Motwani R., Raghavan P., "Randomized Algorithms", Cambridge University Press, 1995.(Unit 5)

ii.Reference Books:

1. Kleinberg J., Tardos E., "Algorithm Design", 1st Edition, Pearson, 2012.

2. Vazirani, Vijay V., "Approximation Algorithms", Springer, 2001.

3. Floyds L.R,"Graph Theory Applications ", Springer, 1994.

iii.Online References:

1. Course on "Advanced Data Structures and Algorithms",Dec 2021, Available: https://nptel.ac.in/courses/106/102/106102064/

2. Course on "Data Structures and Algorithms Specialization course" Jan 2022 , Available : https://www.coursera.org/specializations/data-structures-algorithms

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS210	Modern Operating Systems	3	0	2	4

A.Preamble

To provide an in-depth knowledge in operating system concepts

B.Prerequisite Courses

C.Course Objectives

Students undergoing this course are expected to

- Be familiar with the concepts of synchronization problems.
- Characterize the kinds of algorithms and process management in distributed Operating system.
- Apply the dead lock in distributed Operating system.
- Demonstrate skills in fault tolerance and familiar with the design issues in real time OS

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K – Level
CO1	Understand the various types of operating systems and synchronization problems.	K2
CO2	Outline the algorithms to manage and process Distributed OS	K2
CO3	Apply the concepts of Deadlocks in distributed OS	K3
CO4	Develop the concepts of fault tolerance in distributed OS.	K3
CO5	Explain the design issues of Real time OS.	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M				M	M
CO2	M		M				M	M
CO3	M		M	M			M	M
CO4	M		M	M	M		M	M
CO5	M	H	M	M	M		M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 FUNDAMENTALS OF OPERATING SYSTEMS   L-9 Hours

Overview – Synchronization Mechanisms – Processes and Threads - Process Scheduling– Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques.

UNIT 2 DISTRIBUTED OPERATING SYSTEM   L-9 Hours.

Scheduling: Issues in load distributing, Components of load distributing algorithms, Stability, Load distributing algorithms, Performance Comparison, Selecting load sharing Algorithm-Synchronization: Physical and logical clocks -Distributed Mutual Exclusion: Mutual Exclusion algorithms and its classification.

UNIT 3 DISTRIBUTED DEADLOCK HANDLING   L-9 Hours

Introduction, deadlock handling strategies, detection: Issues and resolution, Control Organizations, Centralized algorithms, Distributed algorithms, Hierarchical algorithms.

UNIT 4 DISTRIBUTED FAULT HANDLING   L-9 Hours

Agreement Protocol: System Model, Classification, solution to Byzantine Agreement Problem- Fault Recovery: Concepts, Classification of failures, Backward error recovery, Recovery in concurrent Systems, Consistent Check Points, Synchronous and Asynchronous check pointing and recovery-Fault tolerance: Issues, Atomic actions and committing, Commit Protocols, Non-blocking Commit protocols, Voting protocols and Dynamic Voting Protocol.

UNIT 5 REAL TIME OPERATING SYTEMS   L-9 Hours

Types of Real time tasks, Timing Constraints, Modeling Timing Constraints-Task Scheduling: Types of tasks and their characteristics, Clock driven Scheduling, Hybrid Schedulers, Event driven Scheduling, EDF Scheduling, Rate Monotonic Algorithm - Resource Handling: Resource Sharing, Priority Inversion, PIP, PCP, HLP.

G.Laboratory Experiments

TASK 1	Implement the Mutual Exclusion Problem Using Dekker's Algorithm. **Tools: C/C++/ Java**
TASK 2	Implement Inter Process Communication Problem (Producer-Consumer / Reader- Writer Problem) Using Semaphores. **Tools: C/C++/ Java**
TASK 3	Implement Banker's algorithm. **Tools: C/C++/ Java**
TASK4	Implement and study the incremental/decremented growth of response and service times for different number of client and servers for servicing continuous stream(s) of constant sized messages. **Tools: C/C++/ Java**

TASK5	Implement a name server for registration and identification of services running on another server. **Tools: C/C++/ Java**
TASK6	Implement a client-server application for a computing problem (of exponential complexity).Compare the performance for a loscal and remote machine of different speeds. **Tools: C/C++/ Java**
TASK7	Implement a fault tolerant client and server application using the concept of name server. The client incorporates fault tolerant by sending a service request to another server using name server, if the current server fails to respond within 10 seconds. **Tools: C/C++/ Java**
TASK8	Implement a stateful server for a transaction consisting of mainly four operations viz. open a file, close opened file, read from opened file and write to opened file. The state of file operation is maintained at stateful server. **Tools: C/C++/ Java**
TASK9	Schedule the task set using e Rate-Monotonic scheduling algorithm. **Tools: C/C++/ Java**
TASK10	Schedule the task set using EDF Scheduler. **Tools: C/C++/ Java**

Total: 75 Hours

H.Learning Resources (in IEEE Format)

i. Text Books:
1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", MC Graw Hill education, 2001.(Unit 1-4)
2. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson education, 2008. (Unit -5)

ii. Reference Books:
1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.
2. Andrew S.Tanenbaum, "Modern Operating System", Pearson Edition, Thrid Edition, 2009.

iii. Online References:
1. Course on "Power of Operating system" ,Jan 2022 [online], Available: https://www.coursera.org/learn/os-power-user
2. Course on "Operating Systems and You: Becoming a Power User" , Dec 2021 [online],Available: https://nptel.ac.in/courses/106/105/106105214/

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS217	**Advanced Data Base Management Systems**	**3**	**0**	**2**	**4**

A.Preamble

To provide an in-depth knowledge about how database systems are maintain, manage and mitigate the current real world scenarios via distributed databases, multi version concurrency control, summarizing and provide statistic based decision-making with huge databases like warehouses, big data. This course also provides a basic mining terminologies like rule mining and clustering

B.Prerequisite Courses

C.Course Objectives

Students undergoing this course are expected to\

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Design ER-models to represent simple database application scenarios
- Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Outline the basic OO concepts underlying databases	K2
CO2	Relate object-oriented databases and ODMG model	K2
CO3	Explain the concurrency control through parallel and distributed databases	K2
CO4	Describe the decision-making process in warehouse and through mining process	K2
CO5	Apply the modern data models relating to real time scenarios	K3

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M				M	M
CO2	M		M				M	M
CO3	M		M				M	M
CO4	M		M	M	M	M	M	M
CO5	M		M	M	M	M	M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1   REVIEW OF RELATIONAL DATA MODEL AND OODBS   L-9 Hours

Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations. Overview of Object-Oriented Concepts – Objects, Basic properties. Advantages, examples, Abstract data types, Encapsulation, class hierarchies, polymorphism, examples.

UNIT 2   OBJECT AND OBJECT-RELATIONAL DATABASES   L- 9 Hours

Overview of OOP; Complex objects; Identity, structure etc. Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Conceptual design of Object database. Overview of object relational features of SQL; Object-relational features of Oracle; Implementation and related issues for extended type systems; syntax and demo examples, The nested relational model. Overview of C++ language binding; Mongoose- Object relational features-CRUD operations in Mongoose environment;

UNIT 3   PARALLEL AND DISTRIBUTED DATABASES   L- 9 Hours

Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Multi Version Concurrency Control, Sharding; Distributed transactions; Distributed Concurrency control and Recovery; MVCC with PostgreSQL and SQLite.

UNIT 4 DATA WAREHOUSING, DECISION SUPPORT AND DATA MINING
L-9 Hours

Introduction to decision support; OLAP, multidimensional model; Window queries in SQL; Finding answers quickly; Implementation techniques for OLAP; Data Warehousing; Views and Decision support, View materialization, Maintaining materialized views. Introduction to Data Mining; Counting co-occurrences; Mining for rules; Tree-structured rules; ROC and CMC Curves; Clustering; Similarity search over sequences; Incremental mining and data streams; Additional data mining tasks.

UNIT 5 ENHANCED DATA MODELS FOR SOME ADVANCED APPLICATIONS
L-9 Hours

Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management. NoSQL with Object Oriented Concepts-MongoDB-Mongoose; Graph databases- Neo4j- CRUD operation using Neo4j; Neo4j vs GraphQL; Query modelling using GraphQL; Handling Big Data using MongoDB-Map Reduce using MongoDB-Hadoop Node configuration.

Total: 45 Hours

G.Laboratory Experiments

Part-1

TASK 1	Designing databases using Postgres and SQLite **Tools: SQL Server Management Studio (SSMS)**
TASK 2	Performing Equivalent queries using Oracle for simple clauses and operators like having, group by; like, is, as, in, not in; < ,> ; and, or; **Tools: SQL Server Management Studio (SSMS)**
TASK 3	Performing equivalent queries for nested and join queries using join..with ,join..in, using SQLite
TASK4	Reporting logs of listener controls using listctl of Oracle SQL **Tools: SQL Server Management Studio (SSMS)**
TASK5	Performing Multi version concurrency control using Snapshot using Oracle SQL
TASK6	Making Java GUI and performing OO transactions using Postgres and SQLite **Tools: SQL Server Management Studio (SSMS)**
TASK7	Designing QBE design performing CRUD operations in postgres and SQLite queries. **Tools: SQL Server Management Studio (SSMS)**
TASK8	Devising Cursors for coherence control of database objects. **Tools: SQL Server Management Studio (SSMS)**
TASK9	Devising Cluster partitions using Oracle SQL for Schemas. **Tools: SQL Server Management Studio (SSMS)**
TASK10	Performing Cluster partitions or map reduce using MongoDB. **Tools: MongoDB**
TASK11	Performing CRUD operations using MongoDB **Tools: MongoDB**
TASK12	Performing CRUD operations using GraphQL/Neo4j

Part-2

Use Case-1: Building a Cart analysis for Myph

Myph has just launched their brand new phone range to the eager reception of the consumer market cart analysis. The product's data model has a unique menu that identifies the product, title, description, a stock quantity, and pricing information about the item. All products have categories. To be able to provide a list of all the products in a category, amend the data model with a collection of documents for each category and contain the path for that category in the category tree. Use cart analysis in developing different consumer selection options. Would this answer outlier selection in cart i.e., surplus selections? Is Relational database application can answer these transactions? How recovery is made through carting and commerce?

Use Case-2: Indexing various devices in IoT platform

A generic IoT platform required support for data from a wide range of devices, some of which could not be envisaged while developing the platform. The proficient work necessitated a data storage mechanism that could handle data from different types of devices. Indexing support makes it easy to pull data using a single index or multiple indexes such as device id with location id. Records for a particular device in different locations are easily accessed. Common parameters like temperature from different types of devices and their records are retrieved fast through these indexes. How the application could lead to the choice of JSON-based document database, MongoDB? Assume or create JSON script in support of this.

Total: 75 Hours

H.Learning Resources (in IEEE Format)

i. G.Text Books:

1.J.D.Ullmann et al, "Database Systems: The Complete Book", Second Edition, Pearson Ed, Inc, 2009.[Unit 1-5]

ii. Reference Books:

1.Shannon Bradshaw, E Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide - Powerful and Scalable Data Storage", Third Edition, Shroff/O'Reilly Inc., January 2020.[Unit-5]

2.AgusKurniawin, "Python and SQLite Development", First Edition, PE Press, January 2021. [unit-5]

3.Stephano Ceri and Giusepe Pelagatti,"Distributed databases: Principles & Systems", Mc Graw Hill (India) Pvt Ltd, 2017

iii. Online References:

1. "Designing local library models", Accessed on: May 05, 2021[online]. Available: https://developer.mozilla.org/en-US/docs/Learn/Server-side/Express_Nodejs/mongoose.
2. Vivian Siahaan and Rismon Hasiholan Sianipur," The fast way to learn Java GUIwith PostgreSQL and SQLite", Accessed on : October 27,2021[online].Available:https://www.google.co.in/books/edition/The_Fast_Way_to_Learn_Java_GUI_with_Post/uPvJDwAAQBAJ?hl=en&gbpv=1&dq=sqlite&printsec=frontcover.
3. iii.Michael Hunger, Ryan Boyd & William Lyon, "The Definitive Guide to Graph Databases for the RDBMS Developer", first Ed, E-book, Accessed on: October 27, 2021 [online & Download]. Available: https://neo4j.com/whitepapers/rdbms-developers-graph-databases-ebook/

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS130	**Parallel Computer Architecture**	**3**	**0**	**0**	**3**

A. Preamble

To provide an in-depth knowledge about parallelism, scalability in computer architecture.

B. Prerequisite Courses

C. Course Objectives

Students undergoing this course are expected to

- To study the scalability and clustering issues and the technology necessary for them.
- To understand the technologies enabling parallel computing.
- To study the different types of interconnection networks.
- To study the different parallel programming models.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Outline the terminology and concepts of parallel Architecture	K2
CO2	Understand the concepts of Parallel Programming Performance	K2
CO3	Develop the Workload driven emulation	K3
CO4	Understand the Snoop Based Multiprocessor Design	K2
CO5	Explain the concepts of Scalable Multiprocessors	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M				M	M
CO2	M		M				M	M
CO3	M		M				M	M
CO4	M		M				M	M
CO5	M		M				M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION   L-9 Hours

Introduction to Parallel Architecture, Convergence of Parallel Architecture, Fundamental Design Issues, Parallel Application, Parallelization Process, Example Program..

UNIT 2 PARALLEL PROGRAMMING FOR PERFORMANCE   L-9 Hours

Partitioning for Performance, Data Access and Communication in a Muti-Memory System, Orchestration for Performance, Case Studies.

UNIT 3 WORKLOAD DRIVEN EVALUATION   L-9 Hours

Scaling Workloads and Machines, Evaluating a Real Machine, Cache Coherence, Memory Consistency, Snooping Protocols, Synchronization.

UNIT 4 SNOOP BASED MULTIPROCESSOR DESIGN   L-9 Hours

Correctness Requirements, Base Design, Multi-Level Cache Hierarchies, Split Transaction Bus, Case Studies.

UNIT 5 SCALABLE MULTIPROCESSORS   L-9 Hours

Scalability, Realizing Programming Models, Physical DMA, User Level Access, Dedicated Message Processing, Shared Physical Address Space, Clusters and Networks of Workstations.

Total: 45 Hours

G.Learning Resources (in IEEE Format)

i.   **Text Books**
   1. D.E. Culler, J.P. Singh, and A. Gupta. Parallel Computer Architecture - A Hardware/Software Approach. Morgan Kaufmann Publishers, 2010.(Unit 1-5)

ii.   **Reference Books:**
   1. N.E. Jerger and Li-Shiuan Peh," On-Chip Networks" Morgan and Claypool, 2009.
   2. D.J. Sorin, M.D. Hill, and D.A. Wood,"A Premier on Memory Consistency and Cache Coherence", Morgan and Claypool, 2011.
   3. John P. Hayes, "Computer Architecture and Organisation" ,MCGraw Hill. 3rd Edition, 1998,
   4. Hwang K. and Briggs. F.A, "Computer Architecture and Parallel Processing", MCGraw Hill, 1985.

iii.   **Online References:**

   1. Course on "Computer networks and internetProtocol",Dec 05, 2021[online] Available: https://nptel.ac.in/courses/106/104/106104024/
   2. Course on "Global **network** for advanced **management**" , Dec05, 2021[online], Available: https://globalnetwork.io/

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS211	Software Engineering Principles and Practices	3	0	2	4

A. Preamble

To provide an in-depth knowledge about the Software Architecture, Software Documentation.

B. Prerequisite Courses

Software Engineering

C. Course Objectives

Students undergoing this course are expected to

- To do project management and cost estimation
- To gain knowledge of the System Analysis and Design concepts.
- To understand software testing approaches
- To be familiar with Software Engineering tools
  .

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Outline the basics of software engineering.	K2
CO2	Demonstrate use of software configuration and quality management.	K2
CO3	Construct various models used in software lifecycle.	K3
CO4	Understand various design and testing techniques used in software engineering.	K2
CO5	Apply various tools and techniques for software maintenance.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M						M	
CO2		M						
CO3	H	M	M		H		M	M
CO4	M	M			H			M
CO5			H		H			

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION TO SOFTWARE ENGINEERING   L-9 Hours

What Is Software Engineering, Phases in the Development of Software, Software Engineering Ethics, Planning a Software Development Project, Controlling a Software Development Project, The Waterfall Model, Agile Methods, The Rational Unified Process, Model-Driven Architecture.

UNIT 2 CONFIGURATION AND SOFTWARE QUALITY MANAGEMENT
L-9 Hours

Tasks and Responsibilities, Configuration Management Plan, People Management, Team Organization, On Measures and Numbers, Taxonomy of Quality Attributes, Perspectives on Quality, The Quality System, Software Quality Assurance, Capability Maturity Model, Algorithmic Models, Guidelines for Estimating Cost, Distribution of Manpower over Time, Agile Cost Estimation, A Taxonomy of Software Development Projects, Risk Management.

UNIT 3 SOFTWARE LIFE CYCLE   L-9 Hours

Requirements Elicitation, Requirements Documentation and Management, Requirements Specification Techniques, Verification and Validation, Classic Modeling Techniques, Unified Modeling Language, Software Architecture and the Software Life Cycle, Architecture Design, Architectural Views, Architectural Styles, Software Architecture Assessment.

UNIT 4 SOFTWARE DESIGN AND TESTING   L-9 Hours

Design Considerations, Classical Design Methods, Object-Oriented Analysis and Design Methods, How to Select a Design Method, Design Patterns, Design Documentation, Verification and Validation, Test Objectives, Testing and the Software Life Cycle, Verification and Validation Planning and Documentation, Manual Test Techniques, Coverage-Based Test Techniques, Fault-Based Test Techniques, Error-Based Test Techniques.

UNIT 5 SOFTWARE MAINTENANCE AND TOOLS   L-9 Hours

Maintenance Categories Revisited, Major Causes of Maintenance Problems, Reverse Engineering and Refactoring, Toolkits, Language-Centered Environments, Integrated Environments and Work Benches, Process-Centered Environments, User Interface Design, Human Factors in Human–Computer Interaction, Role of Models in Human–Computer Interaction, Design of Interactive Systems, Reuse Dimensions, Reuse and the Software Life Cycle, Reuse Tools and Techniques, Component-Based Development Process and Component Life Cycle, Service-Oriented Software Engineering, Challenges of Global System Development

Total: 45 Hours

G.Laboratory of Experiments

TASK 1	Create a hash table and perform open addressing for a set of values. **Tools: C/C++/ Java**
TASK 2	For a given graph perform graph coloring. **Tools: C/C++/ Java**
TASK 3	Create a Btree for a given set of values and perform insert and delete operations. **Tools: C/C++/ Java**
TASK4	Perform two types of rotations in Red Black Tree. **Tools: C/C++/ Java**
TASK5	Find out the Maximum flow and Minimum cut in a graph for any given number of nodes. **Tools: C/C++/ Java**
TASK6	Implement string matching by Rabin-Karp Algorithm. **Tools: C/C++/ Java**
TASK7	Implement string matching by Knuth-Morris-Pra Algorithm. **Tools: C/C++/ Java**
TASK8	Solve TSP for a given graph. **Tools: C/C++/ Java**
TASK9	Solve Set Cover Problem for given set of elements. **Tools: C/C++/ Java**
TASK10	Write a program to solve subset sum. **Tools: C/C++/ Java**

Total: 75 Hours

H.Learning Resources (in IEEE Format)

i. Text Books:
1. Hans van Vliet, "Software Engineering: Principles and Practice", 3rd Edition, 2010.(Unit 1-5)

ii. Reference Books:
1. Deepak Jain, "Software Engineering-Principles and Practices", Oxford University Press, First Edition, 2018

iii. Online References:
1. Course on "Software engineering principles" Nov29, 2021[online], Available: https://nptel.ac.in/content/storage2/courses/108105057/Pdf/Lesson-33.pdf
2. Course on "Software Development Processes and Methodologies"Dec 05, 2021[online], Available: https://www.coursera.org/learn/software-processes

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS218	**Advanced Computer Networks**	**3**	**0**	**2**	**4**

A.Preamble

The course deals with the concepts of networking, Modeling and Simulation techniques. Also represents the working principles of wireless, mobile and satellite networks. It also covers the distributed system environment.

B.Prerequisite Courses

Computer Networks, Graph theory

C.Course Objectives

Students undergoing this course are expected to

- Be familiar with the concepts of TCP/IP reference model.
- Understand the concepts of Protocols, network interfaces.
- Performance study of Wireless networks and mobile networks.
- Identify the representation of Satellite networks.
- Understand the impact of Distributed systems.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Develop the Working concepts of TCP-IP reference model and IPV6 message format and its services.	K3
CO2	Identify the networking concepts by Simulation and Modelling.	K3
CO3	Organize the Functionalities of wireless networks and mobile network.	K3
CO4	Build the scenario for Satellite Networks.	K3
CO5	Construct the Distribution System setup and its requirements.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M				M	M
CO2	M		M				M	M
CO3	M		M				M	M
CO4	M		M				M	M
CO5	M		M				M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION   L-9 Hours

Introduction, TCP/IP Fundamentals: TCP, UDP, IP, Performance Measurement of TCP/IP Networks: Reasons for Network Measure, Measurement Task, Classification of Measurement Tools Popular Measurement Tools and Their Applications.

UNIT 2 NETWORK SIMULATION AND MODELING   L-9 Hours

The Role of Simulation, Steps of a Systematic Simulation Study, Types of Simulations, Simulation Validation and Verification, Confidence Level of Simulation Results, Simulation with Self-Similar Traffic,Classification of Simulation Tools, The ''ns''Network,OPNET, TCP Modeling.

UNIT 3 TCP/IP PERFORMANCE OVER WIRELESS NETWORKS AND MOBILE NETWORKS   L-9 Hours

Wireless Networks, TCP Performance Issues Over Wireless Links, Improving TCP Performance over Wireless Links, Wireless System Evolution and TCP/IP, Cellular and Ad Hoc Networks, TCP Performance in Cellular Networks, TCP Performance in Ad Hoc Networks.

UNIT 4 TCP/IP PERFORMANCE OVER SATELLITE NETWORKS   L-9 Hours

A Brief History of Data Satellites, Motivations for Using Satellites, Types of Satellites Satellite Internet Architectures, Satellite Characteristics Affecting TCP, TCP Enhancements for Satellite Networks, Advanced Enhancements and New Versions of TCP, New Transport Protocols for Satellite Links.

UNIT 5 DISTRIBUTED SYSTEMS   L-9 Hours

Distributed System,Goals,Types of Distributed Systems,System Architectures,Architectures Versus Middleware,Self-Management in Distributed Systems,Processes:Threads, Virtualization, Clients, Servers, Code Migration, Communication:Fundamentals,Remote Procedure Call,Message-Oriented Communication,Stream-Oriented Communication,Multicast Communication.

Total: 45 Hours

G.Laboratory Experiments

TASK 1	Working with Networking Commands Tcpdump, Tcpstat, Ttcp, Netperf, NetPIPE.
TASK 2	Extract the Packet from network interfaceand analysis the protocol, addressing. **Tools: Wireshark, JPCAP**
TASK 3	Perform simulation for Multi-Antenna Cellular Network. **Tools: NS3**
TASK4	Perform simulation for Heterogeneous Network.

	Tools: NS3	
TASK5	Simulate the Under-Laid Cellular Networks in-terms of packet transfer and delay. **Tools: NS3**	
TASK6	Simulate a geostationary satellite scenario with their functionalities. **Tools: NS2**	
TASK7	Simulate a Low Earth Orbit (LEO) satelliteswith their workings. **Tools: NS3**	
TASK8	Program to implement Chat Server. **Tools: C /Java**	
TASK9	Program to implement Remote Procedure Call. **Tools: C/Java**	
TASK10	To Simulate the Distributed Mutual exclusion. **Tools: C/Java**	

Part-2

Use cases:

1.Geostationary satellite: Consider an INSAT-3A multipurpose geostationary satellite and two satellite terminals, one at Bangkok and the other at Baghdad. The position of Bangkok is 13.9-degree latitude north and 100.9-degree longitude east. The position of Baghdad is 33.8-degree latitude north and 44.4-degree longitude east. INSAT-3A is used to provide television broadcasting from Bangkok to Baghdad. INSAT-3A is positioned at 93.5 degrees longitude East. The traffic consists of a FTP source and a CBR stream. The simulation lasts for 50 secs.

Analyse the trace file and find the following:

   a. End-to-end delay between two terminals
   b. What is the nature of the delay that you expect in this scenario.

2.Low-earth orbit: Sets up two terminals, one in Boston and one at Berkeley. Send a packet in each second from Berkeley to Boston for whole day. Consider the following parameters for Iridium constellation:

The simulation lasts for one earth rotation (86400 sec).

Analyse the trace file and find the following:

i)What should be the nature of Hop-count for the packets sent from source to destination. Plot and verify this with graph.

ii)What should be the nature of end-to-end delay for the packets sent from source to destination and how it is related with the plot of count.

3.Chat server: Chat server is a standalone application that is made up the combination of two-application, serverapplication (which runs on server side) and client application (which runs on client side). Thisapplication is using for chatting in LAN. To start chatting you must be connectedwiththeserverafterthat your message can broadcast to each and everyclient.

   a. A simple server that will accept a single client connection and display everything the client says on the screen. If the client user types "bye", the client and the server will bothquit.
   b. A server as before, but this time it will remain 'open' for additional connection once a client has quit. The server can handle at most one connection at a time.
   c.   A server as before, but this time it can handle multiple clients simultaneously. The output from all connected clients will appear on the server's screen.
   d. A server as before, but this time it sends all text received from any of the connected clients to all clients. This means that the server has to receive and send, and the client hastosendaswellasreceive.
   e. Wrapping the client from step 4 into a very simple GUI interface but not changing the functionality of either server or client. The client is implemented as an Applet, but a Frame would have worked just as well (for a stand-alone program).

4.Remote procedure call: Remote Procedure Call (RPC) is an inter-process communication that allows a computer program to cause a subroutine or procedure to execute in another address space (commonly on another computer on a shared network) without the programmer explicitly coding the details for this remote interaction.

   a. The client calls the client stub. The call is a local procedure call, with parameters pushed ontothestackinthenormalway
   b. The client stub packs the parameters into a message and makes a system call to send the message. Packing the parameters is called marshalling.
   c. The kernel sends the message from the client machine to the server machine.
   d.   The kernel on the server machine passes the incoming packets to the server stub.
   e.   Finally, the server stub calls the server procedure. The reply traces the same steps in the reverse direction.

5. Distributed Mutual Exclusion:

Concurrent access of processes to a shared resource or data is executed in mutually exclusive manner. Only one process is allowed to execute the critical section (CS) at any given time.In a distributed system, shared variables (semaphores) or a local kernel cannot be used to implementmutual exclusion. Message passing is the sole means for implementing distributed mutual exclusion.

Process1:Requestresource:

Resource Allocated ◊ No more requests process for this resource.

Process2:RequestResource◊Denied
Process1:ExitResource:
Process2: Request Resource◊ Allocated

Press a key (except q) to enter a process into critical section. Press q at any time to exit. Process0enteredcriticalsection.
Error: Another process is currently executing critical section. Please wait till its execution is over. Process0exitscriticalsection.

Process1enteredcriticalsection.

Process1exitscriticalsection.

Process 2 entered critical section.

Error: Another process is currently executing critical section. Please wait till its execution is over.
Process 2 exits critical section.

Total: 75 Hours

H.Learning Resources (in IEEE Format)

   i.   **Text Books:**
           1.   High Performance TCP/IP: Networking Concepts, Issues, and Solutions, Mahbub Hassan and Raj Jain, IST Edition, 2009. (Unit 1-4).
           2.   Distributed Systems,Maarten Van Steen and Andrew S.Tanenbaum,Third Edition, Pearson Publication,2017.(Unit
   ii.   **Reference Books:**
           1.   TCP/IP Illustrated (Volume I, Volume II and Volume III), W. Richard Stevens,
                Addison-Wesley.
   iii.   **Online References:**
           1.   TCP/IP Fundamentals, https://www.thegeekstuff.com/2011/11/tcp-ip-fundamentals/
           2.   NetworkModellingandSimulations,https://www.researchgate.net/publication/220674719_Network_modelling_and_simulation_tools

3. TCP/IPPerformanceoverwirelessnetworks,https://dl.acm.org/doi/10.1145/215530.21554
4. TCP/IPPerformanceoverSatelliteCommunications,https://sites.cs.ucsb.edu/~ebelding/courses/284/s06/papers/Satellite_TCP.pdf
5. Distributed systems, https://blog.stackpCath.com/distributed-system/

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS129	Machine Learning Techniques	3	0	0	3

A.Preamble

To provide an in-depth knowledge in Machine Learning techniques..

B.Prerequisite Courses

C.Course Objectives

Students undergoing this course are expected to

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning
- techniques
- To study the various probability based learning techniques
- To understand graphical models of machine learning tools

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the basic Concepts of Machine Learning	K2
CO2	Outline about the Supervised Machine Learning	K2
CO3	Illustrate the concepts Unsupervised Machine Learning	K2
CO4	Interpret various Probabilistic Models used in Machine Learning	K2
CO5	Apply various Tools used in Machine Learning	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M							
CO2	M				M		M	
CO3	M				M		M	
CO4	M				H		M	
CO5	M		M	H	H	M	H	

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION   L-9 Hours

Machine Learning - Machine Learning Foundations - Types of Machine Learning – Design of a Learning system – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm.

UNIT 2 SUPERVISED LEARNING   L-9 Hours

Regression-Linear Regression- Classification - Naïve Bayes - Discriminant Functions - Probabilistic Generative Models -Probabilistic Discriminative Models-Decision Trees – Pruning -Neural Networks -Feed-forward Network Functions - Back propagation- Support vector machines - Ensemble methods- Bagging- Boosting.

UNIT 3 UNSUPERVISED LEARNING   L-9 Hours

Clustering- K-means - EM Algorithm -The Curse of Dimensionality - Dimensionality Reduction - Factor analysis – Linear Discriminant analysis-Principal Component Analysis - Probabilistic PCA

UNIT 4 PROBABILISTIC GRAPHICAL MODELS   L-9 Hours

Graphical Models - Undirected graphical models - Markov Random Fields - Directed Graphical Models -Bayesian Networks - Conditional independence properties - Inference – LearningGeneralization - Hidden Markov Models.

UNIT 5 MACHINE LEARNING TOOLS   L-9 Hours

Machine Learning using Weka - Python for Machine Learning –Machine Learning using R- Introduction to Mahout

Total: 45 Hours

G.Learning Resources (in IEEE Format)

i. **Text Books:**

1. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.
2. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of DataFirst Edition, Cambridge University Press, 2012.

ii. **Reference Books:**

1. Ethem Alpaydin, Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014.
2. Jason Bell, Machine learning ,Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014.
3. Stephen Marsland, Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

iii. Online References:
1. Course on "Software engineering principles", Dec 05, 2021[online], Available :
    https://nptel.ac.in/content/storage2/courses/108105057/Pdf/Lesson-33.pdf
2. Course on "Software Development Processes and Methodologies" Dec22,
    2021[online], Available: https://www.coursera.org/learn/software-processes

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS140	**Artificial Intelligence**	**3**	**0**	**0**	**3**

A.Preamble

Artificial Intelligence is one of the most advanced fields of computer science which involves use of Mathematics, Statistics, Information Technology and Information Sciences in discovering new information and knowledge from large databases and optimize Human effort overall. It is a new emerging interdisciplinary area of research and development which has created interest among scientists of various disciplines like Computer Science, Mathematics, Statistics, Information Technology.

B.Prerequisite Courses

C.Course Objectives

- Expound the problem solving by Searching StateSpace.
- Solve Problem by Heuristic approach.
- Solve   Problem by Random and Optimal approaches
- Solving Constraint-satisfaction problem and Planning.
- Utilize Logical knowledge representation and Experiment with Uncertainty and Reasoning

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Problem solving by Searching State Space.	K2
CO2	Problem solving by Heuristic approach.	K3
CO3	Problem solving by Random and Optimal approach.	K3
CO4	Constraints oriented problem solving and planning.	K3
CO5	Dealing with Uncertainty and Reasoning	K3
CO6	Logical knowledge representation.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	H		M	M			M	M
CO2	H		M	M			M	M
CO3	M		M	M			M	M
CO4	M		M	M			M	M
CO5	M		M	M			M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION   **L-9 Hours**

Artificial Intelligence - Introduction. State Space Search: Generate and Test- Simple Search- Depth First Search- Breadth First Search- Comparison of BFS and DFS- Quality of Solution- Depth Bounded DFS- Depth First Iterative Deepening.

Heuristic Search: Heuristic Functions- Best First Search- Hill Climbing- Local Maxima- Solution Space Search- Variable Neighborhood Descent- Beam Search- Tabu Search- Peak to Peak Methods.

UNIT 2   RANDOMIZED SEARCH AND EMERGENT SYSTEMS: **L-9 Hours**

Iterated Hill Climbing- Simulated Annealing- Genetic Algorithms- The Travelling Salesman Problem- Neural Networks- Emergent Systems- Ant Colony Optimization. Finding Optimal Paths: Brute Force- Branch & Bound- Refinement Search- Dijkstra's Algorithm- Algorithm A*- Admissibility of A*- Iterative Deepening A*- Recursive Best First Search- Pruning the OPEN and CLOSED List- Divide and Conquer Beam Stack Search.

UNIT 3   PLANNING: **L-9   Hours**

The STRIPS Domain- Forward and Backwards State Space Planning- Goal Stack Planning- Plan Space Planning- A Unified Planning Framework. Constraint Satisfaction Problem: N-Queens- Constraint Propagation- Scene Labeling- Higher Order and Directional Consistency- Algorithm Backtracking- Look-ahead Strategies- Strategic Retreat.

UNIT 4 KNOWLEDGE BASED REASONING: **L-9   Hours**

Agents- Facets of Knowledge. Logic and Inferences**:** Formal Logic- Propositional Logic- Resolution Method in Propositional Logic- First Order Logic- Incompleteness of Forward Chaining- Resolution Refutation in First Order Logic- Deductive Retrieval – Resolution Method's Complexity in FOL- Horn Clauses and SDL Resolution- Backward Chaining- Second Order Logic.

UNIT 5 Structured Knowledge Representation: **L-9 Hours**

Hierarchies in Domain- The Scheme- Frames- Semantic Net- Scripts, Goals, Plans and MOPs- Inheritance in Taxonomies- Description Logics- Formal Concept Analysis- Conceptual Graphs.

Total: 45 Hours

G.Learning Resources (in IEEE Format)

i.   Text Books:
1. "A First Course in Artificial Intelligence", by Deepak Khemani, McGraw-Hill Education, 2013.
2. Peter Norvig, and Stuart Russell, "Artificial Intelligence: A Modern Approach", Global Edition, Pearson; 4th edition (2021)

ii. Reference Books:
1. Luke Dormehl, "Thinking Machines: The Quest for Artificial Intelligence--and Where It's Taking Us Next" 2017, TarcherPerigee
2. V S Janakiraman, "Foundations of Artificial Intelligence and Expert Systems", 2005, Macmillan.

iii. Online References:
1. https://nptel.ac.in/courses/106/102/106102220/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-036-introduction-to-machine-learning-fall-2020/

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS304	**Machine Learning Techniques Laboratory**	**0**	**0**	**2**	**1**

A. Preamble

To understand the Image Processing technology and tool kits for programming.

B. Prerequisite Courses

C. Course Objectives

Students undergoing this course are expected to

- Understand the implementation procedures for the machine learning algorithms.
- Design Java/Python programs for various Learning algorithms.
- Applyappropriate data sets to the Machine Learning algorithms.
- Identify and apply Machine Learning algorithms to solve real world problems.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Apply the programming concepts of lemmatization, tokenization	K3
CO2	Implement the classification Process	K3
CO3	Execute concepts of clustering Process	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1		M		H			M	
CO2	M	M		H	M		M	
CO3	M	M		H	M		M	

H- High; M-Medium; L-Low

F.   Laboratory Experiments

TASK 1	Perform a stop word removal a text file and print the text **Tools: R/ Python / Weka**
TASK 2	Implement lemmatization, tokenization using NLTK tool kit in python using any text file **Tools: R/ Python / Weka**
TASK 3	Perform a classification using naïve bayes in Mahout **Tools: R/ Python / Weka**
TASK4	Perform a classification using Support vector machine **Tools: R/ Python / Weka**
TASK5	Implement k-means clustering algorithm **Tools: R/ Python / Weka**
TASK6	Implement a decision tree and KNN for any dataset and compare the accuracy **Tools: R/ Python / Weka**
TASK7	Illustrate PCA **Tools: R/ Python / Weka**

Total: 30 Hours

PROGRAM SPECIFIC ELECTIVE

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS201	**Foundation Of Data Science**	2	0	2	3

A. Preamble

To provide an in-depth understanding of high dimensional spaces and singular value decomposition

B. Prerequisite Courses

C. Course Objectives

1. To impart the fundamentals of data science.
2. To enable the students think the capability to build big-data
3. Developing design skills of models for big data problems
4. Understand and gain exposure in programming tools for data sciences

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Discuss the high dimensional spaces and singular value decomposition modeling in massive business problems.	K1
CO2	Discuss the process of random walks on undirected graphs and Markov chains model.	K2
CO3	Choose appropriate machine and deep learning technique for massive data problems.	K3
CO4	Use different clustering techniques for massive data problems.	K2
CO5	Design and evaluate random graphs and branching process.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M				M	
CO2	M		M	M	M		M	
CO3	M		M	M	M		M	
CO4	M		M	M	M		M	
CO5	M		M		H			H

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 High-Dimensions and Singular Value Decomposition   L-9 Hours

Introduction, Law of Large Numbers, Geometry of High Dimensions, Properties of the Unit Ball, Generating Points Uniformly at Random from a Ball, Gaussians in High Dimension, Random Projection and Johnson-Lindenstrauss Lemma, Separating Gaussians, Fitting a Spherical Gaussian to Data, Singular Vectors, Singular Value Decomposition, Best Rank-k Approximations, Left Singular Vectors, Power Method for Singular Value Decomposition.

UNIT 2 Random Walks and Markov Chains   L-9 Hours

Singular Vectors and Eigenvectors, Applications of Singular Value Decomposition, Stationary Distribution, Markov Chain Monte Carlo, Areas and Volumes, Convergence of Random Walks on Undirected Graphs, Electrical Networks and Random Walks, Random Walks on Undirected Graphs with Unit Edge Weights, Random Walks in Euclidean Space, Web as a Markov Chain.

UNIT 3 Machine Learning   L-9 Hours

Overfitting and Uniform Convergence, Regularization: Penalizing Complexity, Online Learning and the Perceptron Algorithm, Kernel Functions, Online to Batch Conversion, Support-Vector Machines, VC-Dimension, Strong and Weak Learning - Boosting, Stochastic Gradient Descent, Combining (Sleeping) Expert Advice, Deep Learning, Further Current Directions.

UNIT 4 Massive Data Problems and Clustering   L-9 Hours

Frequency Moments of Data Streams, Matrix Algorithms using Sampling, k-Means Clustering, k-Center Clustering, Finding Low-Error Clustering, Spectral Clustering, Approximation Stability, High-Density Clusters, Kernel Methods, Recursive Clustering based on Sparse Cuts, Dense Submatrices and Communities, Community Finding and Graph Partitioning, Spectral clustering applied to social networks

UNIT 5   Random Graphs: L-9 Hours

The G(n,p) Model, Phase Transitions, Giant Component, Cycles and Full Connectivity, Phase Transitions for Increasing Properties, Branching Processes, CNF-SAT, Non-uniform Models of Random Graphs, Growth Models, Small World Graphs.

Total: 45 Hours

G.Learning Resources (in IEEE Format)
i.   Text Books:

1. Avrim Blum, John Hopcroft, and Ravindran Kannan, "Foundations of Data Science", Draft Version, June, 2017.
2. Mining of Massive Datasets. v2.1, Jure Leskovek, Anand Rajaraman and JefreyUllman, Cambridge University Press. (2019)

ii.   Reference Books:

1. Jonathan Dinu, "Foundations of Data Science: A Practical Introduction to Data Science with Python", Addison Wesley (2 July 2019), ISBN-10: 0134398807.

iii.   Online Resources:

1. https://web.stanford.edu/class/msande226/l_notes.html
2. https://www.cl.cam.ac.uk/teaching/1819/DataSci/materials.html

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS202	**Big Data Analytics**	2	0	2	3

A. Preamble

Understand how to leverage the insights from big data analytics. Analyze data by utilizing various statistical and data mining approaches and perform analytics on real-time streaming data. Understand the various NoSql alternative database models.

B. Prerequisite Courses

C. Course Objectives

- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide hands on Hodoop Eco System

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	To understand the competitive advantages of big data analytics	K2
CO2	To understand the big data frameworks	K3
CO3	To learn data analysis methods	K3
CO4	To learn about stream computing	K3
CO5	To gain knowledge on Hadoop related tools such as HBase,	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	H		M	M			M	M
CO2	H		M	M			M	M
CO3	M		M	M			M	M
CO4	M		M	M			M	M
CO5	M		M	M			M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION TO BIG DATA   L-9 Hours

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems – Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods -Analysis vs Reporting - Modern Data Analytic Tools.

UNIT 2 HADOOP FRAMEWORK   L-9 Hours

Distributed File Systems - Large-Scale File System Organization – HDFS concepts – MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

UNIT 3 DATA ANALYSIS: L-9 Hours

Statistical Methods: Regression modelling, Multivariate Analysis - Classification: - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT 4 MINING DATA STREAMS   L-9 Hours

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream – Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications -Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT 5 BIG DATA TOOLS   L-9 Hours

Introduction to NoSQL – Aggregate Data Models – HBase: Data Model and Implementations – HBase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries

Total: 45 Hours

G.Learning Resources (in IEEE Format)

i. **Text Books:**
    2. "Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, Second Edition, 2014.
    3. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley, 2013.

ii. **Reference Books:**
    1. Bill Franks,Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
    2. David Loshin, Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, 2013.

3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, Second Edition, 2007.

iii. Online References:

1. https://stat.mit.edu/academics/data-science-data-insight-professional-education/
2. https://nptel.ac.in/courses/106/104/106104189/

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS203	**Data Visualization**	2	0	2	3

A.Preamble

Explain principles of visual perception and to apply core skills for visual analysis. Apply appropriate visualization techniques for various data analysis tasks. To design information dashboard

B.Prerequisite Courses

C.Course Objectives

- Know the basics of data visualization
- Understand the importance of data visualization and the design and use of many visual components
- Learn to wisely use various visualization structures such as tables, spatial data, time-varying data, tree and network, etc.
- Learn the basics of colors, views, and other popular and important visualization-based issues.
- Learn basic algorithms in data visualization

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Discuss the skills required to design and critique visualizations	K2
CO2	Explain visual perception and core skills for visual analysis	K2
CO3	Apply visualization for time-series, ranking and deviation analysis.	K3
CO4	Use visualization for distribution, correlation and multivariate analysis.	K3
CO5	Demonstrate the issues and best practices in information dashboard design	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	H		M	M			M	M
CO2	H		M	M	M		M	M
CO3	H		M	M	M		M	M
CO4	H		M	M	M		M	M
CO5	H		M	M	M		M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION   **L-9 Hours**

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

UNIT 2 VISUALIZING DATA METHODS   **L-9 Hours**

Mapping - Time series - Connections and correlations - Scatterplot maps - Trees, Hierarchies and Recursion - Networks and Graphs, Info graphics

UNIT 3 TIME-SERIES, RANKING, AND DEVIATION ANALYSIS   **L-9 Hours**

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT 4 DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS

L-9 Hours

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT 5 INFORMATION DASHBOARD DESIGN   **L-9 Hours**

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

Total: 45 Hours

G.Learning Resources (in IEEE Format)

i.   Text Books:
1. Stephen Few, Now you see it: Simple Visualization techniques for quantitative analysis, Analytics Press, 2009.
2. Stephen Few, Information dashboard design: The effective visual communication of data, O'Reilly, 2006.

ii.   Reference Books:
1. Scott Murray, Interactive data visualization for the web, O‟Reilly Media, Inc., 2013.
2. Ben Fry, Visualizing Data, O‟Reilly Media, Inc., 2007.
3. Edward R. Tufte, The visual display of quantitative information, Second Edition,Graphics Press, 2001

iii. Online References:

1. https://courses.cs.washington.edu/courses/cse512/14wi/
2. https://www.coursera.org/learn/datavisualization

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS204	Modeling for Data Science	2	0	2	3

A.Preamble

Modeling is the process of applying statistical analysis to a dataset. A statistical model is a mathematical model of observed data. This course applies statistical models to the data by investigating,understanding and interpreting the information more strategically. Rather than sifting through the raw data, this practice allows the students to identify the relationships between variables, make predictions about future sets of data, and visualize the data so that non-analysts and stakeholders can consume and leverage it.

B.Prerequisite Courses

NIL

C.Course Objectives

- Determine the optimal data features for the learning model.
- Create an informative learning model that predicts the target most accurately.
- Create a learning model that is suitable for production.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Apply fundamental statistical modeling techniques to interpret linear regression model	K3
CO2	Perform least square procedure to find the best fit for set of data points	K3
CO3	Build interference in Linear regression to fit a linear equation to observed data	K3
CO4	Analyze the linear regression and predict the data through R studio	K3
CO5	Apply the Regression analysis and investigate the assumptions made about the data and the model	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	H		M	M			M	M
CO2	H		M	M			M	M
CO3	H		M	M			M	M
CO4	H		M	M	M		M	M
CO5	H		M	M			M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 INTRODUCTION TO STATISTICAL MODELS   L-6 Hours
Frameworks and Goals of Statistical Modelling - The Assumption of Concept Validity - The Linear Regression Model - Matrix Representation of the Linear Regression Model - Assumptions of Linear Regression - The Appropriateness of Linear Regression - Interpreting the Linear Regression Model I - Interpreting the Linear Regression Model II

UNIT 2 LINEAR REGRESSION PARAMETER ESTIMATION   L-6 Hours
Introduction to Least Squares - Linear Algebra for Least Squares - Deriving the Least Squares Solution - Regression Modelling in R: a First Pass - Justifying Least Squares: The Gauss-Markov Theorem and Maximum Likelihood Estimation - Sums of Squares and Estimating the Error Variance - The Coefficient of Determination - The Problem of Non-identifiability - Regression Modelling in R: a Second Pass

UNIT 3 INFERENCE IN LINEAR REGRESSION   L-6 Hours
Motivating Statistical Inference in the Linear Regression Context - The Sampling Distribution of the Least Squares Estimator - T-Tests for Individual Regression Parameters - T-Tests in R - Motivating the F-Test: Multiple Statistical Comparisons - The F-Test - The F-Test in R - Confidence Intervals in the Regression Context

UNIT 4 PREDICTION AND EXPLANATION IN LINEAR REGRESSION ANALYSIS
                                                               L-6 Hours

Differentiating Prediction and Explanation - Point Estimates for Prediction - Interval Estimates for Prediction - Making Predictions Using Real Data in R - When Prediction Goes Wrong - Defining Causality

UNIT 5 REGRESSION DIAGNOSTICS   L-6 Hours

Linear Regression Diagnostic Methods - Violations of the Linearity Assumption - Violations of the Independence Assumption - Violations of the Constant Variance Assumption - Violations of the Normality Assumption - Diagnostics in R

Total: 30 Hours

G.Laboratory Experiments   Total: 30 Hours

Part - 1

TASK 1	Implement the Linear Regression model to predict the salary. Consider the dataset with the following attributes i)Year of experience ii)Qualification iii)Salary. **Tool: Python**
TASK 2	Implement the Linear Regression model to predict the age of the person. Consider the dataset with the following attributes i)Height ii)Weight iii)Gender **Tool: Python**
TASK 3	Do a least squares regression with an estimation function defined by use of direct inverse method. **Tools: RStudio, Python**
TASK4	Implement the linear regression model that uses a straight line to describe the relationship between the variables. i) Use only one independent variable in simple linear regression ii) Use two or more independent variable in Multiple linear regression **Tools: RStudio, Python**
TASK5	Perform the test in statistics by use of t.test () in R, to determine the means of two groups are equal to each other in normal distribution **Tools: RStudio, Python**
TASK6	Implement the F-Test in R Programming and calculates the ration between the larger variance and the smaller variance **Tools: RStudio, Python**
TASK7	Build a linear regression model to predict that stopping distances of cars on the basis of the speed. **Tools: RStudio, Python**

TASK8	Use the predict () function to make predictions from that model on new data. The new dataset must have all of the columns from the training data, but they can be in a different order with different values **Tools: RStudio, Python**
TASK9	Implementation of regression diagnostics by using R base functionplot () or the autoplot() function. **Tools: RStudio, Python**
TASK10	Conduct the test using R's build in function called Durbin Watson test to check the assumption of independence. **Tools: RStudio, Python**

Part-2

Use Cases:

Use Case 1: I wanted to see if there was a significant linear relationship between the number of fish meals consumed per week and the total mercury levels found amongst fishermen. The dataset used in this analysis is attached as an appendix item at the end of the article. Since we have data between two variables only, I looked at applying a simple linear regression model to the dataset in question.

Let us use the Linear Regression in R to evaluate the extent of a linear relationship between two variables in a dataset using R.

Use Case 2: You're planning a road trip to Las Vegas with two of your best friends. You start off in San Francisco and you know it's going to be a ~9h drive. While your friends are in charge of the party operations, you're in charge of the all the logistics involved. You have to plan every detail: the schedule, when to stop and where, make sure you get there on time.

Prepare a dataset and use Linear Regression in R to find How much money should allocate for fuel? With the attributes of Total Payed, Total Miles.

Total: 60 Hours

H.Learning Resources (in IEEE Format)

i. Textbook(s):
1. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, "Introduction to Linear Regression Analysis", Wiley Publication, Fourth edition, 2013
2. Alvin C. Rencher, G. Bruce Schaalje, "Linear Models in Statistics", Wiley Publication, Second edition, 2007.

ii. Reference Book(s):
1. James D.Miller, "Statistics for Data Science", Packt Publishing, 2017.

iii. Suggested Web Resource(s):
1. "Statistical Modelling for Data Science Applications Specialization", by coursera https://www.coursera.org/specializations/statistical-modeling-for-data-science-applications

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS205	Deep Learning	2	0	2	3

A.Preamble

This course covers the basics of neural networks are included. Artificial Neural Network, Convolutional Neural Network, Recurrent Neural Networks are included Deep learning tool and its application are included.

B.Prerequisite Courses

2161CS129   Machine Learning Techniques

C.Course Objectives

- To introduce the fundamentals of neural networks
- To enable the students to understand Recurrent Neural networks and Convolutional Neural Networks.
- To introduce complex learning models and deep learning models
- Explore different software packages and tools for Deep learning models

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Analyze Artificial Neural Network model and implement the perceptron learning algorithms	K3
CO2	Apply the Convolutional Neural Network Model to build the deep learning applications	K3
CO3	Implement Recurrent Neural Network and LSTM model and its applications.	K3
CO4	Understand the concept of deep Neural Networks and GAN Architecture	K2
CO5	Explore deep learning tools and applications	K2

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	H		M	M			M	M
CO2	H		M	M			M	M
CO3	H		M	M		M	M	M
CO4	H		M	M			M	M
CO5	H		M	M	M		M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 ARTIFICIAL NEURAL NETWORKS   L- 9 Hours

Artificial Neural Networks: Introduction, Single and Multi-layer Perceptron, Perceptron Training Rule, Activation Functions and softmax cross entropy loss function - Gradient Descent, Backpropagation, Radial basis Function Network

UNIT 2 CONVOLUTIONAL NEURAL NETWORKS ARCHITECTURE   L- 9 Hours

Introduction to Convolutional Neural Networks, Principles behind CNNs, Multiple Filters, Kernel filter, Convolution and Pooling Operation, CNN applications. CNN Architecture-AlexNet, ZFNet, VGG, C3D, GoogLeNet, ResNet, MobileNet

UNIT 3 RECURRENT NEURAL NETWORKS   L-9 Hours

Introduction to Recurrent Neural Networks: Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications – Word Embedding

UNIT 4 DEEP NEURAL NETWORK   L- 9 Hours

Deep Neural Network: Generative Adversarial Networks, Conditional GAN, Cycle GAN. Improving Deep NN – Hyperparameter Tuning, Regularization and Optimization, Types of errors, Bias Variance Trade-off, Overfitting and Underfitting.

UNIT 5DEEP LEARNING TOOLS AND APPLICATIONS   L- 9 Hours

Introduction to TensorFlow: Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, TensorBoard, Modularity, Sharing Variables, Keras. Deep Learning applications: Image Processing, Natural Language Processing, Speech Recognition, Video Analytics.

Total: 45 Hours

G.Learning Resources (in IEEE Format)

i. Text Books
   1. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2016.
   2. CosmaRohillaShalizi, Advanced Data Analysis from an Elementary Point of View, 2015.

ii. Reference Books:
   1. Bishop, C.,M., Pattern Recognition and Machine Learning, Springer, 2006.
   2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
   3. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
   4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education,2004

iii. Online References:
   1. https://nptel.ac.in/courses/106/106/106106184/
   2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s191-introduction-to-deep-learning-january-iap-2020/

COURSE CODE	COURSE TITLE	L	T	P	C
2161CS206	**Soft Computing**	**2**	**0**	**2**	**3**

A.Preamble :

This course gives an introduction to some new fields in soft computing with its principal components of fuzzy logic, GA, and it is hoped that it would be quite useful to study the fundamental concepts on these topics for the pursuit of allied research..

B.Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Analyse a given computational task to recognize the appropriateness through fuzzy sets	K2
CO2	Design a fuzzy based soft computing system to address the computational task	K3
CO3	Analyse a given computational task to solve it through neural network	K2
CO4	Applying Genetic Algorithm operations for solving a computational task	K2
CO5	Design and implement a soft computing system to achieve a computational solution	K3

C.Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M	M			M	M
CO2	M		M	M			M	M
CO3	M		M	M			M	M
CO4	M		M	M			M	M
CO5	M		M	M			M	M

H- Strong; M-Medium; L-Low

D.Course Content :

UNIT 1 INTRODUCTION   L- 9 Hours

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models – important technologies – applications. Fuzzy

logic: Introduction – crisp sets- fuzzy sets – crisp relations and fuzzy relations: cartesian product of relation – classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets

UNIT 2 FUZZY LOGIC   L- 9 Hours

Membership functions: fuzzification, methods of membership value assignments-Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic – extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals – fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems- fuzzy expert system-fuzzy decision making.

UNIT 3 OPTIMIZATION   L- 9 Hours

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Simulated Annealing – Random Search – Downhill SimplexSearch.

UNIT 4 GENETIC ALGORITHM   L- 9 Hours

Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle – stopping condition – constraints – classification – genetic programming – multilevel optimization – real life problem- advances in GA

UNIT 5   HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS

L- 9 Hours

Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

Total :60 Periods

E.Learning Resources (in IEEE Format)

i.   Text books

1. J.S.R.Jang, C.T. Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, PHI / Pearson Education 2004.
2. S.N.Sivanandam and S.N.Deepa, Principles of Soft Computing, Wiley India Pvt Ltd, 2011.

F.List of Experiments

1. Defuzzfication Process using Fuzzy Tool Box
2. Genetic Algorithm-Travelling Salesman Problem sing GA Tool

3. Decision Boundaries using Neural Net Tool Box
4. Non Separable Vectors using MATLAB
5. Linear Pattern Classification using Neural Net Tool Box
6. Create and minimize an objective function using Simulated Annealing in the Global Optimization Toolbox
7. Competitive Learning using Neural Net Tool Box
8. Hopfield Network using Neural Net Tool Box

Tools Used :Matlab

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS207	Natural Language Processing	2	0	2	3

A.Preamble

Natural language processing deals with written text. Students will learn how to process written text from basic of fundamental knowledge starts with Finite automata, Regular expression and probabilistic model with n-grams. This course also covers basis of semantic analysis and discourse analysis and drives it to machine translation

B.Prerequisite Courses

Data Structures

C.Course Objectives (verbs)

Student will be able to
- Provide the student with knowledge of various levels of analysis involved in NLP
- Understand the applications of NLP
- Gain knowledge in automated Natural Language Generation and Machine Translation
- Understand Deep learning concepts for NLP.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

COs	Course Outcomes	K-Level
CO1	Comprehend the fundamental concepts of Natural Language Processing.	K3
CO2	Apply the concept of Probabilistic model of defining language and POS tagging for NLP applications	K3
CO3	Develop the Syntactic parser and Semantic Parser for Translation for word forms	K3
CO4	Interpret the concept of text analysis, summarization and extractions for Information Extraction.	K3
CO5	Apply the concepts of machine translation and deep learning for NLTK Modelling.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M	M			M	
CO2	M		M	M			M	M
CO3	M		M	M			M	M
CO4	M		M	M			M	M
CO5	M		M	M			M	M

H- Strong; M-Medium; L-Low

F.Course Contents

Unit 1 Introduction to Natural Language Processing   L-6 Hours

History of NLP, Components of NLP, Applications of NLP, Phases of NLP, NLP APIs, NLP Libraries, Knowledge in Speech and Language processing, Ambiguity and models and algorithm,language and understanding,brief history. Regular Expressions, Extracting Terms from Tokens, Vector Space Representation and Normalization, Similarity Computation in Text

Unit 2 Language Modelling and Part-of-Speech (POS) Tagging   L-6 Hours

Unigram Language Model, , Counting Words in Corpora, Simple (Unsmoothed) N-grams, Smoothing, Back off, Deleted Interpolation, N-grams for Spelling and Pronunciation, Entropy Natural Language Generation, Parts of Speech Tagging, Morphology, Named Entity Recognition, Overview of Hidden Markov Models.

Unit 3 Words and Word Forms   L-6 Hours

Context-Free Grammars for English, Lexicalized and Probabilistic Parsing, Semantic Analysis, Lexical Semantics, WordNet: A Database of Lexical Relations, Bag of words, skip-gram, Continuous Bag-Of-Words, Embedding representations for words Lexical Semantics, Word Sense Disambiguation, Knowledge Based and Supervised Word Sense Disambiguation

Unit 4 Text Analysis, Summarization and Extractions   L-6 Hours
Sentiment Mining, Entity Linking, Text Classification, LDA & Factorization - Text Summarization, Information Extraction, Named Entity Recognition, Relation Extraction, Question Answering in Multilingual Setting; NLP in Information Retrieval, Vector space model, Cross-Lingual IR

Unit 5 Machine Translation and Deep Learning   L-6 Hours

Need of MT, Problems of Machine Translation, MT Approaches, Statistical Machine Translation (SMT), Parameter learning in SMT (IBM models) using EM, Encoder-decoder architecture, Neural Machine Translation Statistical Language Models, Kernel Methods, Word-Context Matrix Factorization Models, Neural Language Models, Recurrent Neural Networks, Sentiment Analysis, Opinion Mining.

Total: 30 Hours

Lab Task: 30 Hours
Part - I

1. Introduction to Python NLTK. **spaCy,**Libraries (CO1)

2. Performing Word Analysis – NLTK & spaCy (CO1)

3. Analyze algorithms for Word Generation - NLTK & spaCy(CO2)

4. Morphology is important factor for word Embedding. Develop algorithms for finding morphology of Word Documents. NLTK & spaCy, Gensim (CO3)

5. Develop N-Grams for Word Document - NLTK & spaCy, Gensim (CO3)

6. Perform N-Grams Smoothing in Word Documents - NLTK & spaCy, Gensim (CO3)

7. Explore the POS Tagging using Hidden Markov Model - NLTK & spaCy, Gensim (CO3)

8. Use POS Tagging using Viterbi Decoding - NLTK (CO4)

9. Building POS Tagger for unstructured Web Documents [PyTorch, Keras] (CO4)

10. Chunking for Web Documents [PyTorch, Keras] (CO5)

11. Building Chunker for Web Documents [PyTorch, Keras] (CO5)

12. Python Visualizations Libraries – matplotlib, seaborne (CO5)

Part – II [CO1 – CO5]

13. Game Winning Prediction (Cricket)

14. Machine Translation from English-Hindi.

15. Query Expansion for Information Retrieval.

16. Emotion detection for texts.

17. Semantic Search Engine for Indian Languages.

18. Large Hindi Corpora

19. Crisp Query relevant Summary of each retrieved webpage

20. Semantic Query-Webpage Relevance

Total Hours: 60 Hours

G.Learning Resources (in IEEE Format)

i. **Text Books:**
   1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech",, Pearson Publication, 2014.(All 5 Units)
   2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O'Reilly Media, 2009.

ii. **Reference Books:**
   1. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015
   2. Charu   C.Aggarwal, "Machine   Learning   for   Text"- by Springer,2018 edition
   3. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

iii.   Online References:

1. "Natural Language Processing", Mar. 2015. Accessed on: Apr. 16, 2021 [Online]: https://onlinecourses.nptel.ac.in/noc19_cs56
2. "Natural Language Processing" Jun 2016. Accessed on: Apr. 16, 2021 [Online]. https://www.udacity.com/course/natural-language-processingnanodegree
3. "Natural Language Processing" Jul. 2, 2018. Accessed on: Apr. 16, 2021 [Online]. https://www.coursera.org/learn/language-processing

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS208	Reinforcement Learning	3	0	0	3

A. Preamble

This course provides the overview of reinforcement learning paradigm that aims to model the trial-and-error learning process. It is a core area of research in artificial intelligence and machine learning, and today provides one of the most powerful approaches to solving decision problems.

B. Prerequisite Courses

10210MA102- Probability, Statistics and Queuing Theory

C. Course Objectives

Learners are exposed to

- Define RL tasks and the core principals behind the RL, including policies, value functions, deriving Bellman equations
- Understand and work with tabular methods to solve classical control problems
- Understand and work with approximate solutions
- Recognize current advanced techniques and applications in RL

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

COs	Course Outcomes	K-Level
CO1	Understand the fundamental knowledge on reinforcement learning	K2
CO2	Explore the tabular solution methods for reinforcement learning	K3
CO3	Apply the policy gradient methods to provide the solution for real use cases	K3
CO4	Explore the model-based learning approaches in RL environment	K3
CO5	Build the prototype and implement RL algorithm for real world application use cases	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Program Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M	M			M	
CO2	M		M	M			M	
CO3	M		M	M			M	M
CO4	M		M	M			M	
CO5	M		M	M	M		M	M

H- Strong; M-Medium; L-Low

F. Course Contents
Unit 1 Introduction to Reinforcement Learning   L-9 Hours

Introduction and Basics of RL- Defining RL Framework- Elements and History of RL- Markov Decision Process- Polices, Value Functions and Bellman Equations- Exploration vs. Exploitation- Code Standards and Libraries used in RL - Python/Keras/Tensorflow

Unit 2 Tabular Solution Methods   L-9 Hours

Dynamic Programming- Policy Evaluation- Policy Improvement-Policy Iteration- Value Iteration- Generalized Policy Iteration- Monte Carlo- Predictions- Control- Incremental implementation- Off policy- Temporal-Difference learning methods -TD(0)- SARSA- Deep Q-networks – DQN- DDQN- Dueling DQN- Prioritized Experience Replay

Unit 3 Policy Gradient Methods   L-9 Hours

Introduction to policy-based methods- Vanilla Policy Gradient- REINFORCE algorithm and stochastic policy search- Actor-critic methods - A2C- A3C- Advanced policy gradient–PPO-TRPO-DDPG-Function Approximation- Value prediction and control-Gradient Descent Methods-Linear methodsplanning- prioritized sweeping-Heuristic search

Unit 4 Model Based RL and Classical Conditioning   L-9 Hours

Model Based RL- Bayesian Approaches to Reinforcement Learning- Data-efficient Reinforcement Learning- Learning with off-line data- Learning with incompletely specified models- RL and planning- Classical Conditioning : Blocking and Higher-order Conditioning -The Rescorla -Wagner Model - TD Model -Simulations - Instrumental Conditioning – DelayedReinforcement- Cognitive Maps.

Unit 5 Applications   L-9 Hours

Meta-learning- Multi-Agent Reinforcement Learning- TD-GammonSamuel's Checkers Player Watson's Daily-Double Wagering-Mastering the Game of Go- AlphaGo-AlphaGo Zero- Ethics in RL- Applying RL for real-world problems- Optimizing Memory Control-Human-level Video Game Play- Autonomous UAV Navigation and path planning -Drones for Field Coverage.

Total: 45 Hours

G.Learning Resources

i.Text Books:
1. Richard S. Sutton and Andrew G. Barto. Introduction to Reinforcement Learning, 2nd Edition, MIT Press. 2018.[Unit 1,2,3, and 4]
2. Csaba Szepesvári, Algorithms for Reinforcement. Morgan & Claypool. 2010. [Unit 4 and 5]

ii.Reference Books:

1. D.P.Bertsekas, Dynamic Programming and Optimal Control, Vol. I, Athena Scientific, 2017

2. Sudharsan Ravichandiran, Hands-On Reinforcement Learning with Python-Master Reinforcement and Deep Reinforcement Learning Using OpenAI Gym and TensorFlow, Packt Publishing ISBN- 9781788836913, 178883691X, 2018.

iii. Online References:

1. https://web.mst.edu/~gosavia/rl_website.html
2. https://link.springer.com/referenceworkentry/10.1007%2F978-0-387-30164-8_714
3. https://onlinecourses.nptel.ac.in/noc19_cs55/preview

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS209	**Computer Vision**	**2**	**0**	**2**	**3**

A.Preamble

This course offers broad area of computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving. Students will learn principles of image processing algorithms, image segmentation/classification techniques, 3D vision and 3D motion.

B.Prerequisite Courses

Machine Learning

C.Course Objectives

The following are the course objectives.
- Basic theory and algorithms that are widely used in digital image processing.
- Current technologies in clustering and classification that are specific to image processing systems.
- Inculcate 3D vision techniques like photometric stereo and multiple view vision
- Build hands-on experience in using computers to process objects in motion.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Develop methods that does camera calibration and color representations	K3
CO2	Implement image filtering, do edge detection and use texture synthesis method	K3
CO3	Apply the concept of pattern analysis and image clustering techniques	K3
CO4	Implement methods to process 2D images to obtain 3D representations.	K3
CO5	Develop the techniques in motion estimation for computer vision applications	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create			

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M	M			M	M
CO2	M		M	M			M	M
CO3	M		M	M			M	M
CO4	M		M	M			M	M
CO5	M		M	M			M	M

H- Strong; M-Medium; L-Low

F.Course Contents

Unit 1 Introduction to Computer Vision   **L-6 Hours**

Introduction to Computer Vision, Fundamentals of Image Formation - Camera Imaging Geometry – Camera Calibration – Color Representations - Linear Filters and Convolution (Discrete/Continuous) – Gradient-Based Edge Detection - Vector Quantization and Textons – Synthesis by Sampling Local Models - Binocular Camera Geometry and the Epipolar Constraint

Unit 2 Hough Transform   **L-6 Hours**

Line detection – Hough Transform (HT) for line detection – The Foot-of-Normal Method RANSAC for straight line detection – HT based circular object detection – Unknown Circle Radius – speed problem – ellipse detection

Unit 3 Image Segmentation and Classification   **L-6 Hours**

Shot Boundary Detection - Interactive Segmentation - Forming Image Regions - The Watershed Algorithm - Segmentation Using K-means - Encoding Layout with GIST Features - Summarizing Images with Visual Words - The Spatial Pyramid Kernel - Classifying images of single objects

Unit 4 3D Vision   **L-6 Hours**

Methods for 3D vision - Projection Schemes - Shape from Shading - Photometric Stereo – The Assumption of Surface Smoothness - Shape from Texture – Horaud's Junction Orientation Technique - 3D object recognition – Multiple View Vision

Unit 5 Digital Video Processing   **L-6 Hours**

Video Sampling and Interpolation, Motion Detection and Estimation, Video Enhancement and Restoration, Video Quality Assessment, Video Segmentation, Motion Tracking, Video Surveillance.

Theory: 30 Hours

G.Lab Experiments:

Part I:
Task 1: Implement the linear and non-linear calibration algorithm using python language. – (CO1)

Task 2: Using the given spectra data set, fit a finite-dimensional linear model to a set of illuminants and surface reflectance's using principal components analysis, render the resulting models, and compare your rendering with an exact rendering. (CO1)

Task 3: Detect the edges of the given image using gradient-based approach. (Python) (CO2)

Task 4: Use k-means clustering algorithm to do vector quantization. (Python) (CO2, CO3)

Task 5: Implement the non-parametric texture synthesis algorithm. Use your implementation to study:
      (a) The effect of window size on the synthesized texture;
      (b) The effect of window shape on the synthesized texture; and
      (c) The effect of the matching criterion on the synthesized texture (i.e., using a weighted sum of squares instead of a sum of squares, etc.) (Python) (CO3)

Task 7: Implement a mean shift segmenter (python). (CO3)

Task 8: Implement the two version of graph-based segmenter discussed in the lecture hours (python). Use your graph-based segmenter to build an interactive segmentation system. (CO3)

Task 9: Build a classifier that classifies materials using the given dataset. Compare the performance of your system using the main feature constructions described here (GIST features; visual words; spatial pyramid kernel). Investigate the effect of varying the feature construction; for example, is it helpful to use C-SIFT descriptors? (CO4)

Task 10: Implement photometric stereo for the given set of similar images. (Tool: python) (CO4)
Task 11: Perform 3D object detection using ZED SDK (Tool: python) (CO5)

Task 12: Process the 2D image to obtain a 3D image representation. (Tool: python) (CO5)

Task 13: For a moving object, detect its motion and track it using python and OpenCV. (Tool: python) (CO5)

Task 14: Compute the depth map of a given image/video programmatically. (Tool: python, MATLAB) (CO5)

Task 15: Implement a Bayesian Model for optimizing the Video Quality . (Tool: python, MATLAB, OpenVeno) (CO5)

Part II: (CO1 – CO5)
Use Case 1: Human Iris Location for determining the gaze direction

Use Case 2: Face detection and recognition for security applications

Use Case 3: Surveillance in transport to monitor traffic and people

Use Case 4: Application of Computer Vision in Visual Hulls: Tracing Intersection Curves, Clipping Intersection Curves, Triangulating Cone Strips, Carved Visual Hulls

Laboratory: 30 Hours

H.Learning Resources (in IEEE Format)

i. Text Books:

1. Computer Vision - A Modern Approach, by D. Forsyth and J. Ponce, Pearson Education, 2003 (UNIT I, III)
2. E. R. Davies , "Computer Vision: Principles, Algorithms, Applications, Learning", 5th Edition, Academic Press, 2018 (UNIT II, IV, V)

ii. Reference Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision,Third Edition, Academic Press, 2012.

iii. Online References:

1. "Computer Vision"" Mar. 2, 2015. Accessed on: Apr. 16, 2021 [Online].

   https://onlinecourses.nptel.ac.in/noc21_ee23/preview

2. "Computer Vision" 2016. Accessed on: Apr. 16, 2021 [Online].

   https://www.coursera.org/learn/machine-learning

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS117	**Cryptography & Network Security**	**3**	**0**	**0**	**3**

A.Preamble :

To provide a thorough knowledge about the cryptography and network security

B.Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understanding the basics of Encryption	K2
CO2	Discussing the Number theory and public key cryptography.	K2
CO3	Learning the concepts of Message authentication and Hash functions.	K2
CO4	Understanding the concepts of digital signature and authentication protocols.	K3
CO5	Understanding the implementation of Network security	K3

C.Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M				M	
CO2	M		M				M	
CO3	M		M				M	M
CO4	M		M				M	
CO5	M		M				M	

H- Strong; M-Medium; L-Low

D.Course Content :

UNIT 1 CONVENTIONAL ENCYRPTION   **L-9 Hours**

Introduction to security attacks (DDoS) - services and mechanism - Conventional encryption model - DES - RC 5 Introduction to AE 5 - Random number generation.

UNIT 2 NUMBER THEORY AND PUBLIC KEY CRYPTOGRAHY   **L-9 Hours**

Modular arithmetic - Euler's theorem - Euclid's algorithm - Chinese remainder theorem - Primary and factorization - Discrete logarithms - RSA algorithm - Diffe Hellmann key exchange.

UNIT 3 MESSAGE AUTHORISATION AND HASH FUNCTIONS   **L-9 Hours**

Hash functions - Authentication requirements - authentication function - Message Authentication codes - Secure Hash Algorithms.

UNIT 4 DIGITAL SIGNATURE AND AUTHENTICATION PROTOCOLSL-9 Hours

Digital Signature - Authentication protocols - Digital Signature standard.

UNIT 5 NETWORK SECURITY   **L-9 Hours**

Pretty good privacy - S/MIME-IP Security Overview - Web Security.

                                        TOTAL : 45 Hours

E.Learning Resources

i. Text Books:

1. Stallings W., "Cryptography and Network Security Principles and Practice", Prentice Hall, New Jersey, 1999.

ii. Reference Books:

1. E.Biham and A. Shamir, "Diffential Crypt analysis of the data encryption standard", Springer Verlag, 1993.

2. D.Denning, "Cryptography and data security", Addison Wesley, 1982.

3. N.Kobliz, "A course on Number theory and Cryptography", Springer Verlag, 1994.

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS156	Cyber Forensics	3	0	0	3

A.Preamble

Cyber forensics is the practice of identifying, collecting, preserving, analyzing, and documenting digital evidence in a legally admissible way in a court of law. This course focuses on the procedures for identification, preservation, and extraction of electronic evidence, analysis and documentation of information gathered. It also provides hands on experience on various forensic tools and resources for system administrators and information system security officers.

B.Prerequisite Courses

S.No.	Course code	Course name
1		Operating systems
2		Computer Networks

C.Course Objectives

Students are able to

- Understand the fundamentals of cyber forensics.
- Know the process of data acquisition and recovery.
- Learn the methods of investigation using digital forensic techniques and tools.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Discuss the basics of forensics, investigation and evidence management.	K2
CO2	Classify evidence and understand quality control procedures	K2
CO3	Apply tools for the acquisition and recovery of data in Windows and UNIX/LINUX.	K3
CO4	Infer and conduct basic network forensic analysis and perform email investigation	K3
CO5	Use forensic tools and perform ethical hacking tasks.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M	M			M	
CO2	M		M	M			M	
CO3	M		M	M	M		M	M
CO4	M		M	M			M	
CO5	M		M	M	M		M	M

E.   H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 Introduction to Forensics   L-9 Hours

Introduction to Forensics-Elements of crime, Knowledge base needed for cyber forensics, Law and Cyber forensics, Types and characteristics. Investigative Process-Code of Ethics, Ethics of Investigations, Evidence: Evidence Management- Collection, Transport, Storage, access control, disposition.

UNIT 2 Forensic Science   L-9 Hours

Principles and Methods: Scientific approach to Forensics, Identification and Classification of Evidence, Location of Evidence: Storage Media, Hard drives, Hardware Interfaces, Recovering Data, Media File Forensic Steps-Forensic Analysis: Planning, Case Notes and Reports, Quality Control.

Unit 3 Data Acquisition and Recovery   L-9 Hours

Windows and CLI Systems: File systems, Disk Drives, Solid-state storage devices. File Structures: Disk partitions, FAT disk, NTFS disk: MFT and File attributes, Microsoft startup tasks Virtual machines. Unix/Linux Forensic Investigation, Unix/Linux forensics investigation steps and technologies, Evidence Recovery: Introduction to Deleted File Recovery, Formatted Partition Recovery, Steganography.

Unit 4 Network and E-mail Forensics   L-9 Hours
Network forensics overview: Securing a Network, Developing procedures for network forensics, Investigating virtual networks, Examining Honeynet projects. E-mail Investigations: Role of client and server in E-mail, Investigating E-mail crimes and violations, E-mail headers, E-mail Files, E-mail Server Forensics, E-mail Forensic tools,Case Study: Device Seizure using Paraben Tool.

Unit 5 Forensics Tools   L-9 Hours

Valuating Forensics Tool Needs - Tasks performed by forensics tools- Forensics Software Tools: Command-line forensic tools, Linux forensic tools- Forensics Hardware Tools: Forensic

work station, Write-Blocker- Validating and Testing Forensics Software, Mobile Forensics Tools.

Total: 45 Hours

G.Learning Resources

i. **Text Books:**
   1. Chuck Eastom, "Certified Cyber Forensics Professional Certification, McGraw Hill, July, 2017. [1-5 Units]

ii. **Reference Books:**
   1. Bill Nelson, Amelia Phillips and Chris Steuart, "Guide to Computer Forensics and Investigations", Cengage Learning, 6th edition, 2019.
   2. Joakim Kavrestad, "Fundamentals of digital forensics, theory, methods, and real life applications", Second Edition, ISBN 978-3-030-38954-3, Springer, 2020.
   3. Nhien-An Le-Khac, Kim-Kwang Raymond Choo, "Cyber and Digital Forensic Investigations, A Law Enforcement Practitioner's Perspective", Polish Academy of Sciences, Warsaw, Poland, ISBN 978-3-030-47131-6 Springer, 2020.

iii. **Online References:**
   1. Rochester Institute of Technology 'Computer Forensics' [Online] Available: https://www.edx.org/course/computer-forensics-3
   2. West Virginia University, "Forensic Accounting and Fraud Examination", https://www.coursera.org/learn/forensic-accounting

COURSE CODE	COURSE TITLE	L	T	P	C
2162CS157	Ethical Hacking	3	0	0	3

A.Preamble

This course provides the skills in hacking techniques, methodologies, tools, tricks and security measures to secure an organization's IT systems. It is a course that has become very important in present-day context, and can help individuals and organizations to adopt safe practices and usage of their IT infrastructure. Starting from the basic topics like networking, network security and cryptography, the course will cover various attacks and vulnerabilities and ways to secure them. There will be hands-on demonstrations that will be helpful to the students.

B.Prerequisite Courses

10211CS109-Computer Networks

C.Course Objectives

Students are exposed to
- Understand and analyse Information security threats & counter measures
- Apply variety of scanning and probing techniques on a network
- Determine the various OS vulnerabilities.
- Understand penetration and security testing issues on wireless network and web application

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the Laws of the Land for ethical hacking, and evaluate credentials and roles of penetration testers.	K2
CO2	Perform reconnaissance on a target network using a variety of scanning and probing techniques.	K2
CO3	Determine the Microsoft and Linux Operating Systems vulnerabilities.	K2
CO4	Classify the various web applications vulnerabilities and wireless networks attacks.	K3
CO5	Describe the cryptography and hashing methods, Intrusion Detection and Prevention System.	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	M		M				M	
CO2	M		M	M			M	M
CO3	M		M				M	M
CO4	M		M				M	M
CO5	M		M				M	M

H- Strong; M-Medium; L-Low

F.Course Contents

UNIT 1 Ethical Hacking Overview   **L-6 Hours**

Introduction to Ethical Hacking – Laws of the Land – Concept of ethical hacking and essential Terminologies – Malicious Software – Protecting against malware attacks – Intruder Attacks – Physical Security

UNIT II Reconnaissance and Scanning   **L-6 Hours**

Foot printing – Web Tools – Conducting Competitive Intelligence – DNS Zone Transfers – Social Engineering – Port Scanning – Types of Port Scanning – Port Scanning tools – Ping Sweeps – Scripting

UNIT III Enumeration   **L-6 Hours**

Introduction to Enumeration – Windows Operating System – NetBIOS – NetBIOS Null Session, NetBIOS Enumeration Tools- Unix Operating System – Windows OS Vulnerabilities – Hardening Windows OS- Linux OS Vulnerabilities.

UNIT IV Web Server and Wireless Hacking   **L-6 Hours**

Understanding Web Application – Web Application vulnerabilities –Web Application Injection Attacks - Code injection, SQL injection, cross site scripting -Tools for Web Attackers and Security Testers – Wireless Technology – Wireless network standard – Authentication – Wardriving – Wireless Hacking

UNIT V Cryptography Attacks and Network Protection systems   **L-6 Hours**

Basics of Cryptography attacks – Brute Force Attack, Replay Attack, Frequency Analysis and the Ciphertext Only Attack, Network Protection systems: Routers – Firewalls – Intrusion Detection and Prevention System - Honey pots.

Total : 45 Hours

G.Learning Resources (in IEEE Format)

i. Text Books:
1. Michael T. Simpson, Kent Backman, James Corley - Hands-On Ethical Hacking and Network Defense, Cengage Learning, Second Edition, 2012 (Unit I-III,V)
2. "Ethical Hacking and Countermeasures ", EC-Council, Publisher: Course Technology; 2nd edition, 2016. (UNIT-IV)

ii.Reference Books:

1. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle - Gray Hat Hacking The Ethical Hackers Handbook, McGraw Hill Education, Third Edition, 2017

2. Sean Philip Oriyano and Michael Gregg - Hacker Techniques, Tools and Incident Handling,

iii.Online Resources:

1. Grey Campus - "Ethical Hacking". Accessed on: Apr. 20, 2021 [Online]. Available: https://www.greycampus.com/opencampus/ethical-hacking