GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

Name of Department:- Computer Science and Engineering

1. Subject Code: TCS 509 Course Title: **Machine Learning**
2. Contact Hours: L: 3 T: - P: 2
3. Semester: V

4. Pre-requisite: TCS201, TCS421
5. Course Outcomes: After completion of the course students will be able to
    1. Haveagoodunderstandingofthefundamentalissuesandchallengesofmachine learning: data, model selection, model complexity,etc.
    2. Distinguishthestrengthsandweaknessesofmanypopularmachinelearningapproaches.
    3. Analyze the underlying relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
    4. Utilize the structure and design concepts of neural networks applications to solve real life problems
    5. Plan and execute successful machine learning and big data projects, including selecting an adequate process for the specific task and avoiding the machine learning pitfalls.
    6. Evaluate the issues raised by current research in the field of machine learning

6.Detailed Syllabus

UNIT	CONTENT	Contact Hrs
Unit – I	**Review of Statistical Concepts:** Mean, Median, Mode, Outliers, Range, Average Deviation, Absolute Deviation, Squared Deviation, Standard Deviation, Total Sum of Squares. **Introduction to Machine Learning:** What is Machine Learning, Introduction to ML's three approaches: Supervised, Unsupervised and Reinforcement Learning. **Introduction to Python:** BasicOpeartions**,** Lists, Tuples, Dictionaries, Flow Control, Strings, File handling, Numpy, Scikit-learn	**10**
Unit - II	**Introduction to Exploratory Data Analysis** Introduction to Exploratory Data Analysis (EDA) –Steps in EDA, Data Types: Numerical Data – Discrete data, continuous data – Categorical data **Data Transformation** Transformation Techniques: Performing data deduplication - replacing values – Discretization and binning. Introduction to Missing data, handling missing data Data Visualization using Matplotlib, Seaborn	
Unit – III	**Supervised Learning Algorithms:** Linear Regression, Logistic Regression, Decision Trees, Random Forest, Support Vector Machine,K-Nearest Neighbours, CN2 Algorithm, Naive Bayes	**10**
Unit -IV	**Clustering:** K-means, Silhoutte Scores, Hierarchical Clustering, Fuzzy c-means, DBScan **Dimensionality Reduction:**Low Variance Filter, High Correlation Filter, Backward Feature Elimination, Forward Feature Selection,Principle Component Analysis, Projection Methods.	**8**

Unit V	Model Evaluation and Selection: Cross-validation, model evaluation metrics, model selection, and hyperparameter tuning. **Hyperparameter Optimization Techniques** Manual Search, Random Search, Grid Search Case study in Python for Hyperparameter Tuning	
	Total	**49**

Text and Reference Books

1. "Machine Learning For Dummies", John Paul Mueller and Luca Massaron
2. "A Course in Machine Learning", Hal Daumé III.
3. "Programming Collective Intelligence: Building Smart Web 2.0 Applications", Toby Segaran
4. "Building Machine Learning Systems with Python", WilliRichert and Luis Pedro Coelho
5. "Learning scikit-learn: Machine Learning in Python", Raúl Garreta and Guillermo Moncecchi
6. "Machine Learning in Action", Peter Harrington

GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

1. Name of Department: - Computer Science and Engineering
2. Subject Code: Course . . **TCS 502** Title: **Operating Systems**
3. Contact Hours: **L:** **3** . **T:** **0** **P**: **0**
4. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
5. Relative Weight: **CIE** **25** **MSE** **25** **SEE** **50**
6. Credits: **3**
7. Semester: **4**
8. Category of Course: **DC**
9. Pre-requisite: **TCS 301, TCS 302, TCS 404**

9. **Course Outcome **:**	After completion of the course the students will be able to**:** CO1 Understand the concept and design issues associated with an operating system. CO2: Identify the problems related to process management, synchronization and apply learned methods to solve basic problems. CO3. Explain the basics of memory management and the use of virtual memory in modern operating systems. CO4. Understand the concept deadlock avoidance, prevention, and detections techniques. CO5: Implementation of process management, memory management and file management using system calls. CO6: Analyze the data structures and algorithms used for developing an operating system.

*** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.*

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours

1	**Introduction to Operating Systems, UNIX:** What operating systems do; Operating System structure; Operating System Services; Operating System Classification; User - Operating System interface; System calls; Types of system calls; Operating System structure; Unix command: Command Structure, Internal and External commands, filters; vi editor.	8
2	**Process Management:** Process concept; Operations on processes; Multithreading models; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling; Thread scheduling. Process Synchronization: Inter-process communication; Synchronization: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization.	10
3	**Deadlocks:** Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance - resource trajectories, safe and unsafe states, bankers' algorithm; Deadlock detection and recovery from deadlock.	8
4	**Memory Management:** Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Page replacement; Allocation of frames; Thrashing	10
5	**File System Management**: File System: File concept; Access methods; Directory structure; Protection. File system structure; Directory implementation; Allocation methods; Free space management. Secondary Storage Structures: Mass storage structures; Disk structure; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Access matrix.	8
	Total	**44**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 7th edition, Wiley India, 2006.	7st	2006
2.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 7th edition, Wiley India, 2006.	7th	2006
3.	Unix concepts and applications – Sumitabha Das	1st	2005
	Reference Books		

1.	Andrew S Tanenbaum: Operating Systems: Design and Implementation, 3rd edition, Prentice Hall, 2006	3rd	2006
2.	Stuart E. Madnick, John Donovan: Operating Systems, Tata McGraw Hill, 2008		2008

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS-503** Course Title: **Database Management System**
2. Contact Hours: **L:** 3 **T:** 0 **P:** 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **SEE** 50
5. Credits: 3
6. Semester: 5th
7. Category of Course: DC
8. Pre-requisite: TCS 302, TCS 404

9. **Course Outcome**:**	After completion of the course the students will be able to**:** **CO1:** Understand the different issues involved in the design and implementation of a database system. **CO2:** Study the physical and logical database designs, database modeling, relational, hierarchical, and network models. **CO3:** Understand and use data manipulation language to query, update, and manage a database. **CO4:** Develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency. **CO5:** Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS. **CO6:** Evaluate a business situation and designing & building a database application

*** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.*

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 1:** **Introduction:** An overview of DBMS; Advantages of using DBMS approach; Database systems vs File Systems, Database system concepts and architecture Data models, schemas, and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of Database Management systems.	9
2	**Unit 2:** **Entity-Relationship Model:** Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets,	9

	Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two.	
3	**Relational Model and Relational Algebra:** Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra and Calculus Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations. Examples of Queries in Relational Algebra; Relational Database Design Using ER- to-Relational Mapping. **SQL – 1:** SQL Data Definition and Data Types; Specifying basic constraints in SQL; Schema change statements in SQL; Basic queries in SQL; More complex SQL Queries. **Insert, Delete and Update statements in SQL;** Specifying constraints as Assertion and Trigger; Views (Virtual Tables) in SQL; Additional features of SQL; Database programming issues and techniques; Embedded SQL, Dynamic SQL; Database stored procedures**.** **Optimization of SQL Queries through Indexes, Concepts of NoSQL.**	11
4	**Unit 4: Database Design – 1:** Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form Properties of Relational Decompositions; Algorithms for Relational Database Schema Design; Multivalued Dependencies and Fourth Normal Form; Join Dependencies and Fifth Normal Form; Inclusion Dependencies; Other Dependencies and Normal Forms	9
5	**Unit 5:** **Transaction Management: The ACID Properties;** Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock 9Management; Log Files; Checkpointing; Recovering from a System Crash; Media Recovery	10
	Total	**48**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	McGraw-Hill. Date K., Swamynathan S. An Introduction to Database Systems. Eight Edition. Pearson.	2nd	**2012**
2.	Elmasri R. and Navathe S.B., Fundamentals of Database Systems.	2nd	**2012**

3.	Fifth Edition.Pearson. Singh S.K., Database Systems- Concepts, Designs and Application. 2nd Edition. Pearson	2nd	**2011**
4.	Date, C.J. Introduction to Database Systems (Vol I & II) 8th Edition. Addison- Wesley.	8th	**2004**
	Reference Books		
1.	Silberschatz A. Korth H. F. Sudarshan S., Database System Concepts. Sixth Edition	1st	**2014**

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

PCS 502 Operating Systems Lab

. **Course Outcome:**	**After completion of the course the students will be able to:** CO1. Implement concept of system calls for process management. CO2. Analyze and Implement various algorithms like FCFS, Priority and Round Robin for CPU scheduling. CO3. Simulate working of page replacement policies like FIFO, LRU. CO4. Compare various algorithms for communication between processes like pipe, named pipe, message queue and shared memory.

Details of the Course:

Sl. No.	List of problems for which student should develop program and execute in the Laboratory	Contact Hours
1	**Problem Statement 1:** Demonstration of FORK() System Call	3
2	**Problem Statement 2:** Parent Process Computes the SUM OF EVEN and Child Process Computes the sum of ODD NUMBERS using fork	3
3	**Problem Statement 3:** Demonstration of WAIT() System Call	3
4	**Problem Statement 4:** Implementation of ORPHAN PROCESS & ZOMBIE PROCESS	3
5	**Problem Statement 5:** Implementation of PIPE	3
6	**Problem Statement 6:** Implementation of FIFO	3
7	**Problem Statement 7:** Implementation of MESSAGE QUEUE	3

8	**Problem Statement 8:** Implementation of SHARED MEMORY	3
9	**Problem Statement 9:** Implementation of FIRST COME FIRST SERVED SCHEDULING ALGO	3
10	**Problem Statement 10:** Implementation of SHORTEST JOB FIRST SCHEDULING ALGO	3
11	**Problem Statement 11:** Implementation of PRIORITY SCHEDULING ALGO	3
12	**Problem Statement 12:** Implementation of First comes first serve page replacement policy	3
13	**Problem Statement 13:** Implementation of Least recent used page replacement policy	3
14	**Problem Statement 14:** Demonstration of execl() where child process executes "ls" COMMAND and Parent process executes "date" COMMAND	3
15	**Problem Statement 15:** Implementation of COMMAND ls|wc USING PIPES.	3
	Total	**45**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Abraham Silberschatz, Peter Baer Galvin, Greg Gagne:	Operating System Principles	7th Edition	Wiley India	2006
Sumitabha Das	Unix concepts and applications	4th Edition	McGraw Hill Education	2017

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year

Andrew S Tanenbaum	Operating Systems: Design and Implementation,	3rd Edition	Prentice Hall,	2006
Stuart E. Madnick, John Donovan:	Operating Systems,	1st Edition	Tata McGraw Hill,	2008

GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **PCS-503** Course Title: **Database Management System Lab**
2. Contact Hours: **L:** 0 **T:** 1 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CIE** 25 **MSE** 25 **SEE** 50
5. Credits: 2
6. Semester: 5th
7. Category of Course: DC
8. Pre-requisite: TCS 302, TCS 404

9. **Course Outcome**:**	**After completion of the course the students will be able to:** **CO1:** Students get practical knowledge on designing and analysis of conceptual model and mapping of conceptual model to relational database systems. **CO2:** Design and implement SQL queries using DDL and DML concepts for updation and managing a database. **CO3:** Design and implement advance SQL queries such as relational constraints, joins, set operations, aggregate functions, and views. **CO4:** Design and implement queries using optimization techniques. **CO5:** Application of transaction control language (TCL), data control language (DCL) in SQL to evaluate practical implications of DBA such as transaction, recovery, and security.

*** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.*

10. **Details of the Course:**

Sl. No.	List of problems for which student should develop program and execute in the Laboratory	Contact Hours
1.	**Week 1: (Store all your data in a file named `db.sql` and email it to yourself for future reference and use in subsequent labs.)** • Create a Scenario based ER-Models with the entities. (Hospital Details like: Wards, Patients, Doctor, Bills etc) • Convert this ER-model into table with all the entities. (Minimum five Entities).	

	• Insert random data in each column of all the tables. • Update the table by applying some conditions.(For example: using alter command) • Apply the `DELETE` and `DROP` command, and then review the results.	
2.	**Week 2:** • Create a user and provide the GRANT privileges to the user on the database then REVOKE the given privileges. • Insert any five records in the previous schema and apply the rollback. Also check the results. • Add default, check, unique and not null constraints to the schema. • Insert NULL values and check the results. • Add duplicate value and try to make a column as primary key, check what happen to the table.	
3.	**Week 3: (If the Employee table is not present in the `db.sql` file, please create it.)** • Create an Employee table with the following attributes and constraints: Employee Table - (Employee Id. (Primary key), Name, Department, Age (check >18), Salary, City). • Display the total number of employees. • Retrieve all information of employees whose age is 22. • Fetch the employee id, name, and department, whose salary >= 50000. • Print the name of the employees and label the column as "Full Name" for those employees whose department name is 'Finance' and age is 22. • Print the department names from the employee table without having the duplicates. **Perform similar queries until the end of the lab session.**	
4.	**Week 4:** • Find out the maximum and minimum salary from the employee table. • Show the total salary and average salary of all the employees. • Show all the details of the employees who have the same salary. • Display the employees name from lowest salary to the highest salary. • Display the employee name and salary (department-wise) for employees, whose salary is greater than or equal to 10,000 and age is greater than 25.	

5.	**Week 5:** • Fetch the information of employees who belong to the city "Delhi" or "Pune." • Print the name and department of employees whose ID is in the range from 2001 to 2005. • Show the names of employees who belong to the same city (use the IN operator). • Check whether the all employee is belongs to the same city or not. (use ALL operator) • Check whether the all employee is belongs to the same city or not. (use ANY operator) • Check whether the all employee is belongs to the same city or not. (use Exists operator)	
6.	**Week 6:** • Show the record of employees who are working in the 'CSE' department. • Fetch the names of employees whose names start with the letters 'ay'. • Fetch the information of employees, including their names and departments, whose names end with the letters 'sh'. • Display the employee names and their departments of employees, whose city name starts with 'D' or ends with 'h'. • Print all records of employees whose salary is greater than 15,000 and whose name starts with 'h'. • Print the names of employees whose names consist of exactly three letters. • Print the names of employees along with their city for those whose names have at least five letters.	
7.	**Week 7:** • Create two tables named as employee and department with the given constraints and attributes: Employee table - (Employee Id.(Primary key), Department ID, Name, Age (check >18), Salary, City) Department table - (Department Id, and Department name) • Display the details of employees along with their corresponding department names. • Print the names of employees who are not assigned to any department. • Print the employee names and department names for employees whose salary is greater than 25,000. (Using left join). • Display the names of employees along with their department names for those who are not assigned to any department.	

	• Print the employee names and their corresponding department names for employees with a salary greater than 25,000. (Using right join). • Display the names of departments along with the names of employees who are older than 30 years.	
8.	**Week 8:** • Create the table to keep track of customer records and their order. Customer table - (Name as Not null, Customer_id as primary key, Age, Address) Order table - (Customer_id, order_id, date). • Apply the full join and the full outer join to the schema and review the results. • Display the name of the city as "destination" for customers who have placed orders. • Apply the cross join and check the results. • Display the customer names and order IDs for customers who have placed orders from the same city.	
9.	**Week 9:** • Create the Student table, Register table and Program table. Student table - (Roll no. as primary key, Name as not null, city) Program table - (Program ID as primary key, Program Name as not null, Program Fee not less than 10000, Department) Register table - (Program ID and Roll no. as primary composite key) • Display the details of students who are registered in the "MCA" program. • Display the list of all students, who are registered in at least one program. • Display the details of programs that have fees greater than the average fee. • Display the names of students who are registered in a program having fees less than 30000. • Display the details of students who have not registered in any course. • Display the names of programs in which a maximum number of students are registered. • Display the names of programs in which a minimum number of students are registered.	
10.	**Week 10:** • Find out the second minimum salary of an employee.	

	• Find out the second minimum salary of an employee without using limit, dense range, and order by clause. • Find out the third maximum salary of an employee. • Find out the third maximum salary of an employee without using limit, dense range, and order by clause. • Display the names and salaries of employees who earn more than the average salary of their department. • Fetch the list of the employee who belongs to the same department but earns less than the second employee. • Display the names of employees who are older than their colleagues in the same department.	
11.	**Week 11:** • Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the EMPLOYEE table. This trigger will display the salary difference between the old values and new values. • Add a new employee with the salary value inserted and check the result. • Try to update the existing employee salary and see what happens. • Delete a record of employees and check what happens. • Convert employee name into uppercase whenever an employee record is inserted or updated.	
12.	**Week 12:** **Case study 1: (General Hospital)** A hospital relies on a database to manage its operations effectively. This database helps keep track of various aspects, including different wards like the General Ward, Emergency Ward, and Specific Ward. Each ward contains patients who are admitted based on their General Practitioner's (GP) recommendation and the approval of a consultant from the hospital. When a patient is admitted, the hospital records essential personal details such as their name, age, gender, address, and contact information. This information is crucial for medical and administrative purposes. Additionally, the hospital maintains a separate register to record all medical tests and treatments for each patient, ensuring that their medical history is thoroughly documented. Patients may undergo multiple tests during their stay, and the database is designed to link each patient with these test	

	records. Each patient is assigned a leading consultant who oversees their treatment, but they may also be examined by other doctors if needed. The database also tracks the connections between patients, consultants, and doctors. Consultants and doctors might specialize in different medical fields and can treat patients from various wards, adding flexibility to the care provided. Overall, this database ensures that patient information, medical records, and hospital operations are managed efficiently. It supports the hospital in delivering high-quality care, streamlining administrative tasks, and addressing the specialized needs of patients and medical staff. **Based on the details provided in the case study, address the following requirements:** Create an ER diagram based on the hospital's database system case study. Include entities like patients, wards, consultants, and doctors with relevant attributes such as Patient ID, Ward ID, and Consultant ID. Also, none of the entities in the template are marked as weak; if you wish to change that, you may. You will need to specify two things: a. Specify all attributes and keys for each entity. Clearly define relationships, such as patients being associated with wards, consultants, and doctors, and include connections between patients and their medical tests. b. Define all relationships and constraints, including primary keys, cardinality, and participation constraints. Show how a patient can undergo multiple tests and be treated by various doctors. Note: Model most constraints from the description. If some constraints can't be represented, provide comments explaining the limitations.	
13.	**Week 13:** **Case Study 2: (Tracking the Employee Record)** An organization has implemented a detailed database system to manage and track its employees and departmental activities. The organization is divided into various departments, each with a unique identification number and name. Each department is managed by a designated manager, who is responsible for overseeing the operations within that department. Additionally, some departments may be located in different geographic locations, reflecting the organization’s diverse operational reach. The database maintains comprehensive records for each employee, including their name, identification number, birth date, address, gender, and salary. Employees are assigned to specific departments, and the system tracks the date on which a manager was appointed to each department, ensuring that managerial changes are recorded accurately. Beyond departmental assignments, the database captures supervisory relationships where employees may be directly supervised by others. This helps in understanding the hierarchical structure within the organization. Moreover, every project undertaken by the organization is managed by a specific	

	department, although employees from various departments may be assigned to these projects based on their expertise and the project's requirements. For each project, the database includes details such as the project name, project number, and location. Additionally, it records the hours spent by employees on each project, providing insights into individual contributions and project progress. This tracking helps in managing project resources effectively and ensures that employees' time and efforts are properly accounted for. Overall, this database system facilitates efficient management of employee information, departmental structures, and project assignments. It allows the organization to monitor departmental performance, manage employee roles and responsibilities, and track the progress of various projects with precision. This comprehensive approach ensures that all aspects of employee and project management are well-coordinated and effectively managed. **Based on the details provided in the case study, address the following requirements:** Create an ER diagram representing the organization's database system. Include key entities such as Departments, Employees, and Projects. For each Department, capture attributes like Department ID, Department Name, Manager ID, and Location. For Employees, include attributes such as Employee ID, Name, Birth Date, Address, Gender, Salary, and Department ID. Projects should have attributes like Project ID, Project Name, and Project Location. a. Specify all attributes and primary keys for each entity. Clearly define relationships between entities, such as employees being assigned to departments, departments managing projects, and supervisory relationships among employees. b. Define the relationships and constraints, including primary keys, cardinality, and participation constraints. For example, a department can manage multiple projects, and employees can work on multiple projects while reporting to one or more supervisors. Note: Include comments to address any constraints from the case study that cannot be fully represented in the ER diagram. Ensure the diagram accurately reflects the management of employee information, departmental structures, and project assignments as described. **Based on the provided case study, perform the following queries:** a. Write an SQL query to identify the department(s) with the highest average salary among its employees. b. Write an SQL query to list all employees who are directly supervised by more than one manager. c. Write an SQL query to find the project(s) with the highest total hours spent by employees.	

	d. Write an SQL query to find all employees who have never been assigned to any project. e. Write an SQL query to list each department along with the total number of projects managed by the department and the total number of employees assigned to it.	
14.	**Week 14:** **Case Study 2: (Trainee Record in a Institution)** A training institute requires a sophisticated database to effectively track the progress of trainees in their various training programs. Trainees enroll in different programs, such as Java Developer, Full Stack Developer, and Data Scientist. Each of these programs consists of several courses offered by the institute, each with its own unique code, title, and number of credit hours. Courses are overseen by an instructor, who may also be involved in teaching the course. In addition to the main instructor, each course has one or more teaching assistants who help facilitate the course. An instructor can manage and teach multiple courses across different programs, reflecting their expertise and versatility. The database captures detailed information about each course, including its unique code, title, credit hours, the instructor responsible for managing and teaching the course, the teaching assistants assigned, and the department to which the course belongs. Each course may have prerequisites, which means that some courses must be completed before others can be taken. This requirement ensures that trainees follow a structured learning path. Additionally, some training programs have mandatory courses that all trainees must complete to successfully finish the program. For trainees, the database records essential details such as their ID numbers, names, addresses, the training program they are enrolled in, and their academic performance. This includes information on the courses they have taken and the grades they received. By maintaining these records, the database helps monitor each trainee's progress and ensures they meet the necessary requirements for their chosen program. This database system plays a crucial role in managing the training institute's operations. It provides a clear view of course offerings, tracks the performance of trainees, and ensures that the educational requirements and prerequisites are properly enforced. This comprehensive approach allows the institute to deliver a well-organized training experience and supports both the instructors and trainees in achieving their educational goals. **Based on the details provided in the case study, address the following requirements:** Develop an ER diagram to model the training institute's database system, incorporating all key entities and their attributes. The primary entities to include are Trainees, Programs, Courses, Instructors, and Teaching Assistants. For each entity, specify attributes and primary keys: Trainees should have Trainee_ID, Name, Address, Program_ID, and Performance	

	details. Courses should include Course_Code, Title, Credit_Hours, Prerequisites, and links to Instructors and Teaching Assistants. a. Define the relationships between entities, such as Trainees being enrolled in Programs, Courses assigned to Programs, and Instructors and Teaching Assistants managing and teaching Courses. Include relationships for course prerequisites and mandatory courses within Programs. b. Clearly specify key constraints like primary keys for each entity and cardinality and participation constraints for relationships. For instance, a Course may have multiple Teaching Assistants and prerequisites, while a Trainee can be enrolled in multiple Courses. Note: Add comments to highlight any constraints from the case study that are challenging to represent in the ER diagram. Ensure the diagram effectively captures the management of trainees' progress, course requirements, and instructor roles as outlined. **Based on the provided case study, perform the following queries:** a. Write an SQL query to show the names and IDs of trainees who have completed all the required courses for their program. b. Write an SQL query to get the names of instructors and the courses they teach, including any courses that have prerequisites. c. Write an SQL query to find the average grade for each course and list the courses where the average grade is below than 70%. d. Write an SQL query to find the trainees who have signed up for the most courses, no matter which program they are in. e. Write an SQL query to list all courses and the total hours all trainees have spent on each course.	
	Total	**40**

11. **Suggested Books:**

S. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Text Books		
1.	RamezElmasri, Shamkant, B. Navathe, “Database Systems”, Pearson Education, 7Th Edition.	**7th**	**2015**
3.	M L Gillenson, “Introduction to Database Management”, Wiley Student Edition	**2nd**	**2012**
	Reference Books		

1.	Mary Beth Roeser: [1Oracle® Database] SQL Language Reference 12c Release 1 (12.1) E41329-25	**2nd**	**2017**

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS 552** Course Title: Cloud-Based Application Development and Management
2. Contact Hours: **L:** 3 **T:** 0 **P:** 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **SEE** 50
5. Credits: 3
6. Semester: 5
7. Category of Course: **DE**
8. Prerequisite: **TCS-451**

9. **Course Outcome**:**	After completion of the course the students will be able to**:** CO1: Recognize the cloud based application development platforms and economic benefits. CO2: Analyze the use case of various cloud service provider's applications and platforms. CO3: Apply the advanced cloud computing application's concepts. CO4: Analyze the use case of cloud-based application deployment and management concepts. CO5: Explore the use case of various cloud platforms, offered services and security aspects. CO6: Develop and deploy the cloud based server-side application using Node.js and the front-end using React.

*** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.*

10. **Details of the Course:**

SL. NO.	Contents	Contact Hours
1	**Unit 1:** **Fundamental of Cloud Based Applications** Cloud Data centers, Software stack, Virtualization, software defined networks and storage, cloud storage, and programming models, Clouds Based Application development motivating factors, benefits, challenges, service models, SLAs and security. Concepts behind data center design and management, Economic and technological benefits of the cloud paradigm.	**9**

2	**Unit 2:** **Cloud Platforms in Industry**	**9**

	Amazon Web Services: Compute Services, Storage Services, Communication Services. Google App Engine: Architecture, Core Concepts, Application Life Cycle, Cost Model, Observations. Microsoft Azure: Azure Core Concepts, SQL Azure, Azure Compute and Storage, Azure Database and Networking, Monitoring and Managing Azure Solutions. IBM Cloud (Kyndryl), Salesforce, Heroku, Alibaba Cloud, Oracle Cloud, Tencent Cloud, OVHcloud, DigitalOcean, and Linode (Akamai). Case study on available Cloud Platforms in Industry.	
3	**Unit 3:** **Advanced Cloud Computing** Energy Efficiency in Clouds, Green Cloud Computing Architecture, Market based Management of Clouds, Market-Oriented Cloud Computing, Reference Model for MOCC. Federated Clouds/Intercloud: Definition, Characterization, Cloud Federation Stack, Technologies for Cloud Federation. Third Party Cloud Services, MetaCDN, Spot Cloud, Cloud Authentication Protocols, Cloud Security Threats with Cloud Apps. Virtualized CPU, memory and I/O resources, network (SDN) and storage (SDS), Key role of virtualization to enable the cloud. Cloud storage concepts like data distribution, durability, consistency and redundancy. Case study on Advanced Cloud Computing services.	**9**
4	**Unit 4:** **Cloud Management** Fundamentals of Cloud Management, Management Services, Cloud properties, Multi-tier Application Deployment in Clouds, Challenges, Requirements, Service Level Agreements (SLAs),Billing& Accounting. Cloud Policy and Governance: Risk Management and Regulatory Practices. Cloud Analytics and Cost Metrics. Case study on Cloud Management Services, Distributed file systems, NoSQL databases, object storage using HDFS, CephFS, HBASE, MongoDB, Cassandra, DynamoDB, S3, and Swift.	**9**
5	**Unit 5:** **Cloud Based Secured Applications Development** Current trends in cloud computing i.e. IoT, Big Data, Machine Learning. Cloud Infrastructure Security, Network level security, Host level security, Application level security, Access management and control. MapReduce, Spark and GraphLab programming models, Develop and deploy the cloud based server-side application using Node.js and the front-end using React, Case Study on Open Source and Commercial Clouds applications: Amazon EC2, Amazon S3,Amazon Redshift, GitHub Repository, AWS IoT Core, AWS IoT Device Defender, AWS IoT Device Management, AWS IoT FleetWise, AWS IoT SiteWise, AWS IoT Events, AWS IoT TwinMaker, AWS IoT Analytics, Azure IoT Hub, Azure IoT Central, Azure Digital Twins, Azure IoT Edge, Azure Percept, Azure Sphere, and Azure RTOS. Design and Deploy a Restaurant Application to Cloud.	**9**
	Total	**45 Hrs.**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	Mastering Cloud Computing by Rajkumar Buyya, Vecchiola & Selvi (Published by McGraw Hill Education Pvt. Ltd),	1st	2013.
2	Cloud Management & Security by Imad. M. Abbadi (WILEY Publication	3rd	2014.
	Reference Books		
1.	Cloud Computing – A Hands-On Approach by Arshdeep Bahga, Vijay Madisetti.	1st	2014

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS 591** Course Title: **Computer System Security**

2. Contact Hours: **L:** 3 **T:** 0 **P:** 0

3. Examination Duration (Hrs): **Theory** 3 **Practica** 0

4. Relative Weight: **CIE** 25 **MSE** 25 **SEE** 50

5. Credits: 3

6. Semester: V

7. Category of Course: DE

8. Pre-requisite: **TCS-491**

9. **Course Outcome**:**	After completion of the course, the students will be able to: CO1: Explain different security threats and attacks. CO2: Know the working of different attacks and security protocols. CO3: Analyze the different security protocols. CO4: Use programming to implement security protocols. CO5: Use programming to implement security protocols. CO6: Develop system security protocols

*** Describe the specific knowledge, skills, or competencies the students are expected to acquire or demonstrate.*

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 1:** **Introduction to System security:** Control hijacking attacks buffer overflow, integer overflow, bypassing browser memory protection, Sandboxing and Isolation, Tools and techniques for writing robust application software, Security vulnerability detection tools, and techniques program analysis (static, concolic and dynamic analysis), Privileges, access control, and Operating System Security, Exploitation techniques, and Fuzzing	10

2	**Unit 2:** **Software security:** Vulnerabilities, Attacks, and Countermeasures: Privileged programs (Set-UID programs) and vulnerabilities & Privilege Separation, Buffer Overflow vulnerability and defences, Return-to-libc attack, Race, Condition vulnerability	10
	and attack, Dirty COW attack, Format String vulnerability and attack, Shellshock attack, Heartbleed attack Interactivity, Annotation, and Arrangement;	
3	**Unit 3:** **Web Security:** Same origin Policy, Cross site scripting attack, Cross site request forgery attack, Sql Injection attack, Clickjacking attack, Content Security Policies (CSP) in web, Web Tracking, Session Management and User Authentication, Session Integrity, Https, SSL/TLS, Threat Modelling	10
4	**Unit 4:** **Smartphone Security**: Android vs. ioS security model, threat models, information tracking, rootkits, Access control in Android operating system, Rooting android devices, Repackaging attacks, Attacks on apps, Whole- disk encryption, hardware protection, Viruses, spywares, and keyloggers and malware detection	9
5	**Unit 5:** **Hardware and system security**: Meltdown Attack, spectre attack, Authentication and password, Access control concept, Access control list, Capability, Sandboxing, Threats of Hardware Trojans and Supply Chain Security, Side Channel Analysis based Threats, and attacks. Issues in Critical Infrastructure and SCADA Security.	6
	Total	**45**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	Security in Computing, Book by Charles P Pfleeger and Shari Lawrence Pfleeger, V edition	5th	**2015**
2.	Cryptography and Network Security: Principles and Practice, Book by William Stallings, VII edition	7th	**2017**
	Reference Books		

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

TCS 512 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

1. Contact Hours: **L:** 3 **T:** 0 **P:** 0
2. Examination Duration (Hrs.): **Theory** 3 **Practical** 0
3. Relative Weight: **CIE** 25 **MSE** 25 **SEE** 50
4. Credits: 3
5. Semester: 5
6. Category of Course: DC
7. Pre-requisite: **Python Programming**

9. **Course Outcome**:**	After completion of the course the students will be able to**:** CO1: Understand the concepts of Artificial Intelligence and Machine Learning with their related terminologies. CO2: Analyze and Apply various programming skills and libraries for understanding Data nature and its requirements. CO3: Analyze and apply various modelling techniques for basic data Analytics. CO4: Demonstrate Problem Solving using ML algorithms. CO5: Understand, Apply and Demonstrate different techniques and tools for Analysis. CO6: Analyze Real World Case Studies on Applications of Artificial Intelligence and Machine Learning

*** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.*

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 01:** Introduction to AI: Definitions, Foundations AI, History of AI, Intelligent Agents, Structure of Intelligent Agents, Environments; Problem solving Agents, Problem Formulation, Search Strategies, Constraint Satisfaction Search, Informed search Methods	**10**
2	**Unit 02:** Knowledge representation and reasoning: Agents that Reason Logically, Propositional Logic and Inference, First-Order Logic, Inference in First-Order Logic	**10**

	Planning and Learning: Introduction to Planning, Types, Learning from observations, Forms of Learning, Inductive Learning, Reinforcement Learning	
3	**Unit 3:** **Introduction to Machine Learning:** What is Machine Learning, Introduction to ML's three approaches: Supervised, Unsupervised and Reinforcement Learning, Important Statistical Concepts used in Machine Learning, Current Status of Machine Learning Supervised Learning Algorithms: Linear Regression, Logistic Regression, Gradient Descent, Decision Trees, Random Forest, Support Vector Machine, ,K- Nearest Neighbors, Naive Bayes	**10**
4	**Unit 4:** Clustering: K-means, Hierarchical Clustering, Dimensionality Reduction, Principle Component Analysis. Model Evaluation and Selection: Cross-validation, model evaluation metrics, model selection, and hyperparameter tuning. Hyperparameter Optimization Techniques Manual Search, Random Search, Grid Search Case study in Python for Hyperparameter Tuning	**10**
5	**Unit 5:** Problem Solving Agent, Formulating Problems, Example Problems, Uninformed Search Methods, Informed Search Method, Local Search Methods, Genetic algorithms, Adversarial Search	**8**
	Total	**48**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education	6th	2018
2.	N. P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford	1st	2005
3	B.Uma Maheshwari, R.Sujatha, Introduction to Data Science, Wiley	1st	2021
4	Jake VanderPlas, Python Data Science Handbook, O'Reilly	1st	2022
	Reference Books		
1.	Stuart J. Russell and Peter Norvig, Artificial Intelligence a Modern Approach, McGraw Hill	3rd	2009

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

GRAPHIC ERA HILL UNIVERSITY, DEHRADUN

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS 548** Course Title: **Computer Vision**
2. Contact Hours: **L:** 3 **T:** 0 **P:** 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **SEE** 50
5. Credits: 3
6. Semester: **6th**
7. Category of Course: DE

8. Pre-requisite: TCS 301, Any Programming Language

9. **Course Outcome**:**	After completion of the course the students will be able to**:** **CO1:** Understand the principals the Image Processing terminology used to describe features of images. **CO2:** Understand the mathematical foundations for digital manipulation of images **CO3:** Design, code and test digital image processing applications using MATLAB. **CO4:** Analyze a wide range of problems and provide solutions related to the design of imageprocessing systems through suitable algorithms, structures, diagrams, and other appropriate methods. **CO5:** Plan and undertake a major individual image processing project. **CO6:** Write programs in Matlab for digital manipulation of images; image acquisition; preprocessing; segmentation.

*** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.*

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	**Unit 1:** **INTRODUCTION TO IMAGE PROCESSINGAND COMPUTER VISION:** Pixels, Intensity, Coordinate Conventions, Sampling and Quantization, Histogram Analysis, Videos, Image Processing Pipeline, Image Processing and Computer Vision Research Areas: Low-level, Mid-Level and High-Level Vision. INTRODUCTION TO MATLAB / OCTAVE:Basic Opeartions, Image / Video handling, Flow Control, Vectorization. INTRODUCTION TO PYTHON:Basic Opeartions, Lists, Tuples, Strings, Dictionaries, Flow Control, Numpy, Image/Video handling, OpenCV, PIL, Orange.	9
2	**Unit 2: IMAGE PROCESSING / LOW-LEVEL VISION:** Image Enhancement in Spatial Domain, Image Enhancement in Frequency Domain, Edge Detection, Image Restoration, Color Image Processing, Wavelet Transform, Image Compression, Morphological Image Processing, Color Image Processing, Stereo Vision, Motion Analysis, Local and Image Features, Visual Saliency	9
3	**Unit 3: MID-LEVEL VISION:** Hough Transform, Otsu Thresholding, k-means, GraphCut, GrabCut, Normalized Cut, Watersheds, Skeleton Extraction, Object Proposals, Cosegmentation, Background Subtraction in Videos, Motion History Image	11
4	**Unit 4: HIGH-LEVEL VISION:** Image Classification, Object Localization, Object Recognition, Object Detection, CNN, AlexNet, VGG, GoogleNet, DenseNet, FCN for Semantic Segmentation, YOLO, Image Captioning, generative adversarial networks	9
5	**Unit 5:** **APPLICATIONS OF IMAGE PROCESSING AND COMPUTER VISION:** Video Surveillance Systems, Medical Diagnosis, Facial recognition system, Automatic activity recognition system, Fire detection System, traffic sign detection and recognition	10
	Total	**48**

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	Digital Image Processing, by R. C. Gonzalez, R. E. Woods and S. L. Eddins , Publisher: Pearson.	4th Edition	**2017**
2.	Digital Image Processing using Matlab, by R. C. Gonzalez, R. E. Woods and S. L. Eddins , Publisher: Pearson.	2nd	**2017**
3.	Deep Learning for Computer Vision, by Rajalingappaa Shanmugamani, Publisher: O Reilly	1st	**2018**
	Reference Books		
1.	Deep Learning with Keras by Antonio Gulli, Sujit Pal, Publisher: O Reilly	1st	**2017**
2.	Programming Computer Vision with Python", Jan Salem, Publisher: O Reilly	1st	**2012**

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS562** Course Title: **Introduction to Artificial Intelligence and Data**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 3
6. Semester: V
7. Category of Course: DSC
8. Pre-requisite: (**TCS-342)** **Introduction to Statistical Data Science**, (TCS-462) **Introduction to Big Data**

9. **Course Outcome:**	After completion of the course the students will be able to**:** CO1: Understand the concepts of Artificial Intelligence and Data Science with their related terminologies. CO2: Analyze and Apply various programming skills for understanding Data nature and its requirements. CO3: Analyze and apply various modelling techniques for basic data Analytics. CO4: Demonstrate Problem Solving using AI algorithms. CO5: Understand, Apply and Demonstrate different techniques and tools for Data Analysis. CO6: Analyze Real World Case Studies on Applications of Data Science.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 01:** Data Science History, Data Science and Related Terminologies, Types of Analytics, Applications of Data Science, Data Science Process Models. Introduction to AI, History and Foundation of AI, Intelligence, and it's type, Categorization of Artificial Intelligent based System, Agents & Environments, Applications, and Current trends in AI	**10**
2	**Unit 02:** Introduction to Data, Types, Data Preprocessing, Understanding Data Requirements, Dealing with Erroneous/Missing Values, Standardizing Data, Steps involved in EDA using Python Programming/R. Knowledge and Reasoning in AI: Knowledge based Agents, Syntax and Semantics, Forward Chaining, Backward Chaining, Knowledge Engineering, Belief Network	**10**
3	**Unit 3:** Introduction to Modelling Techniques, Supervised Learning Algorithms- Regression, Classification, and Unsupervised Learning Algorithms- Clustering, Association Rule Mining Feature Selection, Dimensionality Reduction, Independent and Dependent Variables, Relationship between Variables: Correlation, Multicollinearity, Factor Analysis, Treatment of Outliers	**10**
4	**Unit 4:** Problem Solving Agent, Formulating Problems, Example Problems, Uninformed Search Methods, Informed Search Method, Local Search Methods, Genetic algorithms, Adversarial Search	**10**
5	**Unit 5:** Applications of Analytics in Healthcare, Applications of Analytics in Agriculture, Applications of Analytics in Business, Applications of Analytics in Sports, Forms of Learning, Introduction to Expert Systems, Expert System Architecture, Capstone Project	**8**
	Total	**48**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Deepak Khemani	A First Course in Artificial Intelligence	6th	McGraw Hill Education, American	2018
N. P. Padhy	Artificial Intelligence and Intelligent Systems	1st	Oxford, England	2005
B.Uma Maheshwari, R.Sujatha	Introduction to Data Science	1st	Wiley, United States	2021
Jake VanderPlas	Python Data Science Handbook	1st	O'Reilly,United Kingdom	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Stuart J. Russell and Peter Norvig	Artificial Intelligence a Modern Approach	3rd	McGraw Hill Education, American	2009

Graphic Era Hill University, Dehradun

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS562** Course Title: **Introduction to Artificial Intelligence and Data**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 3
6. Semester: V
7. Category of Course: DSC
8. Pre-requisite: (**TCS-342) Introduction to Statistical Data Science**, (TCS-462) **Introduction to Big Data**

9. **Course Outcome:**	After completion of the course the students will be able to**:** CO1: Understand the concepts of Artificial Intelligence and Data Science with their related terminologies. CO2: Analyze and Apply various programming skills for understanding Data nature and its requirements. CO3: Analyze and apply various modelling techniques for basic data Analytics. CO4: Demonstrate Problem Solving using AI algorithms. CO5: Understand, Apply and Demonstrate different techniques and tools for Data Analysis. CO6: Analyze Real World Case Studies on Applications of Data Science.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 01:** Data Science History, Data Science and Related Terminologies, Types of Analytics, Applications of Data Science, Data Science Process Models. Introduction to AI, History and Foundation of AI, Intelligence, and it's type, Categorization of Artificial Intelligent based System, Agents & Environments, Applications, and Current trends in AI	**10**
2	**Unit 02:** Introduction to Data, Types, Data Preprocessing, Understanding Data Requirements, Dealing with Erroneous/Missing Values, Standardizing Data, Steps involved in EDA using Python Programming/R. Knowledge and Reasoning in AI: Knowledge based Agents, Syntax and Semantics, Forward Chaining, Backward Chaining, Knowledge Engineering, Belief Network	**10**
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4	**Unit 4:** Problem Solving Agent, Formulating Problems, Example Problems, Uninformed Search Methods, Informed Search Method, Local Search Methods, Genetic algorithms, Adversarial Search	**10**
5	**Unit 5:** Applications of Analytics in Healthcare, Applications of Analytics in Agriculture, Applications of Analytics in Business, Applications of Analytics in Sports, Forms of Learning, Introduction to Expert Systems, Expert System Architecture, Capstone Project	**8**
	Total	**48**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Deepak Khemani	A First Course in Artificial Intelligence	6th	McGraw Hill Education, American	2018
N. P. Padhy	Artificial Intelligence and Intelligent Systems	1st	Oxford, England	2005
B.Uma Maheshwari, R.Sujatha	Introduction to Data Science	1st	Wiley, United States	2021
Jake VanderPlas	Python Data Science Handbook	1st	O'Reilly,United Kingdom	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Stuart J. Russell and Peter Norvig	Artificial Intelligence a Modern Approach	3rd	McGraw Hill Education, American	2009

Graphic Era Hill University, Dehradun

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS 511** Course Title: **Computer Networks**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 3
6. Semester: V
7. Category of Course: DSC
8. Pre-requisite: Introduction to Artificial Intelligence (XXXXXX)

9. **Course Outcome:**	After completion of the course the students will be able to**:** CO1: Apply and Characterize computer networks from the view point of components and from the view point of services. CO2: Display good understanding of the flow of a protocol in general and a network protocol in particular CO3: Evaluate and Select the most suitable Application Layer protocol (such as HTTP, FTP, SMTP, DNS, BitTorrent) as per the requirements of the network application and work with available tools to demonstrate the working of these protocols. CO4: Design a Reliable Data Transfer Protocol and incrementally develop solutions for the requirements of Transport Layer CO5: Describe the essential principles of Network Layers and use IP addressing to create subnets for any specific requirements CO6: Evaluate and select the appropriate technology to meet Data Link Layer requirements and design a framework to implementing TCP/IP protocol suite.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 1:** Introduction: Computer Networks and the Internet, Overall view: As components and as services; What is a protocol, what is a network protocol, Access Networks and Physical Media, Circuit and Packet Switching, Internet Backbone, Delays: Processing, Queuing, Transmission and Propagation delays, The Layered Architecture: Protocol Layering, The OSI Reference Model and the TCP/IP protocol stack, History of Computer Networking, and the Internet.	11
2	**Unit 2:** Application Layer: Principles and Architectures of Network Applications, Client and Server processes, the idea of socket, Transport services available to Application Layer especially in the internet Application Layer Protocols: The Web and http: Persistent and Nonpersistent connections, http message format, cookies, proxy server, conditional GET, File Transfer Protocol, Email: smtp, mail message formats, mail access protocols: pop3, imap, MIME, DNS: Services, How it works, Root, Top-Level and Authoritative DNS servers, Resource Records, DNS messages A simple introduction to p2p file distribution: BitTorrent	11
3	**Unit 3:** Transport Layer: Introduction and Services, The Transport layer in internet, Difference between Connection Oriented and Connectionless services, UDP: Segment structure, checksum in UDP, stop-and-wait, Go Back N, Selective Repeat, TCP: Connection Establishment, TCP header, Sequence and acknowledgement numbers, Round Trip Time, Flow Control, Congestion, Control. Transport Layer: Introduction and Services, The Transport layer in internet, Difference between Connection Oriented and Connectionless services UDP: Segment structure, checksum in UDP	6
4	**Unit 4:** Network Layer: Introduction, Packet Forwarding and Routing, Difference between Virtual Circuits and Datagram networks, The internals of a router: Input ports, output ports, switching architecture The Internet Protocol(IP), Datagram format, IP fragmentation, IPv4, addressing, subnets, CIDR, classful addressing, DHCP, Network Address Translation(NAT), Universal Plug and Play as a provider of NAT, Internet Control Message	6

	Protocol(ICMP), IPv6 Header, Moving from IPv4 to IPv6: tunnelling. Routing Algorithms: Introduction, global vs decentralized routing, The Link State(LS) Routing Algorithm, The Distance Vector (DV) Routing Algorithm, Hierarchical Routing, Introduction to Routing in the Internet: RIP, OSPF, BGP; Introduction to Broadcast and Multicast Routing.	
5	**Unit 5:** Link Layer and Local Area Networks: Introduction to Link Layer and its services, Where Link Layer is implemented? Error detection and correction techniques: Parity checks, Checksum, CRC; Multiple Access protocols: Channel Partitioning, Random Access (Slotted Aloha, Aloha, CSMA), Taking Turns; Link Layer Addressing: MAC addresses, ARP, Ethernet, CSMA/CD, Ethernet Technologies, Link Layer Switches, Switches vs Routers, VLANS	10
	Total	**45**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Ross and Kurose	Computer Networking: "A Top Down Approach (5th edition	7th	Pearson/Addison-Wesley, American	2007

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Andrew Tanenbaum and David Wetherhall	Computer Networks	5th	Prentice Hall, American	2010
Peterson and Davie	Computer Networks: A System Approach	4th	Elsevier,India	2007
Forouzan	Data Communication and Networking	5th	McGraw Hill Education, American	2013
William Stallings	Data and Computer Communication	8th	Pearson/Addison-Wesley, American	2007
Nader F. Mir	Computer and Communication Networks	1st	Pearson/Addison-Wesley, American	2007

Graphic Era Hill University, Dehradun

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **PCS 562** Course Title: **Introduction to AI and DS Lab**
2. Contact Hours: **L:** **0** **T**: **0** **P**: **2**
3. Examination Duration (Hrs): **Theory** **0** **Practical** **3**
4. Relative Weight: **CIE** **25** **MSE** **25** **ESE** **50**
5. Credits: **1**
6. Semester: **V**
7. Category of Course: **DSC**
8. Pre-requisite: (TCS-341) Python Programming for Computing, **(TCS-342) Introduction to Statistical Data Science**

9. **Course Outcome:**	After completion of the course the students will be able to**:** CO1: Understand the nature of data collection, cleaning, correction. CO2: Identify the analysis and models useful to draw inferences. CO3: Explore and apply techniques designed for artificial intelligence. CO4: Analyze and apply data science and artificial intelligence to solve real world problems.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1.	Demonstrate Data Wrangling. Using Python Using R	**2**
2.	Demonstrate EDA. Using Python Using R	**2**
3.	Demonstrate Feature Selection Techniques in Python	**2**
4.	Apply Informed Search on given problem	**2**

5.	Apply Uninformed Search on given problem	**2**
6.	Implement Supervised Algorithm on given dataset	**2**
7.	Implement Unsupervised Algorithms on given dataset	**2**
8.	Application and Identification of Data Cleaning Methodologies	**2**
9.	Identification of outliers and way to treat them	**2**
10.	Data Visualization of data using Python.	**2**
11.	Implement Classification and Regressions using Python.	**2**
12.	Information Extraction from Text using Python.	**2**
13.	Find distributions - Binomial, Poisson, Normal, distributions, their Mean and Variance, Measures of Central Tendency and Dispersion.	**2**
14.	Apply the concept of correlation in the given dataset.	**2**
15.	Using different sampling technique showcase data analysis on different dataset.	**2**
16.	Test Hypothesis for means and variance, T- Test, Z Test	**2**
17.	Fraud Detection using AI and DS	**2**
18.	Sentiment Analysis using AI and DS	**2**
19.	Text Mining using AI and DS	**2**
20.	Recommendation System using AI and DS	**2**
21.	Smart application development using AI	**2**
22.	Chatbot Development using AI	**2**
23.	Prediction System Development using AI	**2**
24.	An expert system development using AI	**2**
25.	Case Study of any health disease using AI and DS	**2**
	Total	**50**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Denis Rothman	Artificial Intelligence	2nd	Packt Publishing Limited, UK	2020
Vinod Chandra S.S. , Anand Hareendran S.	Artificial Intelligence And Machine Learning	1st	PHI Learning,India	2014

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
John Paul Mueller	Machine Learning (in Python and R)	1st	Wiley, United States	2016

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **PCS 511** Course Title: **Computer Networks Lab**
2. Contact Hours: **L:** **0** **T**: **0** **P**: **2**
3. Examination Duration (Hrs): **Theory** **0** **Practical** **3**
4. Relative Weight: **CIE** **25** **MSE** **25** **ESE** **50**
5. Credits: **3**
6. Semester: **V**
7. Category of Course: **DSC**
8. Pre-requisite: Computer networks (TCS 511)

9. **Course Outcome:**	**After completion of the course the students will be able to:** **CO1:** Understand various components that make up a computer network, including routers, switches, hubs, servers, and clients and learn about the basic commands used troubleshooting. **CO2:** Design UTP cable for cross and direct connection using crimping tool. **CO3:** Implement the common network protocols such as TCP/IP, UDP, HTTP, DNS, DHC and FTP Understand how these protocols function and their role in facilitating communication between devices using network simulation tool like Packet tracer. **CO4:** Apply the static and dynamic routing concepts in the network core and monitoring network traffic using Wireshark and develop skills in troubleshooting network connectivity issues. **CO5:** Design network applications using UDP and TCP socket programing concepts and network design principles and test these applications using real or virtual network devices.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Problem Statement 1:** Familiarization of Network Environment, Understanding and using network utilities: ipconfig, netstat, ping, telnet, ftp, traceroute etc.	2
2	**Problem Statement 2:** Familiarization with Transmission media and tools: Co-axial cable, UTP cable, Crimping tool, Connectors etc. Preparing the UTP cable for cross and direct connection using crimping tool.	2
3	**Problem Statement 3:** Installation and introduction of simulation tool. **(Packet Tracer)**	2
4	**Problem Statement 4:** To configure a basic network topology consisting of routers, switches, and end devices such as PCs or laptops. Configure IP addresses and establish connectivity between devices. **(Using packet Tracer)**	2
5	**Problem Statement 5:** To configure a DHCP server on a router or a dedicated DHCP server device. Assign IP addresses dynamically to devices on the network and verify successful address assignment. **(Using packet Tracer)**	2
6	**Problem Statement 6:** To configure a local DNS server to resolve domain names within a network**. (Using packet Tracer)**	2
7	**Problem Statement 7:** To analyze complete TCP/IP protocol suite layer's headers using **Wire Shark**	2
8	**Problem Statement 8:** Static Routing: Configure static routes on multiple routers to enable communication between different networks. Test the connectivity	2

	by pinging between hosts in different networks. **(Using packet Tracer)**	
9	**Problem Statement 9:** Dynamic Routing (RIP): Configure routers to use the Routing Information Protocol (RIP) for dynamic routing. Enable RIP on the interfaces connected to different networks and verify that routes are being learned and propagated. Test the connectivity between hosts in different networks. **(Using packet Tracer)**	2
10	**Problem Statement 10:** Dynamic Routing (OSPF): Configure routers to use the Open Shortest Path First (OSPF) routing protocol. Set up OSPF on the routers and advertise network information. Verify that OSPF is establishing neighbor relationships and propagating routes. Test connectivity between hosts in different networks. **(Using packet Tracer)**	2
11	**Problem Statement 11:** TCP Client-Server Communication: Implement a TCP client program that sends a message to a TCP server program. Implement the corresponding TCP server program that receives the message and displays it. Test the communication between the client and server by exchanging messages **(Using 'C' Language)**	2
12	**Problem Statement 12:** UDP Client-Server Communication: Implement a UDP client program that sends a message to a UDP server program. Implement the corresponding UDP server program that receives the message and displays it **(Using 'C' Language)**	2
1.	**Optional programs for advanced learner** **Problem Statement 1:** File Transfer using TCP: Implement a TCP server program that listens for incoming connections.	2

	Implement a TCP client program that sends a file to the server. The server should receive the file and save it on the local machine. Verify the successful transfer by comparing the original file with the received file	
2.	**Problem Statement 2:** Chat Application using TCP: Implement a TCP client program for a chat application. Implement the corresponding TCP server program. Multiple clients should be able to connect to the server and exchange messages. Test the chat application by simulating multiple clients communicating with each other.	2
3.	**Problem Statement 3:** DNS Lookup using UDP: Implement a UDP client program that sends a domain name to a DNS server. Implement the corresponding DNS server program that resolves the domain name to an IP address. The server should send the resolved IP address back to the client. Test the program by performing DNS lookups for different domain names	2
4.	**Problem Statement 4:** HTTP Server using TCP: Implement a TCP server program that acts as an HTTP server. The server should be able to handle HTTP requests and send back appropriate HTTP responses. Test the server by accessing it through a web browser and requesting different resources.	2
5.	**Problem Statement 5:** Virtual LANs (VLANs): Create multiple VLANs and configure inter-VLAN routing using a router or Layer 3 switch. Assign hosts to different VLANs and test communication between hosts in different VLANs.	2
6.	**Problem Statement 6:** Access Control Lists (ACLs): Implement access control lists on routers to control traffic flow based on source/destination IP	2

	addresses, port numbers, or protocols. Test the ACLs by allowing or denying specific types of traffic between hosts.	
7.	**Problem Statement 7:** Network Address Translation (NAT): Configure Network Address Translation on a router to translate private IP addresses to public IP addresses and vice versa. Test connectivity between hosts with private IP addresses and hosts on the public internet.	2
	Total	**38**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Behrouz A. Forouzan	Data Communications and Networking with TCPIP Protocol Suite	5th	McGraw Hill Education, American	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Ross and Kurose	Computer Networking: "A Top-Down Approach	6th	Pearson/Addison-Wesley, American	2017

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SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS564** Course Title: **Natural Language Processing and Computer Vision**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 3
6. Semester: V
7. Category of Course: DSC
8. Pre-requisite: Fundamentals of Artificial Intelligence and Machine Learning (TCS364)

9. **Course Outcome:**	After completion of the course, the students will be able to**:** CO1: Define Natural Language Processing (NLP) and Computer Vision (CV) and their significance in various applications. CO2: Describe the concepts of part-of-speech tagging, syntactic parsing, and n-gram language models used in NLP CO3: Apply basic image manipulation techniques (e.g., filtering, transformations) and color space conversions in computer vision. CO4: Analyze the trade-offs between different object detection frameworks like R-CNN and YOLO. CO5: Evaluate the performance of different object detection models based on metrics like accuracy and precision-recall. CO6: Design a simple NLP pipeline for sentiment analysis or text classification using pre-existing techniques and tools.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**UNIT 1: Introduction to NLP, Text Processing** Overview of NLP and its significance, Key challenges in NLP, Common NLP tasks and applications Text normalization: tokenization, stemming, lemmatization, Regular expressions for pattern matching, Stop words removal and text cleaning	9

2	**UNIT 2: Syntax and Parsing, Language Models** Part-of-speech tagging, Syntactic parsing, Dependency parsing, Introduction to n-grams, Smoothing techniques, Introduction to neural language models **Feature Extraction from Text** Bag of words and TF-IDF, Word embeddings: Word2Vec, GloVe-Contextual embeddings from transformers	10
3	**UNIT 3: Sentiment Analysis** Techniques for sentiment analysis, Rule-based and machine learning approaches, Application of sentiment analysis in business and social media **NLP Applications** Machine translation, Speech recognition, Chatbots and conversational agents	9
4	**UNIT 4: Introduction to Computer Vision, Image Processing Basics** Overview of computer vision and its significance, Key challenges in computer vision, Common applications of computer vision Digital image fundamentals, Image manipulation techniques (filtering, transformations), Color spaces and conversions **Feature Detection and Matching, Image Segmentation** Edge detection algorithms, Corner and interest point detection, Feature matching and object recognition, Thresholding techniques, Region-based segmentation, Clustering methods in segmentation (k-means, mean shift)	10
5	**UNIT 5: Object Detection and Recognition** Introduction to object detection frameworks, Haar cascades and HOG features, Modern approaches: R-CNN, Fast R-CNN, YOLO, and SSD **Deep Learning for Vision** Convolutional neural networks (CNNs) for vision, Transfer learning in vision tasks, Applications in real-time video processing **Advanced Topics and Applications** 3D vision and depth estimation, Motion analysis and object tracking, Computer vision in autonomous vehicles and drones	10
	Total	**48**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Steven Bird, Ewan Klein, and Edward Loper	Natural Language Processing with Python	3rd Edition	O'Reilly Media, Inc., USA	2021
Daniel Jurafsky and James H. Martin	Speech and Language Processing	3rd Edition	Pearson Education Limited, USA	2020
Richard Szeliski	Computer Vision: Algorithms and Applications	2nd Edition	Springer Science, New York, USA	2011
Joseph Howse, Joe Minichino, and Prateek Joshi	Learning OpenCV 4: Computer Vision with Python 3	1st Edition	Packt Publishing Ltd, UK	2019

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Hobson Lane, Cole Howard, and Hannes Hapke	Natural Language Processing in Action	1st Edition	Manning Publications Co., USA	2019
Yoav Goldberg	Deep Learning for Natural Language Processing	1st Edition	MIT Press, USA	2017
Phil Kim	Deep Learning for Computer Vision	1st Edition	Apress, USA	2017
Richard Hartley and Andrew Zisserman	Computer Vision: Principles, Algorithms, Applications, Learning	5th Edition	Cambridge University Press, UK	2012

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SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS597** Course Title: **Computer System Security**
2. Contact Hours: **L:** 0 **T**: 1 **P**: 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 1
6. Semester: V
7. Category of Course: DSE
8. Pre-requisite: TCS-492 Fundamental of Cyber Security

9. **Course Outcome:**	After completion of the course, the students will be able to: CO1: Explain different security threats and attacks. CO2: Know the working of different attacks and security protocols. CO3: Analyze the different security protocols. CO4: Use programming to implement security protocols. CO5: Use programming to implement security protocols. CO6: Develop system security protocols

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to System security:** Control hijacking attacks buffer overflow, integer overflow, bypassing browser memory protection, Sandboxing and Isolation, Tools and techniques for writing robust application software, Security vulnerability detection tools, and techniques program analysis (static, concolic and dynamic analysis), Privileges, access	10

	control, and Operating System Security, Exploitation techniques, and Fuzzing	
2	**Software security:** Vulnerabilities, Attacks, and Countermeasures: Privileged programs (Set-UID programs) and vulnerabilities & Privilege Separation, Buffer Overflow vulnerability and defences, Return-to-libc attack, Race, Condition vulnerability and attack, Dirty COW attack, Format String vulnerability and attack, Shellshock attack, Heartbleed attack Interactivity, Annotation, and Arrangement;	10
3	**Web Security:** Same origin Policy, Cross site scripting attack, Cross site request forgery attack, Sql Injection attack, Clickjacking attack, Content Security Policies (CSP) in web, Web Tracking, Session Management and User Authentication, Session Integrity, Https, SSL/TLS, Threat Modelling	10
4	**Smartphone Security**: Android vs. ioS security model, threat models, information tracking, rootkits, Access control in Android operating system, Rooting android devices, Repackaging attacks, Attacks on apps, Whole- disk encryption, hardware protection, Viruses, spywares, and keyloggers and malware detection	9
5	**Hardware and system security**: Meltdown Attack, spectre attack, Authentication and password, Access control concept, Access control list, Capability, Sandboxing, Threats of Hardware Trojans and Supply Chain Security, Side Channel Analysis based Threats, and attacks. Issues in Critical Infrastructure and SCADA Security.	6
	Total	**45**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Charles P Pfleeger and Shari Lawrence Pfleeger	Security in Computing	5th	Pearson/Addison-Wesley, American	2011
Principles and Practice, Book by William Stallings	Cryptography and Network Security	7th	Pearson/Addison-Wesley, American	1998

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
W. Stallings	Network Security Essentials	6th	Prentice Hall, India	2017
Ch. P. Pfleeger, S. L. Pfleeger	*Security in Computing*	4th	Prentice Hall, India	2006

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SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **PCS597** Course Title: **Computer System Security Lab**
2. Contact Hours: **L:** **0** **T**: **1** **P**: **2**
3. Examination Duration (Hrs): **Theory** **0** **Practical** **3**
4. Relative Weight: **CIE** **25** **MSE** **25** **ESE** **50**
5. Credits: **3**
6. Semester: **V**
7. Category of Course: **DSC**
8. Pre-requisite:

9. **Course Outcome:**	After completion of the course the students will be able to**:** CO1: Explain different security threats and attacks CO2: Know the working of different attacks and security protocols CO3: Analyse the different security protocols CO4: Use programming to implement security protocols CO5: Apply security mechanisms to secure various applications CO6:Develop system security protocols

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1.	Practical demonstration of buffer overflow vulnerability and attack. Also write down the solutions available to mitigate the buffer overflow attack.	2
2.	Practical demonstration of race condition and vulnerability and attack. What are possible solutions for race condition vulnerability.	2
3.	Practical demonstration of dirty cow vulnerability and attack.	2

4.	Installation and demonstration of burp suite tool.	2
5.	Installation and demonstration of metasploit tool.	2
6.	Practical demonstration of XSS using burp suite tool.	2
7.	Practical demonstration of CSRF vulnerability and attack. What are the possible solutions for CSRF?	2
8.	Practical demonstration of SQL injection vulnerability and attack. What are the possible solutions for SQLi?	2
9.	Installation and demonstration of wireshark tool.	2
10.	Practical demonstration of HTTPs using the wireshark tool.	2
11.	Practical demonstration of ICMP using the wireshark tool.	2
12.	Case study of hardware security and attacks like Stuxnet and hardware trojan.	2
13.	Case study of side channel attack.	2
	Total	26

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Charles P Pfleeger and Shari Lawrence Pfleeger	Security in Computing	5th	Pearson/Addison-Wesley, American	2011
Principles and Practice, Book by William Stallings	Cryptography and Network Security	7th	Pearson/Addison-Wesley, American	1998

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
W. Stallings	Network Security Essentials	6th	Prentice Hall, India	2017
Ch. P. Pfleeger, S. L. Pfleeger	*Security in Computing*	4th	Prentice Hall, India	2006

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SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS592** Course Title: **Block chain Technology and its application**
2. Contact Hours: **L:** 3 **T**: 1 **P**: 0
3. Examination Duration (Hrs): **Theory** 4 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 3
6. Semester: V
7. Category of Course: DSE
8. Pre-requisite: **TCS 302 Data Structure with C, TCS 332 Fundamental of Information security and Block Chain**

9. **Course Outcome:**	After completion of the course the students will be able to**:** **CO1:** Explain blockchain technology and its immutable property. **CO2:** Know the working of distributed ledger. **CO3:** Analyze the different consensus protocols. **CO4:** Use Ethereum to implement Blockchain. **CO5:** Apply blockchain techniques in different applications. **CO6:**Develop blockchain based frameworks to secure a communication environment

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	Introduction to blockchain- Overview of blockchain, structure of a block, block header, block identifiers: block header hash and block height, genesis block, linking of blocks, merkle trees, and use of merkle root in payment verification	10

2	Application of cryptography to blockchain- Overview of ECDSA, DSA and RSADS, use of hash functions to chain blocks, use of digital signatures to sign transactions	9
3	Distributed ledger- Introduction to distributed systems, fault tolerance and paxos, byzantine agreement, authenticated agreement, eventual consistency & bitcoin consistency- availability and partitions, bitcoin, smart contracts, weak consistency, distributed storage, consistent hashing mechanism	8
4	**Blockchain mining and consensus-**Overview of various consensus algorithms, decentralized consensus, independent verification of transactions, mining nodes, aggregating transactions into blocks, constructing the block header, successfully mining of block, validating a new block, assembling and selecting chains of blocks, consensus attacks**,** DoS attack on blockchain, changing the consensus rules, soft fork signaling with block version	10
5	Ethereum- Differences between ethereum and bitcoin, block format, mining algorithm, proof-of-stake (PoS) algorithm, account management, contracts and transactions, decentralized applications using ethereum proof-of-stake (PoS) algorithm, contracts, and transactions. Applications of blockchain technology- Blockchain in banking and marketing, smart contracts, blockchain of Internet of Things, blockchain in healthcare, Future Research directions of blockchain technology	8
	Total	**45**

Text Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
George Icahn	Blockchain: the complete guide to understanding blockchain technology	4th	Prentice Hall, American	2020
Antony lewis	The basics of bitcoins and blockchains: an introduction to cryptocurrencies and the technology that powers them	5th	McGraw Hill Education, American	2018

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Andreas M. Antonopoulos	Mastering Bitcoin: unlocking digital cryptocurrencies	2nd	O'Reilly,United Kingdom	2017
Roger Wattenhofer	Distributed Ledger Technology, The science of the Blockchain	2nd	Inverted Forest Publishing, United State	2017

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SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS571** Course Title: **Big Data Visualization**
2. Contact Hours: **L:** 3 **T**: 1 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 3
6. Semester: V
7. Category of Course: DSE
8. Pre-requisite: Fundamental of Cloud Computing and Bigdata (TCS351)

9. **Course Outcome:**	After completion of the course, the students will be able to: CO1: Create and adapt visualizations to represent complex data sets and emphasize targeted concepts for effective communication CO2: Analyze and interpret large volumes of data to identify patterns, trends, and insights. CO3: Apply data visualization techniques to communicate complex data sets effectively. CO4: Develop skills in storytelling with data, effectively conveying narratives through visual representations. CO5: Demonstrate proficiency in using tools and technologies for big data visualization. CO6: Use leading open-source and commercial software packages (Tableau) to create and publish visualizations that enable clear interpretations of big, complex, and real-world data

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 1: Techniques for visual data representations:** Data Visualization, Information Visualization, Concept Visualization, Strategic Visualization, Metaphor Visualization, and Compound	10

	Visualization. **Visualization design objectives**: Methodology, Establishing intent, The visualization's function-explain, explore, exhibit; Tone-analytical and abstract, key factors in a visualization project, The eight hats of data visualization design	
2	**Unit 2: Demonstrating Editorial Focus**: Importance of editorial focus, Preparing and familiarizing of data, Refining the editorial focus, Using visual analysis to find stories **Conceiving and Reasoning**: Preparing data, Refining, The Visualization anatomy - Data Representation: choosing correct visualization method, physical properties of data, degree of accuracy in interpretation, creating an appropriate design metaphor, choosing the final solution; The Visualization anatomy- Data presentation: Interactivity, Annotation, and Arrangement;	10
3	**Unit 3: Taxonomy of Data Visualization**: Choosing appropriate chart type: Dot plot, Column chart, Floating bar, pixelated bar chart, Histogram, Slopegraph, Radial chart, Glyph chart, Sankey diagram, Area size chart; Assessing hierarchies and part-to-whole relationships: Pie chart, Stacked bar chart, Square pie, Treemap, Circle packing diagram, Bubble hierarchy, Tree Hierarchy; Showing changes over time: Line chart, Sparklines, Area chart, Horizon chart, Stacked area chart, Candlestick chart, Barcode chart, Flow map; Plotting connections and relationships: Scatter plot, Bubble plot, Scatter plot matrix, Heatmap, Parallel sets, Radial network, Network Diagram; Mapping geospatial data: Choropleth map, dot plot map, Bubble plot map, Isarithmic map	9
4	**Unit 4: Tools for data visualization:** Tableau, Google Charts, Datawrapper, Chartio, IBM Watson Analytics, and Sisense	9
5	**Unit 5: Data Visualization through Tableau**: Tableau basics, connecting Tableau to various datasets, creating bar charts, area charts, maps, scatterplots, pie charts, and tree maps; Create Interactive Dashboards, storylines, Joins, Data Blending, Table calculations, parameters, Dual axis charts, Export results from Tableau to other software, Work with time-series data, Creating data extracts, Aggregation, Granularity and Level of detail, Adding filters, create data hierarchies, Adding actions to dashboards	8
	Total	**46**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Andy Kirk,	Data Visualization: a successful design process	1st Edition	, Packt Publishing	2015

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Tamara Munzer,	Visualization Analysis and Design,	2nd Edition	CRC Press	2014

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SEMESTER V (ELECTIVE)

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS545** Course Title: **Reinforcement Learning**
2. Contact Hours: **L:** 3 **T**: 1 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 3
6. Semester: V
7. Category of Course: DSE
8. Pre-requisite: Fundamentals of Artificial Intelligence and Machine Learning (TCS364)

9. **Course Outcome:**	After completion of the course, the students will be able to**:** CO1: Define fundamental concepts in reinforcement learning, such as agents, environments, states, actions, rewards, and policies. CO2: Explain the core principles of Markov Decision Processes (MDPs) and their use in reinforcement learning. CO3: Apply dynamic programming algorithms (policy iteration and value iteration) to solve simple MDPs relevant to engineering problems. CO4: Compare and contrast TD learning algorithms (SARSA, Q-learning) based on their suitability for specific scenarios. CO5: Evaluate the performance of RL agents using appropriate metrics relevant to the engineering domain. CO6: Design and implement a simple RL agent using techniques like Q-learning or policy gradients to solve a basic engineering-related problem.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**UNIT 1: Introduction to Reinforcement Learning, Markov Decision Processes** Overview of reinforcement learning and its applications, Key concepts: agents, environments, states, actions, rewards, Basics of Markov	10

	decision processes (MDPs), Policy and value functions, Bellman equations	
2	**UNIT 2: Dynamic Programming, Monte Carlo Methods** Policy iteration, Value iteration, Applying dynamic programming to MDPs, Monte Carlo simulation for estimating value functions, On-policy and off-policy learning, Importance sampling	10
3	**UNIT 3: Temporal Difference Learning** TD learning, SARSA (State-Action-Reward-State-Action), Q-learning	8
4	**UNIT 4: Advanced RL Algorithms** Deep Q-Networks (DQN), Policy gradient methods, Actor-critic methods	9
5	**UNIT 5: RL in Practice** Applications in games (e.g., AlphaGo), RL for robotics, Challenges in real-world RL applications	8
	Total	**45**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Richard S. Sutton and Andrew G. Barto	Reinforcement Learning: An Introduction	2nd Edition	MIT Press, USA	2018
Maxim Lapan	Hands-On Reinforcement Learning with Python	1st Edition	Packt Publishing Ltd, UK	2020

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Maxim Lapan	Deep Reinforcement Learning Hands-On	1st Edition	Packt Publishing Ltd, UK	2020

SEMESTER V

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS-584** Course Title: **Foundation of Quantum Computing**
2. Contact Hours: **L:** 3 **T**: 1 **P**: 0
3. Examination Duration (Hrs): **Theory** 4 **Practical** 0
4. Relative Weight: **CIE** 25 **MSE** 25 **ESE** 50
5. Credits: 3
6. Semester: 3
7. Category of Course: DSE
8. Pre-requisite: **Programming for problem solving (TCS 201), Python Programming (TCS 346)**

9. **Course Outcome:**	After completion of the course the students will be able to**:** CO1: Understand techniques and mechanism of quantum computing CO2: Understand the working of various quantum computing techniques CO3: Analyze the different quantum computing techniques CO4: Use programming language to implement quantum computing techniques/ algorithms CO5: Apply quantum computing techniques to various applications CO6: Develop quantum computing schemes

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 1: Introduction to Quantum Mechanics for Quantum Computing** History of quantum computation and quantum information Classical vs. quantum systems Key quantum phenomena-Superposition, entanglement, interference Dirac notation (Bra-Ket notation, Inner product) Postulates of quantum mechanics Qubits and quantum state representation Single-qubit gates (Pauli-X, Y, Z, Hadamard)	9
2	**Unit 2: Mathematical Foundations of Quantum Computing** Linear algebra for quantum computing (vectors, matrices, tensor products) Hilbert spaces and unitary operators Quantum measurement (Born rule, projective measurement) Mixed states and density matrices No-cloning theorem	10
3	**Unit 3: Quantum Circuits and Multi-Qubit Systems** Multi-qubit systems and entanglement (Bell states, EPR pairs, applications) Two-qubit gates (CNOT, SWAP, Toffoli) Quantum circuit model Quantum parallelism Quantum teleportation and superdense coding Quantum Teleportation Protocol	9
4	**Unit 4: Quantum Algorithms** Deutsch-Jozsa algorithm Bernstein-Vazirani algorithm	10

	Simon's algorithm Grover's search algorithm (overview & applications) Shor's factoring algorithm (conceptual framework)	
5	**Unit 5: Quantum Error Correction and Applications** Challenges in quantum computing (decoherence, noise) Basics of quantum error correction (QEC) Stabilizer codes (e.g., Shor code, surface codes) Overview of quantum hardware (NISQ era, superconducting qubits, trapped ions) Current and future applications (quantum cryptography-BB84 protocol (QKD), optimization, quantum machine learning-Variational quantum eigensolvers (VQE))	10
	Total	**48**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Michael A. Nielsen, Isaac L. Chuang	Quantum Computation and Quantum Information" (10th Anniversary Edition)	**10th**	Cambridge University Press	**2013**
Johannes A. Buchmann	Introduction to Quantum Algorithms		American Mathematical Society	**2025**
Phillip Kaye, Raymond Laflamme, Michele Mosca	An Introduction to Quantum Computing		Oxford University Press	**2007**

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year

Chris Bernhardt	Quantum Computing for Everyone		The MIT Press	**2020**
Jack D. Hidary	Quantum Computing: An Applied Approach	**2nd**	Springer Nature	**2019**

SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS-546** Course Title: **Advanced Python Programming**

2. Contact Hours: **L:** 2 **T**: **0** **P**: **0**

3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**

4. Relative Weight: **CIE** **25** **MSE** **25** **ESE** **50**

5. Credits: **3**

6. Semester: **3**

7. Category of Course: **DSC**

8. Pre-requisite: Programming for problem solving (TCS201), Python Programming (TCS346)

9. **Course Outcome:**	After completion of the course, the students will be able to**:** CO1: Identify and describe the fundamental data types and operators used in Python programming, Explain the purpose and usage of functions in Python, including parameters, return values, and modules. CO2: Apply data structures like lists, tuples, and dictionaries to organize and manipulate data for engineering problems. CO3: Analyze the differences between object-oriented programming concepts like inheritance, polymorphism, and encapsulation, and their impact on program design. CO4: Evaluate the suitability of various libraries like NumPy, Pandas, Matplotlib, and Seaborn for specific tasks related to numerical computing, data analysis, and visualization in engineering applications. CO5: Design and implement Python programs using fundamental concepts, data structures, and libraries to solve basic engineering problems involving data cleaning, analysis, and visualization.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**UNIT 1: Python Basics and Functions and Modules** Syntax and Semantic Basics: Data types: strings, integers, floats, Variable assignments and expressions, input/output operations, Loops and Conditional Statement, Defining and calling functions: Function parameters and return values- Using built-in modules, Creating and using custom modules, Exception handling: Handling multiple exceptions, Using finally block, Raising exceptions manually with raise, Custom exception classes (user-defined exceptions), The else block in exception handling, Working with built-in exceptions (ValueError, KeyError, ZeroDivisionError, etc.)	10
2	**UNIT 2: Data Handling** Lists: Creation, indexing, slicing, iteration, built-in methods (append, extend, insert, remove, pop, sort, reverse) Tuples: Creation, accessing elements, immutability, packing and unpacking Dictionaries: Creating dictionaries, accessing values, adding/removing key-value pairs, dictionary methods (keys, values, items) Reading from and writing to files: Opening and closing files, reading/writing text files, file modes (r, w, a), with statement and binary files	8
3	**UNIT 3: Object-Oriented Programming** Introduction to classes and objects, Attributes and methods, Class variables, static methods, class methods, __init__ and __str__ Inheritance: Extending classes, Multiple inheritance, multilevel inheritance, mixins, composition vs inheritance	10

	Polymorphism: Using a unified interface, Abstract classes and interfaces (abc module), duck typing, polymorphism with inheritance vs interfaces Encapsulation: private and public members, Encapsulation with property decorators, controlling attribute access (__getattr__, __setattr__), data hiding vs abstraction	
4	**UNIT 4: Libraries for AI/ML** NumPy: arrays, array operations, indexing, reshaping, Broadcasting, vectorization, masking, linear algebra (dot product, eigenvalues, matrix decomposition), random number generation, Pandas: DataFrame operations, indexing, merging, grouping, MultiIndexing, pivot tables, window functions (rolling, expanding), handling missing data efficiently, categorical data, time-series analysis with Pandas Matplotlib: basic plotting, figures, and axes, Subplots and multiple plots, customizing plots (styles, colors, fonts) Seaborn: statistical data visualization, Pair plots, joint plots, facet grids, categorical plots (strip, swarm, bar, count), regression plots, heatmaps	10
5	**UNIT 5: Intro to Data Science** Data cleaning techniques, Exploratory data analysis (EDA): Introduction to EDA, Data Collection & Understanding, Data Cleaning, Descriptive Statistics, Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Feature Engineering in EDA. Visualization techniques: Histograms, Boxplots, Scatter plots, Heatmaps, and Time-series plots.	8
	Total	**46**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Eric Matthes	Python Crash Course: A HandsOn, Project-Based Introduction to Programming	3rd Edition	No Starch Press, USA	2023

Mark Lutz	Learning Python	5th Edition	O'Reilly Media, USA	2013
Wes McKinney	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython	2nd Edition	O'Reilly Media, USA	2017

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Joel Grus	Data Science from Scratch: First Principles with Python	2nd Edition	O'Reilly Media, USA	2019
Al Sweigart	Automate the Boring Stuff with Python: Practical Programming for Total Beginners	2nd Edition	No Starch Press, USA	2019

Syllabus: TCS 595 Security Audit and Compliance -I

Sl No	Contents	Contact Hours
1	**Introduction to Cybersecurity :** Definition of Netizen, Malware and its existence, Definition of Security hole, Security Patch, Viruses, Worms, Trojan Horses, Bot Networks, Social Engineering, Avoiding Malwares, Spyware, Adware, Keyboard Loggers, Rogue Software and Scareware, Ransomware, White Hat Search Engine Optimization, Current and Fulltime Threats, Hackers, Hacker's tools, E-Mail and SPAM, Spoofing, Spammer's tools, SPIM, Cyberbullies, Online Reputation Attacks, Phishing, Cyber stalkers	9
2	**Cyber Ethics, Cyber Law , Cyber Policy and Compliance:** Cybersecurity Management Concepts, Security governance, Management models, roles, and functions, Enterprise Roles and Structures, Information security roles and positions, Strategic planning and security strategy, Information Security Standards & Laws**,** Information Security Standards-ISO, IT Act, Copyright Act, Patent Law, IPR, Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Patent Law; GDPR, HIPAA, SOX, NIST, ISO27001	11
3	**Secured Communication :** Access Control and Authentication, User authentication methods (e.g., passwords, biometrics, multi-factor authentication), Role-based access control (RBAC), Access control lists (ACLs), Data Encryption, Encryption of data at rest and in transit, Transparent Data Encryption (TDE), Encryption - Symmetric vs. asymmetric encryption; SSL/TLS encryption for web traffic, Encryption algorithms (e.g., AES, RSA).	10
4	**Database Security :** Data lifecycle: Data roles, classification, maintenance, retention, collection, destruction, Database Auditing and Monitoring, Database activity monitoring (DAM), Audit trails and logs, Database security policies and procedures. Backup and Recovery, Secure backup and recovery procedures, Disaster recovery planning, Off-site backup storage	8
5	**Auditing & Monitoring:** Database Auditing and Monitoring, Database activity monitoring (DAM), Audit trails and logs, Database security policies and procedures, Database Vulnerability Assessment and Penetration Testing, Identifying and remediating database vulnerabilities, Penetration testing methodologies, Security scanning tools.	7
	Total	45

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SEMESTER V

TCS 593 DEEP LEARNING FUNDAMENTALS

	Deep Learning	
S.No.	Topic	No. of Lectures
Unit -1	History of Deep Learning, Deep Learning Success Stories, Machine learning basics, Introduction to deep learning, Neural Network Basics, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs	8
Unit - 2	Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam	9
Unit - 3	Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization	9
Unit - 4	Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks, Learning Vectorial Representations Of Words	10
Unit - 5	Recurrent Neural Networks, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, Gated Recurrent Units (GRUs), Long Short Term Memory (LSTM) Cells, Solving the vanidhing gradient problem with LSTMs	9

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Name of Department:- Computer Science and Engineering

1. Subject Code: TCS 514 Course Title: **Computer Network-I**
2. Contact Hours: L: 3 T: - P: -
3. Semester: V

4. Pre-requisite: TCS 101, TCS 302

5. Course Outcomes: After completion of the course students will be able to

1. Characterize and appreciate computer networks from the view point of components and from the view point of services
2. Display good understanding of the flow of a protocol in general and a network protocol in particular
3. Model a problem or situation in terms of layering concept and map it to the TCI/IP stack
4. Select the most suitable Application Layer protocol (such as HTTP, FTP, SMTP, DNS, Bittorrent) as per the requirements of the network application and work with available tools to demonstrate the working of these protocols.
5. Design a Reliable Data Transfer Protocol and incrementally develop solutions for the requirements of Transport Layer
6. Describe the essential principles of Network Layers and use IP addressing to create subnets for any specific requirements

6. Detailed Syllabus

UNIT	**CONTENTS**	**Contact Hrs**
Unit – I	Introduction: Computer Networks and the Internet, Overall view: As components and as services; What is a protocol, what is a network protocol, Access Networks and Physical Media, Circuit and Packet Switching, Internet Backbone, Delays: Processing, Queing, Transmission and Propagation delays The Layered Architecture: Protocol Layering, The OSI Reference Model and the TCP/IP protocol stack, History of Computer Networking and the Internet	**11**
Unit – II	Application Layer: Principles and Architectures of Network Applications, Client and Server processes, the idea of socket, Transport services available to Application Layer especially in the internet.	**12**

	Application Layer Protocols: The Web and http: Persistent and Non-persistent connections, http message format, cookies, proxy server, conditional GET File Transfer Protocol Email: smtp, mail message formats, mail access protocols: pop3, imap, MIME DNS: Services, How it works, Root, Top-Level and Authoritative DNS servers, Resource Records, DNS messages A simple introduction to p2p file distribution: BitTorrent	
Unit – III	Transport Layer: Introduction and Services, The Transport layer in internet, Difference between Connection Oriented and Connectionless services UDP: Segment structure, checksum in UDP	**6**
Unit – IV	Transport Layer2:The principles behind connection oriented data transfer, designing a connection oriented protocol, stop-and-wait, Go Back N, Selective Repeat TCP: Connection Establishment, TCP header, Sequence and acknowledgement numbers, Round Trip Time, Flow Control, Congestion Control	**6**
Unit – V	Network Layer I: Introduction, Packet Forwarding and Routing, Difference between Virtual Circuits and Datagram networks, The internals of a router: Input ports, output ports, switching architecture The Internet Protocol(IP), Datagram format, IP fragmentation, IPv4 addressing, subnets, CIDR, classful addressing, DHCP, Network Address Translation(NAT), Universal Plug and Play as a provider of NAT, Internet Control Message Protocol(ICMP), IPv6 Header, Moving from IPv4 to IPv6: tunnelling, A brief discussion on IP security (Note: Network Layer will continue with Routing Algorithms in Computer Networks II in the next semester)	**10**
	Total	**45**

Text Books:

1. Computer Networking: "A Top Down Approach (5th edition)", Ross and Kurose, Pearson/Addison-Wesley

Reference Books:

1. Andrew Tanenbaum and David Wetherhall, "Computer Networks(5th edition)", Prentice Hall

2. Peterson and Davie, “Computer Networks: A System Approach (4th edition)”, Elsevier
3. Forouzan, “Data Communication and Networking (4th edition)”, McGraw Hill
4. William Stallings: “Data and Computer Communication”, 8th Edition, Pearson Education, 2007
5. Nader F. Mir:” Computer and Communication Networks”, Pearson Education, 2007.