

# **SEMESTER**

# **V**

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	<b>TCS501</b>	Course Title:	<b>System Software</b>		
2.	Contact Hours:	L: <b>3</b>	T: <b>0</b>	P: <b>0</b>		
3.	Examination Duration (Hrs):	<b>Theory</b>		<b>3</b>	<b>Practical</b>	<b>0</b>
4.	Relative Weight:	<b>CIE</b>	<b>25</b>	<b>MSE</b>	<b>25</b>	<b>ESE</b>
5.	Credits:	<b>3</b>				
6.	Semester:	<b>V</b>				
7.	Category of Course:	<b>DSC</b>				
8.	Pre-requisite:	Finite Automata and Formal Languages (TCS402)				

<b>9. Course Outcome:</b>	<p>After completion of the course the students will be able to:</p> <p>CO1: Define system software and differentiate system software with other software's.</p> <p>CO2: Assess the working of Assembler, Loader/Linker and Macro processor.</p> <p>CO3: Understand the concept of passes in translators.</p> <p>CO4: Determine the purpose of linking, and types of linking.</p> <p>CO5: Develop the system software according to machine limitations.</p> <p>CO6: Compare and Contrast the various text editors.</p>
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### 10. Details of the Course:

SL. NO.	Contents	Cont act Hour s
1	<b>Unit 1:</b> <b>Machine Architecture:</b> Introduction, System Software and its relation to Machine Architecture, Simplified Instructional Computer (SIC), Architecture of SIC Machine , SIC Programming Examples	9
2	<b>Unit 2:</b> <b>Assemblers:</b> Basic Assembler Functions, A Simple SIC Assembler, Algorithm and Data Structures for Assemblers, Machine Dependent Assembler Features - Instruction Formats & Addressing Modes, Program Relocation.  Machine Independent Assembler Features – Literals, Symbol-Definition Statements, Expression, Program Blocks, Control Sections and Programming Linking, Assembler Design Operations - One-Pass Assembler, Multi-Pass Assembler	9

	<b>Unit 3:</b> <b>Loaders and Linkers:</b> Basic Loader Functions - Design of an Absolute Loader, A Simple Bootstrap Loader, Machine-Dependent Loader Features – Relocation, Program Linking, Algorithm and Data Structures for a Linking Loader; Machine-Independent Loader Features - Automatic Library Search, Loader Options, Loader Design Options - Linkage Editor, Dynamic Linkage, Bootstrap Loaders  <b>Editors and Debugging Systems:</b> Text Editors - Overview of Editing Process, User Interface, Editor Structure, Interactive Debugging Systems - Debugging Functions and Capabilities, Relationship With Other Parts Of The System, User-Interface Criteria	10
3	<b>Unit 4:</b> <b>Macro Processor:</b> Basic Macro Processor Functions - Macro Definitions and Expansion, Macro Processor Algorithm and Data Structures, Machine-Independent Macro Processor Features - Concatenation of Macro Parameters, Generation of Unique Labels, Conditional Macro Expansion, Keyword Macro Parameters, Macro Processor Design Options, General-Purpose Macro Processors, Macro Processing Within Language Translators	8
4	<b>Unit 5:</b> <b>Lex and Yacc :</b> Lex and Yacc - The Simplest Lex Program, Recognizing Words With LEX, Symbol Tables, Grammars, Parser-Lexer Communication, The Parts of Speech Lexer, A YACC Parser, The Rules Section, Running LEX and YACC, LEX and Hand-Written Lexers, Using LEX - Regular Expression, Examples of Regular Expressions, A Word Counting Program, Parsing a Command Line.  Using YACC – Grammars, Recursive Rules, Shift/Reduce Parsing, What YACC Cannot Parse, A YACC Parser - The Definition Section, The Rules Section, Symbol Values and Actions, The LEXER, Compiling and Running a Simple Parser, Arithmetic Expressions and Ambiguity, Variables and Typed Tokens.	10
	<b>Total</b>	<b>46</b>

### Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Leland.L.Beck	System Software : An Introduction to Systems Programming	3 <sup>rd</sup> Edition	Addison-Wesley,..	1997
John.R.Levine	Lex & Yacc	1 <sup>st</sup> Edition	shroff	1992

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
TCS501.1	Define system software and differentiate system software with other software's.	-	3	-	-	1	1	-	1	1	1	1	-	2	-	1
TCS501.2	Assess the working of Assembler, Loader/Linker and Macroprocessor.	1	3	-	1	1	1	-	-	1	-	1	-	2	-	1
TCS501.3	Understand the concept of passes in translators.	1	-	-	-	-	-	1	-	1	1	-	-	-	1	1
TCS501.4	Determine the purpose of linking, and types of linking.	1	-	-	-	2	1	-	1	1	-	1	-	1	2	1
TCS501.5	Develop the system software according to machine limitations.	1	2	3	-	2	-	1	1	2	-	2	2	3	2	1
TCS501.6	Compare and Contrast the various text editors.	-	2	2	2	2	2	-	1	1	2	1	-	1	-	2
<b>TCS501</b>		<b>1</b>	<b>2.5</b>	<b>2.5</b>	<b>1.5</b>	<b>1.6</b>	<b>1.25</b>	<b>1</b>	<b>1</b>	<b>1.16</b>	<b>1.33</b>	<b>1.2</b>	<b>2</b>	<b>1.8</b>	<b>1.66</b>	<b>1.16</b>

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

1. Name of Department: - Computer Science and Engineering

2. Subject Code: **TCS502**

Course Title: **Operating Systems**

3. Contact Hours: L: **3** O: **0**

P: **0**

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

5. Relative Weight: CIE **25** MS **25** ESE **50**

6. Credits: **3**

7. Semester: **V**

8. Category of Course: **DSC**

9. Pre-requisite: TCS 301, Data Structures with C (TCS 302), TCS 404

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

Sl. No .	Contents	Contact Hours
1	<b>Introduction to Operating Systems, UNIX:</b> What operating systems do; Operating System structure; Operating System Services; 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	<b>Process Management:</b> Process concept; Operations on processes; Multithreading models; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling; Thread scheduling.	10

	<b>Process Synchronization:</b> Inter-process communication; Synchronization: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization.	
3	<b>Deadlocks:</b> Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. <b>Memory Management:</b> 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
4	<b>File System, Implementation of File System:</b> File System: File concept; Access methods; Directory structure; Protection. File system structure; Directory implementation; Allocation methods; Free space management. <b>Secondary Storage Structures:</b> Mass storage structures; Disk structure; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Access matrix.	8
5	<b>File System, Implementation of File System:</b> File System: File concept; Access methods; Directory structure; Protection. File system structure; Directory implementation; Allocation methods; Free space management. <b>Secondary Storage Structures:</b> Mass storage structures; Disk structure; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Access matrix.	9
	Total	<b>45</b>

### Text Books:

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

**Reference Books:**

<b>Authors Name</b>	<b>Title</b>	<b>Edition</b>	<b>Publisher, Country</b>	<b>Year</b>
Andrew S Tanenbaum	Operating Systems: Design and Implementation,	3 <sup>rd</sup> Edition	Prentice Hall,	2006
Stuart E. Madnick, John Donovan:	Operating Systems,	1 <sup>st</sup> Edition	Tata McGraw Hill,	2008

**Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
TCS502.1	Understand the concept and design issues associated with an operating system.	2	-	-	-	-	-	1	-	1	1	1	-	1	-	1
TCS502.2	Identify the problems related to process management, synchronization and apply learned methods to solve basic problems.	-	2	-	-	1	1	-	1	1	-	1	-	1	-	2
TCS502.3	Explain the basics of memory management and the use of virtual memory in modern operating systems.	1	3	-	-	1	-	1	1	1	2	-	-	-	1	1
TCS502.4	Understand the concept deadlock avoidance, prevention, and detections techniques.	2	-	-	-	-	-	-	1	1	1	-	-	1	-	1
TCS502.5	Implementation of process management, memory management and file management using system calls.	1	2	3	-	1	-	-	1	1	-	2	1	2	2	-
TCS502.6	Analyze the data structures and algorithms used for developing an operating system.	1	2	-	2	2	1	-	-	1	1	1	-	2	-	1
TCS502		1.4	2.25	3	2	1.25	1	1	1	1	1.25	1.25	1	1.4	1.5	1.2

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	<b>TCS503</b>	Course Title:	<b>Database Management System</b>
2.	Contact Hours:	L: <b>3</b>	T: <b>0</b>	P: <b>0</b>
3.	Examination Duration (Hrs):	<b>Theory</b> <b>3</b>	<b>Practical</b> <b>0</b>	
4.	Relative Weight:	<b>CIE</b> <b>25</b>	<b>MSE</b> <b>25</b>	<b>ESE</b> <b>50</b>
5.	Credits:	<b>3</b>		
6.	Semester:	<b>V</b>		
7.	Category of Course:	<b>DSC</b>		
8.	Pre-requisite:	Data Structures with C(TCS302), TCS 404		

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

Sl. No.	Contents	Contact Hours
1	<p><b>Unit 1:</b></p> <p><b>Introduction:</b> An overview of DBMS; Advantages of using DBMS approach; Database systems vs File Systems, Database system concepts and architecture</p> <p>1 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.</p>	9
2	<p><b>Unit 2:</b></p> <p><b>Entity-Relationship Model:</b> Using High-Level Conceptual Data</p>	9

	Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, 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	<p><b>Relational Model and Relational Algebra:</b> 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.</p> <p><b>SQL – 1:</b> SQL Data Definition and Data Types; Specifying basic constraints in SQL; Schema change statements in SQL; Basic queries in SQL; More complex SQL Queries.</p> <p><b>Insert, Delete and Update statements in SQL;</b> 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.</p> <p><b>Optimization of SQL Queries through Indexes, Concepts of NoSQL.</b></p>	11
4	<p><b>Unit 4: Database Design – 1:</b> 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</p> <p>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</p>	9
5	<p><b>Unit 5:</b></p> <p><b>Transaction Management: The ACID Properties;</b> 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</p> <p>Management; Log Files; Check pointing; Recovering from a System Crash; Media Recovery</p>	10
	Total	48

**Text Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Date K., Swamynathan S.	An Introduction to Database Systems.	8 <sup>th</sup> Edition	Pearson.	2012
Elmasri R. and Navathe	Fundamentals of Database Systems.	2 <sup>nd</sup> Edition	McGraw Hill	2012
Singh S.K.	Database Systems- Concepts, Designs and Application	5 <sup>th</sup> Edition	Pearson	2011
Date, C.J.	Introduction to Database Systems (Vol I & II)	8 <sup>th</sup> Edition	Wesley.	2004

**Reference Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Silberschatz A. Korth H. F. Sudarshan S.,	Database System Concepts.	6 <sup>th</sup> Edition	McGraw Hill	2013

**Course Articulation Matrix**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
TCS503.1	Understand the different issues involved in the design and implementation of a database system.	-	2	-	-	2	1	-	-	1	2	-	1	2	-	2
TCS503.2	Study the physical and logical database designs, database modelling, relational, hierarchical, and network models..	-	3	-	-	1	1	-	1	1	-	-	-	2	-	1
TCS503.3	Understand and use data manipulation language to query, update, and manage a database.	1	1	2	-	1	-	-		1	-	1	-	2	1	-
TCS503.4	Develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency.	1	2	1	-	1	-	1	1	1	1	-	-	1	1	-
TCS503.5	Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.	1	2	3	-	2	-	2	2	2	-	2	1	2	2	-
TCS503.6	Evaluate a business situation and designing & building a database application	-	2	-	2	1	1	-	-	-	-	-	-	2	2	1
TCS503		1	2	2	2	1.33	1	1.5	1.33	1.2	1.5	1.5	1	1.83	1.5	1.33

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	<b>TMA502</b>	Course Title:	<b>Computer Based Numerical and Statistical Technique</b>				
2.	Contact Hours:	L: <b>3</b>	T: <b>0</b>	P: <b>0</b>				
3.	Examination Duration (Hrs):	<b>Theory</b>		<b>3</b>	<b>Practical</b>	<b>0</b>		
4.	Relative Weight:	<b>CIE</b>	<b>25</b>	<b>MSE</b>	<b>25</b>	<b>ESE</b>		
5.	Credits:	<b>3</b>						
6.	Semester:	<b>V</b>						
7.	Category of Course:	<b>DSC</b>						
8.	Pre-requisite:	Engineering Mathematics-I(TMA 101), Engineering Mathematics-II(TMA 201)						

<b>9. Course Outcome:</b>	<p>After completion of the course the students will be able to:</p> <p>CO1: Develop the notation of errors, finding of errors, roots and apply them in problem solving in concern subject.</p> <p>CO2: Understand the methods of interpolation techniques and apply them.</p> <p>CO3: Elaborate the basics of numerical differentiation and integration and implement them.</p> <p>CO4: Explain the concepts of differential equation.</p> <p>CO5: Elaborate the basics of correlation and regression, curve fitting and be able to apply the methods from these subjects in problem solving.</p> <p>CO6: Examine statistical techniques and able to relate these to real problems.</p>
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### 10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	<p><b>Unit 1:</b> Introduction to Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Order of Approximation.</p> <p><b>Solution of Algebraic and Transcendental Equation:</b> Bisection Method, Iteration method, Secant Method, Newton Raphson method, Rate of convergence and their algorithms.</p> <p><b>Solution of system of linear equations:</b> Gauss Elimination method,</p>	10

	Gauss Jordan method and Gauss Seidel method and their algorithms.	
2	<b>Unit 2: Interpolation:</b> Introduction to Finite Differences, Difference tables, Polynomial Interpolation: Newton's forward and backward formula, Central difference formulae: Gauss forward and backward formula. Interpolation with unequal intervals: Lagrange's interpolation, Newton divided difference formula and their algorithms.	09
3	<b>Unit 3: Numerical Differentiation and Integration:</b> Numerical Differentiation for Interpolation Formulae, General Quadrature formula, Trapezoidal rule, Simpson's 1/3 and 3/8 rule and their algorithms. <b>Numerical Solution of Differential Equations:</b> Euler's explicit and implicit methods, modified Euler's method, Runge-Kutta Method, Solution of Boundary Value Problem by Finite Difference Method and their algorithms.	09
4	<b>Unit 4: Statistical Computation:</b> Introduction to Method of least squares, Curve Fitting of different types of curves. Data fitting with Cubic spline Interpolation.	08
5	<b>Unit 5: Correlation and Regression Analysis:</b> Introduction of correlation and regression, Correlation coefficient and it's application in computer science, Linear and Nonlinear Regression, Multiple Regression.	09
	<b>Total</b>	<b>45</b>

#### Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Gupta C. B. Singh S. R. and Kumar Mukesh	Engineering Mathematics for Semesters III and IV	1 <sup>st</sup> Edition	McGraw Hill Education,	2016
Rajaraman V,	Computer Oriented Numerical Methods”	1 <sup>st</sup> Edition	Pearson Education.	2020

**Reference Books:**

<b>Authors Name</b>	<b>Title</b>	<b>Edition</b>	<b>Publisher, Country</b>	<b>Year</b>
Sastry, S. S,	Introductory Methods of Numerical Analysis”	2 <sup>nd</sup> Edition	Pearson Education	2009
Jain, Iyengar and Jain	Numerical Methods for Scientific and Engineering Computations”,	4 <sup>th</sup> Edition	New Age Int.	2003
Steven C Chapra	Applied Numerical Methods with Matlab”.	2 <sup>nd</sup> Edition	McGraw Hill	2007

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
TMA502.1	Develop the notation of errors, finding of errors, roots and apply them in problem solving in concern subject.	2	2	3	-	-	-	-	-	1	-	1	-	1	2	1
TMA502.2	Understand the methods of interpolation techniques and apply them.	1	2	3	-	1	-	-	-	1	1	-	1	2	2	1
TMA502.3	Elaborate the basics of numerical differentiation and integration and implement them.	1	-	-	3	2	-	-	-	-	-	-	1	2	1	1
TMA502.4	Explain the concepts of differential equation.	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1
TMA502.5	Elaborate the basics of correlation and regression, curve fitting and be able to apply the methods from these subjects in problem solving.	1	3	1	-	1	-	-	-	1	1	-	-	3	1	1
TMA502.6	Examine statistical techniques and able to relate these to real problems.	1	1	2	-	1	-	-	-	1	1	-	-	3	1	1
TMA502		1.2	1.8	2.25	3	1.25	-	-	-	1	1	1	1	2.2	1.33	1

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	<b>PCS503</b>	Course Title:	<b>Database Management System Lab</b>		
2.	Contact Hours:	L: <b>0</b>	T: <b>0</b>	P: <b>2</b>		
3.	Examination Duration (Hrs):	<b>Theory</b>			<b>0</b>	<b>Practical</b>
4.	Relative Weight:	<b>CIE</b>	<b>25</b>	<b>MSE</b>	<b>25</b>	<b>SEE</b>
5.	Credits:	<b>1</b>				
6.	Semester:	<b>V</b>				
7.	Category of Course:	<b>DSC</b>				
8.	Pre-requisite:	Data Structures with C (TCS 302), TCS 404				

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

Sl. No.	List of problems for which student should develop program and execute in the Laboratory	Contact Hours
1.	<b>Problem Statement 1:</b> Granting Permissions: Data Control Language (DCL) Commands: Grant/Revoke.	2
2.	<b>Problem Statement 2:</b> Creation of database/tables for different applications (DDL commands): Creating tables (without constraints)	2

3.	<b>Problem Statement 3:</b> Creation of database/tables for different applications (DDL commands): Creating tables (with Column level and Table level constraints)	2
4.	<b>Problem Statement 4:</b> Inserting data into database (DML Commands): updating / deleting records in a table.	2
5.	<b>Problem Statement 5:</b> TCL command: saving (commit) and undoing (rollback)	2
6.	<b>Problem Statement 6:</b> Data retrieval (DR) command: Fetching data from database using SELECT, FROM and WHERE command (Projection and Selection)	2
7.	<b>Problem Statement 7:</b> Perform the following: Altering a Table, Dropping/ Truncating/ renaming Tables, backing up/ restoring a database	2
8.	<b>Problem Statement 8:</b> For a given set of relational schemas, create tables and perform the following: Simple queries; Simple queries with aggregate functions (group by and having clause).	2
9.	<b>Problem Statement 9:</b> Queries involving, Date functions, string functions (character manipulations and case manipulation functions)	2
10.	<b>Problem Statement 10:</b> Math functions, CASE, DECODE, Implicit and explicit typecasting functions.	2
11.	<b>Problem Statement 11:</b> Join Queries: Inner join, Equi-join, natural join, Outer join (LEFT-OUTER JOIN, RIGHT OUTER JOIN and FULL OUTER JOIN)	3
12.	<b>Problem Statement 12:</b> Subqueries-with IN clause, with EXISTS clause	2
13.	<b>Problem Statement 13:</b> For a given set of relation tables perform the following: Creating Views (with and without Check options), Dropping a view, Selecting data from a view.	3
14.	<b>Problem Statement 14:</b>	2

	For a given set of relation tables perform the following: Creating Views (with and without Check options), Dropping a view, Selecting data from a view.	
15.	<b>Problem Statement 15:</b> Generate primary key values with Sequence.	2
16.	<b>Problem Statement 16:</b> optimization of queries with Indexes	2
17.	<b>Problem Statement 17:</b> Applying <b>SYNONYMS</b> on database objects.	2
18.	<b>Problem Statement 18:</b> Introduction to Dynamic SQL	2
19.	<b>Problem Statement 19:</b> Introducing Triggers on data objects	3
20.	<b>Problem Statement 20:</b> Introducing Procedures on data objects for optimization of queries	3
	Total	<b>40</b>

**Text Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Elmasri R. and Navathe	Fundamentals of Database Systems.	2 <sup>nd</sup> Edition	McGraw Hill	2012
M L Gillenson,	Introduction to Database Management	2 <sup>nd</sup> Edition	Wiley Student Edition	2012

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
PCS503.1	Students get practical knowledge on designing and analysis of conceptual model and mapping of conceptual model to relational database systems.	3	1	3	-	2	-	-	-	1	2	1	1	3	2	2
PCS503.2	Design and implement SQL queries using DDL and DML concepts for updation and managing a database.	1	1	3	3	1	-	-	-	2	1	-	1	3	2	2
PCS503.3	Design and implement advance SQL queries such as relational constraints, joins, set operations, aggregate functions, and views.	-	2	3	3	1	-	-	-	1	1	-	1	3	1	2
PCS503.4	Design and implement queries using optimization techniques.	1	-	3	3	1	-	-	-	1	1	1	1	3	1	1
PCS503.5	Application of transaction control language (TCL), data control language (DCL) in SQL to evaluate practical implications of DBA such as transaction, recovery, and security.	-	1	3	3	2	-	-	-	2	2	-	2	3	2	2
PCS503		1.66	1.25	3	3	1.4	-	-	-	1.4	1.4	1	1.2	3	1.6	1.8

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	<b>PCS502</b>	Course Title:	<b>Operating System Lab</b>		
2.	Contact Hours:	L: <b>0</b>	T: <b>0</b>	P: <b>2</b>		
3.	Examination Duration (Hrs):	<b>Theory</b>	<b>0</b>	<b>Practical</b>	<b>3</b>	
4.	Relative Weight:	<b>CIE</b>	<b>25</b>	<b>MSE</b>	<b>25</b>	<b>ESE</b>
5.	Credits:		<b>1</b>			
6.	Semester:		<b>V</b>			
7.	Category of Course:	<b>DSC</b>				
8.	Pre-requisite:	Data Structures with C(TCS 302), TCS 404				

<b>9. Course Outcome:</b>	<b>After completion of the course the students will be able to:</b>
	<p>CO1. Implement concept of system calls for process management.</p> <p>CO2. Analyze and Implement various algorithms like FCFS, Priority and Round Robin for CPU scheduling.</p> <p>CO3. Simulate working of page replacement policies like FIFO, LRU.</p> <p>CO4. Compare various algorithms for communication between processes like pipe, named pipe, message queue and shared memory.</p>

### 10. Details of the Course:

Sl. No.	List of problems for which student should develop program and execute in the Laboratory	Contact Hours
1	<b>Problem Statement 1:</b> Demonstration of FORK() System Call	3
2	<b>Problem Statement 2:</b> Parent Process Computes the SUM OF EVEN and Child Process Computes the sum of ODD NUMBERS using fork	3
3	<b>Problem Statement 3:</b> Demonstration of WAIT() System Call	3
4	<b>Problem Statement 4:</b>	3

	Implementation of ORPHAN PROCESS & ZOMBIE PROCESS	
5	<b>Problem Statement 5:</b> Implementation of PIPE	3
6	<b>Problem Statement 6:</b> Implementation of FIFO	3
7	<b>Problem Statement 7:</b> Implementation of MESSAGE QUEUE	3
8	<b>Problem Statement 8:</b> Implementation of SHARED MEMORY	3
9	<b>Problem Statement 9:</b> Implementation of FIRST COME FIRST SERVED SCHEDULING ALGO	3
10	<b>Problem Statement 10:</b> Implementation of SHORTEST JOB FIRST SCHEDULING ALGO	3
11	<b>Problem Statement 11:</b> Implementation of PRIORITY SCHEDULING ALGO	3
12	<b>Problem Statement 12:</b> Implementation of First comes first serve page replacement policy	3
13	<b>Problem Statement 13:</b> Implementation of Least recent used page replacement policy	3
14	<b>Problem Statement 14:</b> Demonstration of execl() where child process executes "ls" COMMAND and Parent process executes "date" COMMAND	3
15	<b>Problem Statement 15:</b> 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	7 <sup>th</sup> Edition	Wiley India	2006
Sumitabha Das	Unix concepts and applications	4 <sup>th</sup> Edition	McGraw Hill Education	2017

**Reference Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Andrew S Tanenbaum	Operating Systems: Design and Implementation,	3 <sup>rd</sup> Edition	Prentice Hall,	2006
Stuart E. Madnick, John Donovan:	Operating Systems,	1 <sup>st</sup> Edition	Tata McGraw Hill,	2008

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
PCS506.1	Implement concept of system calls for process management.	1	2	3	3	2		1	2	2	2	1	2	2	2	2
PCS506.2	Analyze and Implement various algorithms like FCFS, Priority and Round Robin for CPU scheduling.	2	2	3	3	2	1		2	2	2		2	3	3	1
PCS506.3	Simulate working of page replacement policies like FIFO, LRU.		2	2	2	2		1	2	2	2	1	2	2	3	2
PCS506.4	Compare various algorithms for communication between processes like pipe, named pipe, message queue and shared memory.	1	2	2	3	3	2		2	2	2	2	2	3	3	2
PCS506		1.33	2	2.5	2.75	2.25	1.5	1	2	2	2	1.33	2	2.5	2.75	1.75

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	<b>PMA502</b>	Course Title:	<b>CBNST Lab</b>		
2.	Contact Hours:	L: <b>0</b>	T: <b>0</b>	P: <b>2</b>		
3.	Examination Duration (Hrs):	<b>Theory</b>			<b>0</b>	<b>Practical</b>
4.	Relative Weight:	<b>CIE</b>	<b>25</b>	<b>MSE</b>	<b>25</b>	<b>ESE</b>
5.	Credits:	<b>1</b>				
6.	Semester:	<b>V</b>				
7.	Category of Course:	<b>DSC</b>				
8.	Pre-requisite:	Data Structures with C(TCS 302), TCS 404				

<b>9. Course Outcome:</b>	<b>After completion of the course the students will be able to:</b>
	<p>CO1. Implement the methods (Bisection, False position, Newton Raphson and Iteration) to find the roots of non-linear equations.</p> <p>CO2. Implement the method to interpolate numerically using Newton's forward difference, Newton's backward difference, Lagrange's.</p> <p>CO3. Implement the method to integrate numerically using Trapezoidal, Simpsons 1/3 and 3/8.</p> <p>CO4. Implement the method to find numerical solution of ordinary differential equations by Euler's method, Runge-Kutta (fourth order) method</p>

### 10. Details of the Course:

Sl. No.	List of problems for which student should develop program and execute in the Laboratory	Contact Hours
1	<b>Problem Statement 1:</b> WAP to find the roots of non-linear equation using Bisection method.	
2	<b>Problem Statement 2:</b> WAP to find the roots of non-linear equation using False position method.	
3	<b>Problem Statement 3:</b> WAP to find the roots of non-linear equation using Newton's Raphson method.	
4	<b>Problem Statement 4:</b> WAP to find the roots of non-linear equation using Iteration method.	

5	<b>Problem Statement 5:</b> WAP to interpolate numerically using Newton's forward difference method.	
6	<b>Problem Statement 6:</b> WAP to interpolate numerically using Newton's backward difference method.	
7	<b>Problem Statement 7:</b> WAP to interpolate numerically using Lagrange's method.	
8	<b>Problem Statement 8:</b> WAP to Integrate numerically using Trapezoidal rule.	
9	<b>Problem Statement 9:</b> WAP to Integrate numerically using Simpson's 1/3 rules.	
10	<b>Problem Statement 10:</b> WAP to Integrate numerically using Simpson's 3/8 rules.	
11	<b>Problem Statement 11:</b> WAP to find numerical solution of ordinary differential equations by Euler's method.	
12	<b>Problem Statement 12:</b> WAP to find numerical solution of ordinary differential equations by Runge-Kutta(fourth order) method.	
13	<b>Problem Statement 13:</b> WAP to linear Curve fitting by least – square approximations.	
<b>Total</b>		

### Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Gupta C. B. Singh S. R. and Kumar Mukesh	Engineering Mathematics for Semesters III and IV	1 <sup>st</sup> Edition	McGraw Hill Education,	2016
Rajaraman V,	Computer Oriented Numerical Methods"	1 <sup>st</sup> Edition	Pearson Education.	2020

**Reference Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Sastry, S. S,	Introductory Methods of Numerical Analysis”	2 <sup>nd</sup> Edition	Pearson Education	2009
Jain, Iyengar and Jain	Numerical Methods for Scientific and Engineering Computations”,	4 <sup>th</sup> Edition	New Age Int.	2003
Steven C Chapra	Applied Numerical Methods with Matlab”.	2 <sup>nd</sup> Edition	McGraw Hill	2007

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
PMA502.1	Implement the methods(Bisection, False position, Newton Raphson and Iteration) to find the roots of non-linear equations.	1	2	2	2	1		1	2	2	2		2	3	2	1
PMA502.2	Implement the method to interpolate numerically using Newton's forward difference, Newton's backward difference, Lagrange's.	1	2	2	2	1	1		2	2	2		2	3	3	1
PMA502.3	Implement the method to integrate numerically using Trapezoidal, Simpsons 1/3 and 3/8.	1	2	2	2	1	1		2	2	2		2	3	3	1
PMA502.4	Implement the method to find numerical solution of ordinary differential equations by Euler's method, Runge-Kutta (fourth order) method	2	2	3	2	1		1	2	2	2	1	2	2	2	2
PMA502		1.25	2	2.25	2	1	1	1	2	2	2	1	2	2.75	2.5	1.25
High	correlation	(3);	Medium	correlation	(2);	Low	correlation	(1),	No	correlation	(-)					

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	TCS552	Course Title:	Cloud-Based Application Development and		
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.	Prerequisite:	Virtualization and Cloud Computing(TCS451)				

<b>9. Course Outcome:</b>	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.
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### 10. Details of the Course:

SL. NO.	Contents	Contact Hours
1	<b>Unit 1: Fundamental of Cloud Based Applications</b> 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	<p><b>Unit 2:</b></p> <p><b>Cloud Platforms in Industry</b></p> <p>Amazon Web Services: Compute Services, Storage Services, Communication Services.</p> <p>Google App Engine: Architecture, Core Concepts, Application Life Cycle, Cost Model, Observations.</p> <p>Microsoft Azure: Azure Core Concepts, SQL Azure, Azure Compute and Storage, Azure Database and Networking, Monitoring and Managing Azure Solutions.</p> <p>IBM Cloud (Kyndryl), Salesforce, Heroku, Alibaba Cloud, Oracle Cloud, Tencent Cloud, OVHcloud, DigitalOcean, and Linode (Akamai).</p> <p>Case study on available Cloud Platforms in Industry.</p>	9
3	<p><b>Unit 3:</b></p> <p><b>Advanced Cloud Computing</b></p> <p>Energy Efficiency in Clouds, Green Cloud Computing Architecture, Market based Management of Clouds, Market-Oriented Cloud Computing, Reference Model for MOCC.</p> <p>Federated Clouds/Intercloud: Definition, Characterization, Cloud Federation Stack, Technologies for Cloud Federation.</p> <p>Third Party Cloud Services, MetaCDN, Spot Cloud, Cloud Authentication Protocols, Cloud Security Threats with Cloud Apps.</p> <p>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.</p> <p>Case study on Advanced Cloud Computing services.</p>	9
4	<p><b>Unit 4:</b></p> <p><b>Cloud Management</b></p> <p>Fundamentals of Cloud Management, Management Services, Cloud properties, Multi-tier Application Deployment in Clouds, Challenges, Requirements, Service Level Agreements (SLAs), Billing &amp; Accounting.</p> <p>Cloud Policy and Governance: Risk Management and Regulatory Practices.</p> <p>Cloud Analytics and Cost Metrics.</p> <p>Case study on Cloud Management Services, Distributed file systems, NoSQL databases, object storage using HDFS, CephFS, HBASE, MongoDB, Cassandra, DynamoDB, S3, and Swift.</p>	9
5	<p><b>Unit 5:</b></p> <p><b>Cloud Based Secured Applications Development</b></p> <p>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.</p> <p>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</p>	9

	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.	
		<b>Total</b> <b>45 hrs</b>

**Text Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi	Mastering Cloud Computing	1 <sup>st</sup> Edition	McGraw Hill Education	2017
Imad. M. Abbadi	Cloud Management & Security	3 <sup>rd</sup> Edition	WILEY Publication	2014

**Reference Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Arshdeep Bahga, Vijay Madisetti.	Cloud Computing – A Hands- On Approach	1 <sup>st</sup> Edition	The Orient Blackswan	2014

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
TCS552.1	Recognize the cloud based application development platforms and economic benefits.	2	-	-	-	2	-	-	-	1	1	-	2	3	2	1
TCS552.2	Analyze the use case of various cloud service provider's applications and platforms.	-	3	-	1	3	1	1	-	2	2	1	1	3	2	2
TCS552.3	Apply the advanced cloud computing application's concepts.	1	-	3	-	-	-	-	-	2	1	-	2	3	3	1
TCS552.4	Analyze the use case of cloud-based application deployment and management concepts.	1	3	-	-	1	-	-	-	1	1	-	2	3	3	1
TCS552.5	Explore the use case of various cloud platforms, offered services and security aspects.	2	-	-	-	1	-	-	-	1	2	1	2	2	2	2
TCS552.6	Develop and deploy the cloud based server-side application using Node.js and the front-end using React.	1	-	3	3	2	1	1	-	1	1	-	-	3	2	2
TCS552		1.4	3	3	2	1.8	1	1	-	1.33	1.33	1	1.8	2.83	2.33	1.5

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

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

<b>9. Course Outcome:</b>	<p>After completion of the course, the students will be able to:</p> <p>CO1: Create and adapt visualizations to represent complex data sets and emphasize targeted concepts for effective communication</p> <p>CO2: Analyze and interpret large volumes of data to identify patterns, trends, and insights.</p> <p>CO3: Apply data visualization techniques to communicate complex data sets effectively.</p> <p>CO4: Develop skills in storytelling with data, effectively conveying narratives through visual representations.</p> <p>CO5: Demonstrate proficiency in using tools and technologies for big data visualization.</p> <p>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</p>
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### 10. Details of the Course:

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

	Visualization. <b>Visualization design objectives:</b> 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	<b>Unit 2: Demonstrating Editorial Focus:</b> Importance of editorial focus, Preparing and familiarizing of data, Refining the editorial focus, Using visual analysis to find stories <b>Conceiving and Reasoning:</b> 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	<b>Unit 3: Taxonomy of Data Visualization:</b> 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	<b>Unit 4: Tools for data visualization:</b> Tableau, Google Charts, Datawrapper, Chartio, IBM Watson Analytics, and Sisense	9
5	<b>Unit 5: Data Visualization through Tableau:</b> 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	<b>46</b>

**Text Books:**

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

**Reference Books:**

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

### **Course Articulation Matrix**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
TCS571.1	Create and adapt visualizations to represent complex data sets and emphasize targeted concepts for effective communication	2	-	-	-	-	-	-	-	1	1	2	1	2	1	2
TCS571.2	Analyze and interpret large volumes of data to identify patterns, trends, and insights.	1	3	-	-	1	-	-	-	1	-	-	-	3	2	2
TCS571.3	Apply data visualization techniques to communicate complex data sets effectively.	1	-	2	-	2	-	-	-	1	-	-	-	2	3	1
TCS571.4	Develop skills in storytelling with data, effectively conveying narratives through visual representations.	-	-	3	-	1	-	-	-	2	2	2	2	3	1	2
TCS571.5	Demonstrate proficiency in using tools and technologies for big data visualization.	-	-	-	3	3	-	-	-	2	2	2	2	3	2	1
TCS571.6	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	-	-	-	4	3	-	-	-	1	2	3	2	3	2	2
TCS571		1.33	3	2.5	3.5	2	-	-	-	1.33	1.75	2.25	1.75	2.66	1.83	1.66

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	TCS531	Course Title:	Communication models and protocols	
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:	NA			

9. Course Outcome:	<p>After completion of the course the students will be able to:</p> <p>CO1: Understand the common network communication primitives as part of programming tasks in various languages.</p> <p>CO2: Discuss the various Protocols used in Communication</p> <p>CO3: Analyze more complex protocol engineering and network management tasks</p> <p>CO4: Understand terminology, concepts, and technologies required for telecommunication in local area networks (LANs) and on the global Internet</p> <p>CO5: Describe and analyze the Data Encoding and Transmission techniques.</p> <p>CO6: Use of network management tools</p>
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### 10. Details of the Course:

S.NO.	Contents	Contact Hours
1	<p><b>Unit 1:</b></p> <p>Introduction and Overview: Key elements of communications and networking, Layered protocol model, Network edge, End systems, access networks, links, Network core, Packet switching, circuit switching, network structure, Multiplexing, Delay, loss and throughput in networks, Protocol layers, service models, Networks</p>	9

	under attack: security, History.	
2	<b>Unit 2:</b> Application Layer: Principles of network applications, Web and HTTP, FTP, Electronic Mail, SMTP, POP3, IMAP, DNS, P2P applications, Video streaming and content distribution networks, Ethereal (network packet sniffer), Socket programming with UDP and TCP	9
3	<b>Unit 3:</b> Data Encoding and Transmission: Data encoding and transmission concepts, Digital data transmission over digital signal: NRZ encoding, Multilevel binary encodings, Biphasic encodings, Scrambling techniques, Digital data transmission over analog signal: Public telephone system, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Performance of digital to analog modulation schemes, Quadrature Amplitude Modulation (QAM), Analog data transmission over digital signal: Digitization, Pulse Code Modulation, Non-linear encoding, Delta modulation, Analog data transmission over analog signal: Asynchronous transmission, Synchronous transmission, Ethernet link layer frame example.	10
4	<b>Unit 4:</b> Data Link Control: Introduction and services, Error detection and correction, Multiple access protocols, LANs, Addressing & ARP, Ethernet, Switches, VLANs, PPP, Link virtualization, MPLS, Data center networking, Web request processing.	8
5	<b>Unit 5:</b> Wireless and Mobile Networks  Wireless, Wireless links, characteristics, CDMA, IEEE 802.11 wireless LANs (“Wi-Fi”), Cellular Internet Access: Architecture, Standards (e.g., 3G, LTE), Mobility, Principles: addressing and routing to mobile users, Mobile IP, Handling mobility in cellular networks, Mobility and higher-layer protocols	9
	<b>Total</b>	<b>45</b>

**Text Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Douglas E. Comer	Internetworking with TCP/IP Volume One -	6 <sup>th</sup> Edition	Pearson	2014

**Reference Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Seymour Lipschutz,	Data Structures Schaum's Outlines,	1 <sup>st</sup> Editon	McGraw Hill	2014

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
TCS531.1	Understand the common network communication primitives as part of programming tasks in various languages.	3	-	-	-	-	-	-	-	1	1	-	-	3	1	1
TCS531.2	Discuss the various Protocols used in Communication	1	-	-	-	-	-	-	-	1	1	-	-	3	2	1
TCS531.3	Analyze more complex protocol engineering and network management tasks	-	3	-	2	-	-	-	-	2	2	-	1	3	1	2
TCS531.4	Understand terminology, concepts, and technologies required for telecommunication in local area networks (LANs) and on the global Internet	2	-	-	-	-	-	-	-	2	2	1	1	2	2	2
TCS531.5	Describe and analyze the Data Encoding and Transmission techniques.	-	3	2	-	1	-	-	-	1	2	1	1	2	2	1
TCS531.6	Use of network management tools	-	-	-	-	3	-	-	-	-	-	1	3	2	1	2
TCS531		2	3	2	2	2	-	-	-	1.4	1.6	1	1.5	2.5	1.5	1.5

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	<b>TCS591</b>	Course Title:	<b>Computer System Security</b>
2.	Contact Hours:	L: <b>3</b>	T: <b>1</b>	P: <b>0</b>
3.	Examination Duration (Hrs):	<b>Theory</b> <b>3</b>	<b>Practical</b> <b>0</b>	
4.	Relative Weight:	<b>CIE</b> <b>25</b>	<b>MSE</b> <b>25</b>	<b>ESE</b> <b>50</b>
5.	Credits:	<b>3</b>		
6.	Semester:	<b>V</b>		
7.	Category of Course:	<b>DSE</b>		
8.	Pre-requisite:	<b>TCS-491</b>		

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

Sl. No.	Contents	Contact Hours
1	<p><b>Unit 1:</b>  <b>Introduction to System security:</b>  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</p>	10
2	<p><b>Unit 2:</b>  <b>Software security:</b>  Vulnerabilities, Attacks, and Countermeasures: Privileged programs (Set-UID programs) and vulnerabilities &amp; Privilege Separation, Buffer Overflow vulnerability and defences, Return-to-</p>	10

	libc attack, Race, Condition vulnerability and attack, Dirty COW attack, Format String vulnerability and attack, Shellshock attack, Heartbleed attack Interactivity, Annotation, and Arrangement;	
3	<b>Unit 3:</b> <b>Web Security:</b> 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	<b>Unit 4:</b> <b>Smartphone Security:</b> 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	<b>Unit 5:</b> <b>Hardware and system security:</b> 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		<b>45</b>

**Text Books:**

Authors Name	Title	Edition	Publisher, Country	Year
Charles P Pfleeger and Shari Lawrence Pfleeger,	Security in Computing	5 <sup>th</sup> Edition	Pearson	2015
William Stallings	Cryptography and Network Security: Principles and Practice,	7 <sup>th</sup> Edition	Pearson	2017

2023-24 and 2024-25 onwards

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
TCS591.1	Explain different security threats and attacks.															
TCS591.2	Know the working of different attacks and security protocols.															
TCS591.3	Analyze the different security protocols.															
TCS591.4	Use programming to implement security protocols.															
TCS591.5	Use programming to implement security protocols.															
TCS591.6	Develop system security protocols															
TCS591																
High	correlation	(3);	Medium	correlation	(2);	Low	correlation	(1),	No	correlation	(-)					

# GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

## SEMESTER V

Name of Department: - Computer Science and Engineering

1.	Subject Code:	<b>TCS509</b>	Course Title:	<b>Machine Learning</b>
2.	Contact Hours:	L: <b>3</b>	T: <b>1</b>	P: <b>0</b>
3.	Examination Duration (Hrs):	Theory <b>3</b>	Practical <b>0</b>	
4.	Relative Weight:	CIE <b>25</b>	MSE <b>25</b>	ESE <b>50</b>
5.	Credits:	<b>3</b>		
6.	Semester:	<b>V</b>		
7.	Category of Course:	<b>DSE</b>		

8. Pre-requisite: Design and Analysis of Algorithm (TCS409), Fundamental of Statistics and AI (TCS421), Statistical Data Analysis with R (TCS471), Discrete Structures and Combinatorics (TMA 316)

<b>9. Course Outcome:</b>	<p>After completion of the course the students will be able to:</p> <p><b>CO1:</b> Acquire concepts and methods in statistical machine learning</p> <p><b>CO2:</b> Analyze fundamental principles of machine learning algorithms</p> <p><b>CO3:</b> Understand machine learning motivated by case-studies</p> <p><b>CO4:</b> Investigate and evaluate key topics in machine learning algorithms for data science industry</p>
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### 10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	<p><b>Unit 1:</b>  <b>Machine learning foundation</b>                      Review of logic and knowledge system - language, axiom, hypothesis, theorem, logic &amp; types, what is ML, Inductive bias in ML, AI pyramid, Pattern classification pipeline, Linear algebra in ML, Probabilistic logic and statistical inference (Random expt./ variable, CDF, WLLN, Bayes, Markov &amp; Chernoff bound, Hypothesis testing and performance indices - ROC, Estimation - detection, Optimality of Bayes, bias-variance, underfit-overfit, entropy as Information, Cover's packing lemma, Curse of dimensionality, <b>Case study:</b> Wealth – optimal payoffs in portfolios (stock market)                 </p>	14

2023-24 and 2024-25 onwards

2	<b><u>Unit 2:</u></b> <b>Unsupervised Learning</b> Clustering, Clustering methods – Partition vs. Hierarchical, k-Means and k-Medoids, Hierarchical: Agglomerative & Divisive, Error Analysis in Clustering, Ensemble - clustering, <b>Case study:</b> Clustering in Health care, Causal cluster, Graph cluster	8
3	<b><u>Unit 3:</u></b> <b>Supervised Learning</b> Main objectives and types of Supervised methods (Parametric, Semi parametric, Non-parametric), Linear Regression and Weiner filter, Grammar based/ Inductive learning - Decision Trees – CART, ID-3, Pruning metrics for tree; D-tree examples, Linear SVM (basics and V-C bound), k-NN rule and examples, Learning as Factorization, Ensemble learning: Bagging, Boosting. <b>Case studies:</b> covered for mentioned Supervised learning techniques.	10
4	<b><u>Unit 4:</u></b> <b>Reinforcement &amp; Interaction Learning</b> Basic model of Reinforcement Learning as game (Agent, Critic, Environment), Optimal policy & Q – values, Bellman equation, <b>Case studies</b> on R Learning Active learning, Deep Reinforcement, Transfer learning with examples, Federated Machine Learning with examples.	8
5	<b><u>Unit 5:</u></b> <b>Special topics in Machine Learning</b> Sentiment Mining: NLP pipeline process, Data Analytics – Big data and Hadoop model, Business Analytics – Competitive Machine Learning, ANN building blocks (problem solving), Deep learning, Feed forward, Backpropagation, C-NN, Recurrent-NN.	8
	Total	<b>48</b>

**Text Books:**

Authors Name	Title	Edition	Publisher, Country	Year
R, Duda, P. Hart and D. Stork,	Pattern classification –	2 <sup>nd</sup> .Edition	Wiley Publisher	2007
– J. Friedman, R. Tibshirani and T. Hastie,	The Elements of Statistical Learning	3 <sup>rd</sup> .Edition	Springer Publisher	2017
C. Bishop,	Pattern Recognition and Machine Learning –	2 <sup>nd</sup> .Edition	Springer Publisher	2016
A. Courville, I. Goodfellow, Y. Bengio,	Deep Learning –	2 <sup>nd</sup> .Edition	MIT Press	2016

**Reference Books:**

<b>Authors Name</b>	<b>Title</b>	<b>Edition</b>	<b>Publisher, Country</b>	<b>Year</b>
Tom M. Mitchell,	Machine Learning –	1 <sup>st</sup> Edition	Mc Graw Hill Publisher	2017
E. Alpaydin,	Introduction to Machine Learning –	3 <sup>rd</sup> . Edition	PHI Publisher	2015
T M. Cover, J A. Thomas,	Elements of Information Theory	2 <sup>nd</sup> . Edition	Wiley Publisher	2006

### **Course Articulation Matrix**

<b>CO</b>	<b>Statement</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
TCS509.1	Acquire concepts and methods in statistical machine learning	1	-	-	1	-	-	-	-	-	1	-	-	1	2	3
TCS509.2	Analyze fundamental principles of machine learning algorithms	-	3	-	-	-	-	-	-	-	-	-	-	3	1	2
TCS509.3	Understand machine learning motivated by case-studies	2	1	-	1	-	-	-	-	-	1	-	1	2	2	2
TCS509.4	Investigate and evaluate key topics in machine learning algorithms for data science industry	-	-	2	3	3	-	-	-	2	2	2	2	2	3	2
TCS509		1.5	2	2	1.66	3	-	-	-	2	1.33	2	1.5	2	2	2.25

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

